ALGONQUIN AND LAKESHORE CATHOLIC DISTRICT SCHOOL BOARDS

J.J. O'Neill Catholic Elementary School – Addition/Renovation
240 Marilyn Avenue
Napanee, On

salter pilon architecture inc.

Project Manual

Divisions 0-33

Project Number: 22026
Date of Issue: March 26, 2024
Issued for Tender and Permit

Stephenson Engineering
Structural Consultants

Quasar Consulting Engineers
Mechanical / Electrical Consultants

Pearson Engineering
Civil Consultants

CONSULTANT'S SEAL This seal governs all Documents and Sections of these Specifications, except Section 00 30 00 – Existing Conditions.	
STRUCTURAL SUBCONSULTANT'S SEAL This seal governs: 03 10 00 – Concrete Formwork 03 20 00 – Concrete and Masonry Reinforcement 03 30 00 – Cast-in-place Concrete 05 12 10 – Structural Steel 05 21 00 – Steel Joists 05 31 00 – Steel Deck	
MECHANICAL SUBCONSULTANT'S SEAL This seal governs: Division 20 – Common Requirements for Mechanical (all Sections) Division 21 – Fire Suppression (all Sections) Division 22 – Plumbing (all Sections) Division 23 – HVAC (all Sections) Division 25 – Integrated Automation (all Sections)	
ELECTRICAL SUBCONSULTANT'S SEAL This seal governs: Division 26 – Common Requirements for Electrical (all Sections) Division 27 – Communications (all Sections) Division 28 – Electronic Safety and Security (all Sections)	

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END OF SECTION

1 GENERAL

1.1 CONTRACT FORM

.1 The form of contract between the Owner and the Contractor will be CCDC2-2020, as amended by the Supplementary Conditions described in Section 00 30 00.

1.2 IMPORTANT DATES

.1

Documents Issue Date:	March 26, 2024
Mandatory Site Visit Date:	April 3, 2024, 4:00PM local time
Final Date for Questions:	April 11, 2024
Final Addendum, if necessary:	April 15, 2024
Closing Date and Time for Base Bid:	April 23, 2024, 11:00:00 AM local time
Closing Date and Time for Separate Price Bid:	April 23, 2024, 2:00:00 PM local time.

1.3 DEFINITIONS

.1 "Closing Time", means the Tender submission date and time as herein.

.2 "Days", means calendar days.

.3 "Bidder", means an entity that submits a tender in response to this RFT and, in respect of the period prior to the RFT closing time, as the context may suggest, refers to a potential Bidder.

.4 "Contractor", means any person, firm or organization, as the case may be, that has been awarded the contact to perform the work as outlined within this RFT.

1.4 BID FORM

.1 The form of bid between the Owner and the Contractor will be as follows in Section 00 20 00.

.2 Submit Stipulated Price Bid, as requested in Section 00 20 00.

.3 Bids shall be addressed to:

Algonquin & Lakeshore Catholic District School Board
151 Dairy Avenue
Napanee, ON.
Brad Hurdis, Capital Projects Manager

and endorsed: T-2024-PPS02 J.J. O'Neill CES

Each envelope should contain the appropriate documents and outside labeling as described below:

Base Bid - Envelope 1:
Bid Form
Consent for Surety
Bid Bond
Undertaking of Insurance
Labeled as: T-2024-PPS02 J.J. O'Neill CES
Base Bid - Envelope 1

Bidder's Name and Address

Separate Prices – Envelope 2:
Bid Form Appendix 'A' Separate and Itemized Prices
List of Sub-Contractors
Labeled as: T-2024-PPS02 J.J. O'Neill CES
Separate Prices - Envelope 2
Bidder's Name and Address

Submissions not so marked may be disqualified.

.4 Since submissions must be in a sealed envelope/package, submissions by fax or electronic delivery are not acceptable.

1.5 MANDATORY SITE MEETING

.1 A pre-bid mandatory site meeting for **Contractors** will be held at the site at

J.J. O'Neill CES, 240 Marilyn Ave, Napanee, ON
April 3, 2024 at 4:00:00 pm.

.2 The Consultant will oversee the signing of the "Contractor Sign in Sheet" and once all in attendance have signed the sheet and the Consultant has called the meeting to order, bidders who arrive after that time shall be considered late and will not be permitted to sign the "Contractor Sign in Sheet".

.3 Bids received from Contractors not on the list of attendees at the site meeting will be rejected and returned unopened. Sub-trade bidders are also encouraged to attend this meeting.

1.6 SUBMISSION DUE DATE

.1 Tenders must be received by the Board before the closing date and times as contained herein.

.2 Bidders should instruct couriers or any who may be delivering a tender that the tender should be delivered only to the reception desk of the Board's Education Centre to ensure proper receipt by the Board. Tenders delivered to any other facility or to any other area of the Education Centre may be rejected.

.3 Local time shall be governed by the digital clock in the reception area of the Board's Education Centre. The time of any other clock will not be considered.

.4 All tenders received at the reception desk will have the date and time of receipt recorded on the envelope/package. Receipts will be provided upon request and will reflect the time recorded on the envelope/package.

.5 The responsibility of ensuring that a tender has been properly received by the Board remains unequivocally with the Bidder.

1.7 ELIGIBILITY

.1 Bids are by invitation only from prequalified General Contractors. Bids from unsolicited bidders shall be returned unopened.

.2 Prequalified General Contractors for the project are:

- Bourgon Construction — Cornwall
- CoreBuild Construction — Toronto
- Emmons and Mitchell Construction Limited — Kingston
- Peak Engineering and Construction Limited — Brighton

1.8 LATE SUBMISSIONS

.1 Any tender received after the closing time specified in this RFT, shall not be accepted for consideration and will be sent back to the Bidder unopened, with a letter stating the reason for the return.

1.9 ACCEPTANCE OF TERMS

.1 Each Bidder, by submitting a tender, represents that the Bidder has read and completely understands, and accepts all provisions contained in this RFT.

1.10 DRAWINGS AND SPECIFICATIONS

.1 PDF Tender Documents will be available via Biddingo for each prequalified bidder

.2 **Written enquiries only will be accepted and shall be directed to:**
Salter Pilon Architecture Inc.
jjeffery@salterpilon.com
Enquiries by phone will not be accepted.

Final Timeline to submit enquiries:
5:00:00 PM, on the final date for questions noted in 1.2.1. Enquiries received after this time period will not be responded to.

Final addendum, if necessary, will be uploaded to Biddingo to the eligible bidders by 5:00 PM, on the final addendum date noted in 1.2.1.

.3 Bidders shall be responsible for the distribution of all contract Documents and Addenda to all Subcontractors and suppliers. Neither the Board, nor its employees nor its agents shall be responsible for any information or instructions given to the Bidder, with the exception of information or instructions provided in writing by the purchasing designate.

.4 All bidders shall make themselves familiar and be responsible for the requirements set out in Division 00, Project Bidding and Contract Information; and Division 01, General Requirements.

.5 Drawings and Specifications will be on display at:

.1 Kingston Construction Association
575 Counter Street, Kingston, Ontario

.2 Quinte Construction Association
54 Station Street, Belleville, Ontario

.6 The Bidder is to review the Bid Set upon receipt and verify that all drawings, specifications, and schedules are included. Inform Tender Coordinator immediately of any missing information.

1.11 COPYRIGHT

.1 Not withstanding GC 1.1.11 of the contract, for the purposes of the bidding stage only, the related sections of the specifications and drawings may be copied for issue to sub-trades for this project. Each such subdivision shall be accompanied by Divisions 00 and 01 in their entirety.

1.12 ADDENDA

.1 Bidders may, prior to the closing date, be advised in writing by addenda of required additions to, deletions from, or alterations to requirements of the RFT documents.

.2 All addenda will be posted via Biddingo to the eligible bidders at least seven days prior to the closing date. Where it becomes necessary, in the sole opinion of the Board, to issue an addendum less than seven days prior to the closing deadline, the Board will extend the closing date accordingly. The extended closing date will be communicated in the addendum.

.3 All addenda shall become part of the RFT documents and shall be allowed for in arriving at a contract award.

.4 Each Bidder shall be responsible for verifying before depositing its bid that it has received all addenda that may have been issued and acknowledge such addenda as required on the bid form.

1.13 MULTIPLE TENDERS

.1 A contractor may amend their submitted bid at any time up to closing time by submitting a further bid form, subject to the same requirements for submission as the original bid. The last bid received shall govern. Amendments by facsimile transmission, electronic mail, or telephone will not be accepted.

1.14 BIDDER EXPENSES

.1 Bidders are solely responsible for their own expenses in preparing a response to this RFT and for subsequent meetings with the Board. If the Board elects to reject all tenders, the Board will not be liable to any Bidder for any claims, whether for costs or damages incurred by the Bidder in preparing the tender, loss of anticipated profit, or any other matter.

1.15 PROJECT SCHEDULE

.1 Commence work immediately upon award of the contract.

1.16 LITIGATION HISTORY WITH THE BOARD

1. The Board may, in its absolute discretion, reject a bid submitted by the bidder prior to or after bid opening, if the bidder:

   (a) is, or has in the past been, a party to litigation with the Board; or

(b) directly or indirectly, including by common ownership or control or otherwise, is related to a party currently in litigation with the Board or a party that has in the past been in litigation with the Board; or

(c) intends to use a sub-contractor in respect of the specific project who is, or has in the past been, a party to litigation with the Board, or who, directly or indirectly, including by common ownership or control or otherwise, is related to a party currently in litigation with the Board or a party that has in the past been in litigation with the Board.

2. For the purposes of this section, the phrase, "litigation with the Board" includes cases in which the bidder or prospective bidder or any of the parties named above, have advised the Board in writing of their intention to commence litigation, or have commenced or have advised the Board of their intention to commence an arbitral proceeding against the Board.

3. Bids from any bidder in any of the above circumstances, provided the Board has exercised its discretion to reject, shall be rejected as informal, irregular and non-compliant.

4. In determining whether or not to reject a bid under this section, the Board will consider whether the litigation (past or current) is likely to affect a bidder's ability to work with the Board, its consultants and representatives, and whether the Board's experience with the bidder, the related party or sub-contractor, as the case may be, in the matter giving rise to the litigation, indicates that the Board is likely to incur increased staff and legal costs in the administration of the Contract if it is awarded to the bidder.

1.17 TENDER REJECTION

.1 The lowest cost or any tender may not necessarily be accepted. The Board, its sole discretion, reserves the right to accept any or all tenders or to cancel the RFT in whole or in part at any time without award.

.2 Where the Board receives only one compliant tender, the Board reserves the right to either cancel the RFT, award to the Bidder or enter into negotiations with the Bidder.

.3 Where the Board exercises its right to cancel the RFT, the Board may issue a new request for tender, sole source, or do nothing.

.4 Bids will be declared informal and rejected if:

.1 The bid is qualified in any way.
.2 The bid deposit or consent to surety are not provided.
.3 The bid form is not completed properly or entirely.
.4 An improper bid form is used.
.5 Late receipt.
.6 The bid has been withdrawn prior to closing.
.7 Other factors that would cause the bid to be rejected as noted herein, or as are considered reasonable.

1.18 RIGHT TO WAIVE MINOR NON-COMPLIANCE

.1 The Board reserves the right, in its sole and unfettered discretion, to reject or waive minor errors and non-compliance contained in a tender without having to disqualify the Bidder. The Board defines minor errors and matters of non-compliance as those which do not have the effect of creating an advantage of one submission over another but may be merely a matter of form.

1.19 ADDITIONAL RIGHTS OF THE BOARD

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

a) Make public the names of any or all Bidders and the total cost submitted by any Bidder;

b) Request written clarification or the submission of supplementary written information from any Bidder and incorporate such clarification or supplementary written information into the Bidder's tender, at the Board's discretion, provided that any clarification or submission of supplementary written information shall not be an opportunity for the Bidder to correct errors in its tender or to change or enhance the tender in any material manner;

c) Disqualify any Bidder whose tender contains misrepresentations or any other inaccurate or misleading information, or any Bidder whose reasonable failure to cooperate with the Board impedes the evaluation process, or whose tender is determined to be non-compliant with the requirement of the RFT;

d) Disqualify a tender where the Bidder has previously breached a contract with the Board, or the Bidder reveals a conflict of interest or any unfair advantage is brought to the attention of the Board;

e) Disqualify any tender of any Bidder who has breached any applicable laws or who has engaged in conduct prohibited by this RFT, including where there is any evidence that the Bidder or any of its employees or agents colluded with any other Bidder, its employees or agents in the preparation of the tender; and

f) Make changes, including substantial changes, to this RFT provided that those changes are issued by way of addenda in the manner set out in this RFT.

1.20 MUNICIPAL FREEDOM OF INFORMATION AND PROTECTION OF PRIVACY ACT

.1 The tender and any accompanying documentation submitted by the Bidder prior to the closing date specified in this document shall become the property of the Board and shall not be returned. The tender shall be subject to the Municipal Freedom of Information and Protection of Privacy Act, R.S.O. 1990, M-56. The Bidder must identify any information contained in the tender that is submitted in confidence.

1.21 CONFLICT OF INTEREST

.1 Each Bidder shall declare to the Board as part of their tender any situation that may be either a conflict of interest or a potential or perceived conflict of interest with the contractual obligations of their tender.

.2 No member of the Board and no officer or staff member of the Board are, will be, or shall become interested, directly or indirectly, as a contracting party, partner, stockholder, surely or otherwise in the performance of any contract resulting from this solicitation or in the supplies, work or business in connection with any such contract resulting from this solicitation or in the supplies, work or business in connection with any such contract or in any portion thereof, or in any monies to be derived there from.

1.22 PROPRIETARY CONTENT

.1 Information which the Bidder considers to be of a propriety or confidential nature must be clearly marked "proprietary".

1.23 BRIBERY COLLUSION

.1 Should a Bidder or any of their agents offer any gratuity to or attempt to bribe any member of the Board, or attempt to commit fraud, the Board shall be at liberty to reject the Bidder's submission or cancel the contract.

.2 The Bidder further acknowledges that its tender is made without any connection, knowledge, comparison of figures or arrangements with any other company, firm or person making a tender for the same work and is in all respects fair and without collusion or fraud.

1.24 BID ANALYSIS

.1 Within 3 working days of notification by the Consultant, and prior to award of contract, the low bidder or bidders shall submit a trade by trade breakdown of the bid price for analysis by Consultant.

.2 Submit additional information promptly if requested by Consultant.

.3 Requests for information shall not be construed as acceptance of a bid.

.4 The Board reserves the right to seek clarification from any Bidder without being obligated to all Bidders if it finds certain aspects of a tender unclear.

1.25 IDENTICAL BIDS

.1 Where more than one compliant tender offering the lowest total cost is received for the same quality of items or services, the contract will be awarded to the bidder as determined by a coin toss.

1.26 NO LIABILITY

.1 The Bidder agrees that:

a) Any action of proceeding relating to this RFT process shall be brought in any court of competent jurisdiction in the Province of Ontario and for that purpose the Bidder irrevocably and unconditionally attorns and submits to the jurisdiction of that Ontario court;

b) It irrevocably waives any right to and shall not oppose any Ontario action or proceeding relating to this RFT process on any jurisdictional basis; and

c) It shall not oppose the enforcement against it, in any other jurisdiction, of any judgement or order duly obtained from an Ontario court as contemplated by this RFT.

.2 The Bidder further agrees that if the Board commits a material breach of the RFT (that is a material breach of Contract A), the Board's liability to the Bidder, and the aggregate amount of damages recoverable against the Board for any matter relating to or arising from that material breach, whether based upon an action or claim in contract, warranty, equity, negligence, intended conduct or otherwise, including any action or claim arising from the acts or omissions, negligent or otherwise, of the Board, shall be no greater than the tender preparation costs that the Bidder seeking damages from the Board can demonstrate.

1.27 DEBRIEFING

.1 Bidders are entitled to a debriefing meeting with the tender coordinator after award notification has been made. A request for a debriefing meeting must be received in writing by the tender coordinator within sixty calendar days of award notification. Any request that is not received within sixty days may not be considered at the sole discretion of the Board without reason.

.2 The purpose of the debriefing meeting is to provide a Bidder with a general overview of the evaluation process set out in the RFT, discuss the strengths and weaknesses of the Bidder's

submission in relation to the specific evaluation criteria and the Bidder's score and provide suggestions on how the Bidder may improve future submissions.

.3 The tender coordinator will also provide the Bidder's relative ranking (e.g. third of five) and a listing of all Bidders who participated in the RFT, including qualified and disqualified Bidders as well as those who submitted "no bid".

.4 The tender coordinator will address a Bidder's specific questions in relation to their submission. Questions unrelated to the RFT will not be responded to during the debriefing and will be noted as out of scope.

.5 Debriefing meetings will be held in person at the location of the tender coordinator's agency.

1.28 BID PROTEST PROCEDURES

.1 Subsequent to a debriefing meeting where a Bidder believes that the competitive process has not been conducted in accordance with the process requirements contained herein, the Bidder may file a bid protest. Bid protests must be submitted in writing citing the clause of the RFT that has not been adhered to in the opinion of the Bidder and the resultant effect on the Bidder's tender.

.2 Bid protests must be received in writing by the tender Coordinator, allowing the tender coordinator 5 days to investigate and respond to the protest. If the bid protest is not resolved by the tender coordinator, it will be forwarded on to the Superintendent of Business Services by the tender coordinator, allowing the Superintendent of Business Services 10 days to investigate and respond to the bid protest.

.3 Where the Superintendent of Business Services is unable to resolve the protest, the Superintendent will forward the protest to the Director of Education. The Director of Education, at the Director's discretion, will conduct an investigation of the competitive process. The Director's findings and any resolution shall be final and will be communicated to the Bidder and kept on file.

1.29 GOVERNING LAW

.1 The RFT, the Bidder's tender, and any resulting agreement will be governed by the laws of Ontario and the federal laws of Canada applicable therein.

1.30 SUBSTITUTIONS

.1 Bidders shall note that this is a base bid Specification. Products specified or shown on Drawings by Brand name or catalogue number and/or by name of the manufacturer or supplier shall form the basis of the bid. No substitutions shall be considered.

.2 Bidders may propose substitutions for products under the following conditions:
- .1 Base bid price is to be based on products specified and/or shown on Drawings.
- .2 List proposed substitutions under "Bidder's Alternatives" in the appropriate space designated for that purpose on the Bid Form - Section 00 20 00, showing the product name and stating the difference in price, if any, should the proposed substitution be accepted.
- .3 Owner reserves the right to accept or reject any or all of the proposed substitutions.

.3 Consultant will not review substitution requests during bidding period.

1.31 COMMUNICATION DURING THE REQUEST FOR TENDER PROCESS

.1 Communication to Bidders for significant inquiries will be in the way of an electronic amendment. An amendment will take one of two forms:

- Questions and Clarifications; or
- Addenda

.2 Clarifications will be responses to Bidder questions that do not change the RFT documents.

.3 Addenda are changes to the RFT documents that may impact a Bidder's submission. All addenda must be acknowledged on the Agreement to Contract as indicated.

.4 To ensure consistency and quality of information provided to Bidders, any information with respect to significant inquires received and the replies to such inquiries or changes to RFT documents will be provided simultaneously to all Bidders electronically by way of amendment to which this RFT has been sent without revealing the sources of the inquiries.

.5 Where the Board deems a question to be either insignificant to others or the answer is readily apparent to all Bidders within the document, the Board may choose to respond only to that Bidder.

.6 Under no circumstances will meetings related to this RFT be held with individual Bidders prior to the closing date and time of this RFT. Non-compliance with this condition will (for that reason alone) will result in disqualification of the Bidder's submission.

1.32 BIDDER REQUEST FOR CLARIFICATION

.1 It is the responsibility of the Bidder to seek clarification on any matter that they consider unclear before submitting a tender. The Board is not responsible for any misunderstanding of the RFT on the part of a Bidder.

.2 Bidders must obtain their own information on all matters that may in any way influence them in developing their tender. Bidders must satisfy themselves in all respects as to the risks and obligations to be undertaken by them.

.3 Written queries should only be directed through Salter Pilon Architecture Inc.

.4 It will be the responsibility of the Bidder to ensure that it has received a response to the request for clarification before submitting a tender.

.6 The following apply regarding any request for clarification of any aspect of the RFT

a) Questions, inquiries and requests for clarification should be made by the date and time as stated herein;

b) Bidders must submit requests for clarifications through Colbourne & Kembel, Architects Inc.;

c) In submitting a request for clarification, a Bidder should include its address, telephone number, email address and fax number; and

d) Where a question relates to a specific section of this RFT, reference should be made to the specific paragraph number.

Inquiries not meeting these conditions may not be responded to.

.7 In answering a Bidder's questions, the Board will set out the question(s), but without identifying the Bidder that submitted the question(s) the Board may, in its sole discretion,

a) Edit the question(s) for clarity;

b) Exclude questions that are either unclear or inappropriate; and

c) Answer similar questions from various Bidders only once.

1.33 TAXES

.1 Refer to the General Conditions of the Contract.

1.34 BONDING AND CONSENT OF SURETY

.1 The successful General Contractor shall be required to furnish a Surety Bond as approved by the C.C.A. from a licensed Canadian Surety Company as follows:
- **Performance Bond - 50% of the Contract Sum**
- **Material and Labour Bond – 50% of the Contract Sum**

Each Contractor shall include the cost of such Bond in their Bid.

.2 Bids from General Contractors must be accompanied by a Consent of Surety from an approved Surety Company stating that they will bond the Contractor should he be the successful Bidder. Failure to include such consent form will cause the bid to be declared informal.

1.35 BID BOND

.1 The Bid shall be accompanied by a Bid Bond, as approved by the C.C.A. from a licensed Canadian Surety Company or a certified cheque made out in favour of the Owner in the amount of **10% of the bid price**. The Bid Bond shall be valid for a period of 90 days from the date of receipt of Bids.

1.36 INSURANCE

.1 Provide a signed "Undertaking of Insurance": including Builder Risk on a standard form provided by the insurance company stating their intention to provide insurance to the bidder in accordance with the insurance requirements of the Contract Documents.

.2 The Owner and Consultant shall be named as additional insured parties.

1.37 TENDER OPENING

.1 A public opening of submissions for this RFT will be held at **2:15 p.m**. on the date of the closing, as stated herein, at the **Algonquin & Lakeshore Catholic District School Board office, 151 Dairy Avenue, Napanee, ON**. Only the names and total bid amount will be read out. Tender submissions will be reviewed after the tender opening meeting by the tender co-ordinator for compliance. Bidders should not conclude any particular results from the reading.

1.38 CONSTRUCTION HEALTH & SAFETY

.1 The Contractor is to provide and allocate in the schedule for Construction Health and Safety COVID-19 provisions as per the current Government of Ontario Guidelines for construction sites for the duration of the project.

END OF SECTION

Tender No.: T-2024-PPS02

BID FORM

Submitted to:	Algonquin & Lakeshore Catholic District School Board	**PROJECT:**	J.J. O'Neill Catholic Elementary School
	151 Dairy Avenue		Napanee, ON
	Napanee Ontario	**PROJ. NO.:**	22026
	K7R 4B2		
	ATT: Brad Hurdis, Capital Projects Manager	**DATE:**	_____

1. Bidder

Name: _____

Address: _____

_____

Email: _____

Fax: _____

2. Bid Price

Having examined the Place of Work and bid documents for J.J. O'Neill Catholic Elementary School, to perform the Work required by the documents as prepared by Salter Pilon Architecture Inc. and consultants including addenda listed herein, inclusive, we hereby offer to enter into a Contract to perform the Work required by the documents for the Stipulated price of:

_____ dollars. ($ _____)

in Canadian Funds, which price excludes HST.

Prices are free of escalation clauses.

This offer is valid for a period of **ninety (90)** days from close of bidding.

Should either party fail to make payments as they become due under the terms of the Contract, interest at one percent (1 %) per annum above the Bank Rate on such unpaid amounts shall also become due and payable until payment. Such interest shall be compounded on a monthly basis. The Bank Rate means the bank rate established by the Bank of Canada as the minimum rate at which the Bank of Canada makes short term advances to the Chartered Banks.

3. Addenda

The following Addenda have been received. The modifications to the Contract Documents noted therein have been considered and all costs thereto are included in the Bid Price.

Addendum # .....Dated .....

Addendum # .....Dated .....

Addendum # .....Dated .....

Addendum # .....Dated .....

Addendum # .....Dated .....

4. Schedule:

The Contractor hereby declares that they will commence work immediately upon award of Contract

and attain Substantial Performance of the Work by _____ (completion date or number of weeks)

5. Cash Allowances:

A Cash Allowance, with a value of $545,000.00, as outlined in Section 01 21 00 is included as part of the Base Bid Price and shall cover the following (in general):

.1 Finish Hardware: Supply and Install for wood and HM doors. Supply of finish hardware for aluminum doors – installation by others. Supply of finish hardware for teacher's and storage closet doors – installation by others.

.2 Pin mounted cast aluminum signage

.3 Hydro Utility – supply and install of the primary terminations. Connection at the supply point at street and pad mounted transformer. Utility service connection fees.

.1 Note: The Electrical Contractor shall be responsible for coordinating a servicing agreement and all associated work with the electrical company.

.4 Testing and Inspection.

.5 Security Alarm Systems – Supply and install as per Division 26 Sections,

.6 A/V systems – supply and install in gymnasium.

.7 Gas meter upgrades by Utility provider.

.8 Unexpended amounts of Cash Allowances may be reallocated to other work at the sole discretion of the Consultant and Owner.

6. Unit Prices

The Bidder shall perform any additional work that may be required and supply whatever additional articles, materials, or equipment which may be necessary at the unit prices or adjusted unit prices set out below in strict conformance with all terms and conditions of the Contract. The unit price for deductions shall be 90% that for additions.

Trade or Material	**Additional Cost**	**/unit**
Rock Removal (machine) – Includes removal & disposal	_____	/m^3
Engineering Fill Granular B Placed	_____	/m^3

7. Bidder's Alternatives

I/We the undersigned propose the following alternatives:

Product Specified	Proposed Substitution	Deduct from Bid Price
1		$
2		$
3		$

(Add extra lines or pages if necessary)

8. Declarations:

We hereby declare that no person, firm, or corporation other than the undersigned has any interest in this Bid or in the proposed Contract for which this Bid is made.

9. Signatures:

Signed and Submitted for and on behalf of:

_____ **Seal:**
name of bidder

_____
signature

_____
print name and title of person signing

Witness:

_____ _____
signature signature

_____ _____
print name and title of person signing print name and title of person signing

Date: _____

Note: this Bid form must be signed in one of the following ways:
For a corporation: minimum of one signing officer. Corporate seal to be affixed.
For a Partnership: two Partners must sign.
For a Sole Proprietorship: The Owner plus one witness must sign.

END

Tender No.: T-2021-PPS26

SEPARATE PRICES BID FORM

Submitted to: Algonquin & Lakeshore Catholic District School Board
151 Dairy Avenue
Napanee Ontario
K7R 4B2
ATT: Brad Hurdis, Capital Projects Manager

PROJECT: J.J. O'Neill Catholic Elementary School
Belleville, ON

PROJ. NO.: 22026

DATE: _____

1. Bidder

Name: _____

Address: _____

2. SEPARATE PRICES

I / We, the undersigned have inserted below all separate, itemized and alternative prices requested. 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 separate prices are for work which is added to or deleted from the base bid price listed on Bid Form but which may be accepted by the Owner for the price quoted hereunder (added or deleted as indicated),

.3 that the Owner reserves the right to accept or reject any of the prices proposed hereunder.

.4 prices listed hereunder do not include HST, and will remain in effect for a period of **ninety (90)** days from date of Bid closing.

.5 Separate Prices will not be considered in the determination of the lowest bid value.

Separate Price No. 1 (Skylight Replacement):
.1 Provide separate price to replace existing skylight in Heart.
.

Separate Price No 1 $_____ **Add** to Base Bid

.3. List Of Sub-Contractors

I/We, the undersigned propose that the following Subcontractors and/or suppliers will be used 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 list may be made without the express written approval of the Owner.**

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.

Item of Work	Subcontractor
Excavation, Backfilling and Rough Grading	
Landscaping	
Concrete Work	
Masonry	
Structural Steel	
Miscellaneous Metal, Stairs, and Ladders	
Carpentry	
Architectural Woodwork	
Insulation	
Metal Siding	
Firestopping and Fireproofing	
Membrane Roofing	
Hollow Metal Doors & Frames	
Aluminum Doors & Frames	
Windows, Curtainwall, Glass, and Glazing	
Flooring	
Gypsum Board, Acoustic Ceilings, and Acoustic Panels	
Painting	
Mechanical	
Sprinkler	
Electrical	
Communications	
Demolition	
Designated Substances Removal	

4. Declarations:

We hereby declare that no person, firm, or corporation other than the undersigned has any interest in this Bid or in the proposed Contract for which this Bid is made.

5. Signatures:

Signed and Submitted for and on behalf of:

Seal:

_____
name of bidder

_____
Signature

_____
print name and title of person signing

Witness:

_____
signature

_____
signature

_____
print name and title of person signing

_____
print name and title of person signing

Date: _____

Note: this Bid form must be signed in one of the following ways:

For a corporation: minimum of one signing officer. Corporate seal to be affixed.
For a Partnership: two Partners must sign.
For a Sole Proprietorship: The Owner plus one witness must sign.

END

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

(the "Supplementary Conditions")

AGREEMENT, DEFINITIONS, AND

GENERAL CONDITIONS

The Standard Construction Document CCDC 2 2020 for a Stipulated Price Contract, English version, consisting of the Agreement Between *Owner* and Contractor, Definitions and General Conditions of the Stipulated Price Contract, Parts 1 to 13 inclusive, governing same, together with the changes with the new *Construction Act* is hereby made part of these *Contract Documents*, with the following amendments, additions and modifications:

AGREEMENT BETWEEN OWNER AND CONTRACTOR

SC1 ARTICLE A-1 – THE WORK

SC1.1	A-1.3	Amend Article A-1.3 by deleting all of the words after *"Contract Documents"* and replace them with the following" "attain: .1 *Substantial Performance of the Work* by the __ day of _____ in the year 20__. .2 (if applicable) *Occupancy* by the __ day of _____ in the year 20__, and .3 *Ready-for-Takeover* by the __ day of _____ in the year 20__."

SC2 ARTICLE A-3 – CONTRACT DOCUMENTS

SC2.1	A-3.1	Add the following documents to the list of *Contract Documents* in Article A-3.1: • Algonquin & Lakeshore Catholic District School Board's Supplementary Conditions & Amendments to Standard Construction Document CCDC2-2020 Stipulated Price Contract, January 2024 Version, including any Special Supplementary Conditions listed in Appendix 2 thereto; • *Drawings;* • *Specifications;* • 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	Delete Article A-4.4 and replace it with the following: "4.4 The *Contract Price* shall remain fixed for the duration of the *Contract Time*, subject only to adjustments as provided for in the *Contract Documents*. For certainty, and without limiting the general application of the preceding sentence, the *Contractor* assumes all risks in connection with cost increases for overhead, *Products, Labour*, and *Construction Equipment* prescribed by the *Contract Documents* for the performance of the *Work*, and the *Contractor* assumes all responsibility for liabilities and additional costs that may arise as a result of the *Contractor's* inclusion of any *Product, Construction Equipment, Supplier*, or *Subcontractor* in its calculation of the *Contract Price*."

SC4 ARTICLE A-5 – PAYMENT

SC4.1	A-5.1	Delete Article A- 5.1 in its entirety including all subparagraphs and replace it with the following: "5.1 Subject to the provisions of the *Contract Documents* and the *Construction Act*, the *Owner* shall: .1 make progress payments to the *Contractor* on account of the *Contract Price* when due together with such *Value Added Taxes* as may be applicable to such payments, .2 upon *Substantial Performance of the Work* as certified by the *Consultant*, and on the 61st day after the publication of the certificate of *Substantial Performance of the Work*, in accordance with the *Construction Act*, there being no claims for lien registered against the title to the *Place of the Work* and no written notices of lien delivered to the *Owner*, pay the *Contractor* the unpaid balance of the holdback, together with such *Value Added Taxes* as may be applicable to such payment, less any amount stated in the *Owner's Notice of Non-Payment*. .3 after *Ready-for-Takeover* has been achieved in accordance with the *Contract Documents* and the *Work* is complete, there being no claims for lien registered against the title to the *Place of the Work* and no written notices of lien delivered to the *Owner*, pay the *Contractor* any unpaid balance of the *Contract Price* in accordance with GC 5.5 – FINAL PAYMENT, together with such *Value Added Taxes* as may be applicable to such payment."
SC4.2	A-5.2.1	Delete subparagraph 5.2.1 in its entirety and replace it with the following: ".1 Should either party fail to make payments as they become due under the terms of the *Contract* 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 *Courts of Justice Act* (Ontario), as it may change from time to time."

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

SC5.1	A-9	Add new ARTICLE A-9 CONFLICT OF INTEREST as follows: "**ARTICLE A-9 CONFLICT OF INTEREST** 9.1 The *Contractor*, *Subcontractors* and *Suppliers* and any of their respective advisors, partners, directors, officers, employees, agents, and volunteers shall not engage in any activity or provide any services where such activity or the provision of such services creates a conflict of interest (actually or potentially, in the sole opinion of the *Owner*) with the provision of the *Work* pursuant to the *Contract*. The *Contractor* acknowledges and agrees that a conflict of interest, as described in this Article A-9, includes, but is not limited to, the use of *Confidential Information* where the *Owner* has not specifically authorized such use.

		9.2 The *Contractor* shall disclose to the *Owner*, in writing, without delay, any actual or potential situation that may be reasonably interpreted as either a conflict of interest or a potential conflict of interest, including the retention of any *Subcontractor* or *Supplier* that is directly or indirectly affiliated with or related to the *Contractor*. 9.3 The *Contractor* covenants and agrees that it will not hire or retain the services of any employee or previous employee of the *Owner* where to do so constitutes a breach by such employee or previous employee of the *Owner's* conflict of interest policy, as it may be amended from time to time, until after completion of the *Work* under the *Contract*. 9.4 It is of the essence of the *Contract* that the *Owner* shall not have direct or indirect liability to any *Subcontractor or Supplier*, and that the *Owner* relies on the maintenance of an arm's-length relationship between the *Contractor* and its *Subcontractors and Suppliers*. Consistent with this fundamental term of the *Contract*, the *Contractor* will not enter into any agreement or understanding with any *Subcontractor or Supplier*, whether as part of any contract or any written or oral collateral agreement, pursuant to which the parties thereto agree to cooperate in the presentation of a claim for payment against the *Owner*, directly or through the *Contractor*, where such claim is, in whole or in part, in respect of a disputed claim by the *Subcontractor or Supplier* against the *Contractor*, where the payment to the *Subcontractor or Supplier* by the *Contractor* is agreed to be conditional or contingent on the ability to recover those amounts or a portion thereof from the *Owner*, failing which the *Contractor* shall be saved harmless from all or a portion of those claims. The *Contractor* acknowledges that any such agreement would undermine the required arm's-length relationship and constitute a conflict of interest. For greater certainty, the *Contractor* shall only be entitled to advance claims against the *Owner* for amounts pertaining to *Subcontractor or Supplier* claims where the *Contractor* has actually paid or unconditionally acknowledged liability for those claims or where those claims are the subject of litigation or binding arbitration between the *Subcontractor or Supplier* and the *Contractor* 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 *Contractor*, any of the *Subcontractors*, or any of their respective advisors, partners, directors, officers, employees, agents, and volunteers shall entitle the *Owner* to terminate the *Contract*, in addition to any other rights and remedies that the *Owner* has in the *Contract*, in law, or in equity."

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 *Contractor* was selected by the *Owner* for this *Contract* is the ***Contractor's*** representation and covenant that it will attain *Substantial Performance, Occupancy (*if applicable), and *Ready-for-Takeover* within the *Contract Time* stated in Article A-1 of this *Contract*. 10.2 The *Contractor* acknowledges and agrees that it is responsible to marshal its resources and those of its *Subcontractors and Suppliers* in a manner which will permit timely attainment of *Substantial Performance, Occupancy (*if applicable), and *Ready-for-Takeover*. The *Contractor* agrees that time is of the essence of this *Contract*."

SC7 DEFINITIONS

Revisions to Existing Definitions		
SC7.1	Consultant	Amend the definition of "Consultant" by adding the following to the end of the definition: "For the purposes of the *Contract*, the terms "***Consultant"***, "*Architect*" and "*Engineer*" shall be considered synonymous."
SC7.2	Payment Legislation/Construction Act	Delete the Definition of *Payment Legislation* and replace it with "Construction Act" as follows: "**Construction Act** *Construction Act* means the *Construction Act*, 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 *Contract*. For certainty, the first procurement process for the *Project* (*i.e*., the "improvement" as that term is defined in the *Construction Act*) was commenced on or after October 1, 2019."
SC7.3	Ready-for-Takeover	Amend the Definition of *Ready-for-Takeover* by deleting all the words after "as verified" and replacing them with "and approved by the *Owner*."
New Definitions		
SC7.4	Adjudication	Add the following definition: "**Adjudication** *Adjudication* means construction dispute interim adjudication as defined under the *Construction Act*."
SC7.5	Authorities Having Jurisdiction	Add the following definition: "**Authorities Having Jurisdiction** The phrase "*authorities having jurisdiction*" or the term "*authorities*" shall mean those having jurisdiction under law over the Work or parts thereof."
SC7.6	Change Estimate	Add the following definition: "**Change Estimate**

		Change Estimate has the meaning given under GC 6.1.6.”
SC7.7	Close-Out Documentation	Add the following new definition: “**Close-Out Documentation** *Close-Out Documentation* has the meaning given to it under GC 5.4.2.”
SC7.8	Commission	Add the following new definition: “**Commission** Shall mean the procedure which includes checking, testing, adjusting and measuring performed by the Contractor to demonstrate and verify the installation, operation and performance of all components and the entire system.”
SC7.9	Confidential Information	Add the following definition: “**Confidential Information** *Confidential Information* means all the information or material of the *Owner* 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 *Contractor* at any time, but *Confidential Information* shall not include information that: .1 is or becomes generally available to the public without fault or breach on the part of the *Contractor*, including without limitation breach of any duty of confidentiality owed by the *Contractor* to the *Owner* or to any third party, but only after that information becomes generally available to the public; .2 the *Contractor* can demonstrate to have been rightfully obtained by the *Contractor* from a third party who had the right to transfer or disclose it to the *Contractor* free of any obligation of confidence; .3 the *Contractor* can demonstrate to have been rightfully known to or in the possession of the *Contractor* at the time of disclosure, free of any obligation of confidence; or .4 is independently developed by the *Contractor* without use of any *Confidential Information*.”
SC7.10	Construction Schedule	Add the following definition: “**Construction Schedule** *Construction Schedule* means the schedule for the performance of the *Work* provided by the *Contractor*, and approved by the *Owner*, pursuant to GC 3.4.1, including any amendments to the *Construction Schedule* made pursuant to the *Contract Documents*.”
SC7.11	Construction Schedule Update	Add the following definition: “**Construction Schedule Update**

		Construction Schedule Update means an update to the *Construction Schedule* by the *Contractor* using Microsoft Project (or other approved scheduling software) that accurately depicts the progress of the *Work* relative to the critical path established in the *Construction Schedule* approved in GC 3.5.1 (or any approved successor *Construction Schedule*), aligns with the currently approved date for *Substantial Performance of the Work*, 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 *Work* relative to the last *Construction Schedule Update,* and includes the following minimum deliverables: (a) a record version of the updated *Construction Schedule* in .pdf format; (b) an editable copy of the updated original digital file of the *Construction Schedule* (*e.g.*, .mpp format files for Microsoft Project)."
SC7.12	EFT	Add the following definition: "**EFT** *EFT* has the definition given to it under GC 5.3.2."
SC7.13	Excess Soil	Add the following definition: "**Excess Soil** *Excess Soil* means "excess soil" as that term is defined under section 3 of the *Excess Soil Regulation*."
SC7.14	Excess Soil Regulation	Add the following Definition: "**Excess Soil Regulation** *Excess Soil Regulation* means O. Reg. 406/19: On-Site and Excess Soil Management to the *Environmental Protection Act,* R.S.O. 1990, c. E.19."
SC7.15	Final Pre-Invoice Submission Meeting	Add the following ne definition: "**Final Pre-Invoice Submission Meeting** *Final Pre-Invoice Submission Meeting* has the meaning given to it in GC 5.5.1."
SC7.16	Force Majeure	Add the following definition: "**Force Majeure** *Force Majeure* means any cause, unknown at the effective date of the *Contract* and beyond either party's control, other than financial difficulties, bankruptcy or insolvency, which prevents the performance by a party, or both, of any of their respective obligations under the *Contract* and the event of *Force Majeure* did not arise from a party's default and could not be avoided or mitigated by the exercise of reasonable effort or foresight. *Force Majeure* includes *Labour Disputes*; fire; unusual delay by common carriers or

		unavoidable casualties; delays in obtaining third-party licences, permits, agreements, or approvals (excluding approvals of any *Subcontractors* or *Suppliers* 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 *Place of the* Work; acts of God; or declared epidemic or pandemic outbreak or other public health emergency (*e.g*. SARS, COVID-19)."
SC7.17	Install	Add the following definition: "**Install** *Install* means install and connect. *Install* shall mean placement of materials, equipment, or components, including receiving, unloading, transporting, storage, uncrating and installing, and performance of such testing and finish work as is compatible with degree of installation specified. *Install* has this meaning whether or not the first letter is capitalized."
SC7.18	Labour Dispute	Add the following definition: "**Labour Dispute** *Labour Dispute* 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 *Work*."
SC7.19	Notice of Non-Payment	Add the following definition: "**Notice of Non-Payment** *Notice of Non-Payment* means a notice of non-payment of holdback (Form 6) or a notice of non-payment (Form 1.1) under the *Act*, as applicable to the circumstances."
SC7.20	OHSA	Add the following definition: "**OHSA** *OHSA* means the *Occupational Health and Safety Act*, R.S.O. 1990, c. O.1, as amended, including all regulations thereto."
SC7.21	Payment Period	Add the following definition: "**Payment Period** *Payment Period* has the definition given to it under GC 5.2.1."
SC7.22	Pre-Invoice Submission Meeting	Add the following definition: "**Pre-Invoice Submission Meeting**

		Pre-Invoice Submission Meeting has the definition given to it under GC 5.2.1.”
SC7.23	Proper Invoice	Add the following definition: “**Proper Invoice** *Proper Invoice* 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.”
SC7.24	Proper Invoice Submission Date	Add the following definition: “**Proper Invoice Submission Date** *Proper Invoice Submission Date* has the definition given to it under GC 5.2.2.1.”
SC7.25	Provide	Add the following definition: “**Provide** *Provide* means to supply and Install, or supply, Install and connect as applicable, complete and in place including accessories, finishes, tests, and services required to render item so specified complete and ready for use.”
SC7.26	Request for Information (RFI)	Add the following definition: “**Request for Information (RFI)** *Request for Information* or *RFI* 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*.”
SC7.27	Restricted Period	Add the following definition: “**Restricted Period** *Restricted Period* 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*.”
SC7.28	Submittals	Add the following definition: “**Submittals** Submittals are documents or items required by the *Contract Documents* to be provided by the *Contractor,* such as: .1 *Shop Drawings*, samples, models, mock-ups to indicate details or characteristics, before the portion of the *Work* that they represent can be incorporated into the *Work*; and

		.2 As-built drawings and manuals to provide instructions to the operation and maintenance of the *Work.*"
SC7.29	Supply or Furnish	Add the following definition: "**Supply or Furnish** Shall mean fabrication or procurement of materials, equipment, or components, or performance of services to the extent specified and shown. Where used with respect to materials, equipment, or components, the term includes crating and delivery to the Place of Work but is not intended to include installation of item, either temporary or final."

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	Delete GC 1.1.3 in its entirety and replace 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 *Contractor* does not assume any responsibility to the *Owner* or to the *Consultant* for the accuracy of the *Contract Documents*. Provided it has exercised the degree of care and skill described in this GC 1.1.3, the *Contractor* shall not be liable for damage or costs resulting from such errors, inconsistencies, or omissions in the *Contract Documents*, which the *Contractor* could not reasonably have discovered through the exercise of the required standard of care."
SC8.2	1.1.4	Delete GC 1.1.4 in its entirety and replace 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 *Contractor* is not responsible for errors, omissions or inconsistencies in the *Contract Documents*. If there are errors, omissions or inconsistencies discovered by or made known to the *Contractor* as part of its review under GC 1.1.3 or at any time during the performance of the *Work*, the *Contractor* shall immediately notify the *Consultant*, and request instructions, a *Supplemental Instruction*, *Change Order*, or *Change Directive*, as the case may require, and shall not proceed with the *Work* affected until the *Contractor* has received corrected or additional information from the *Consultant*. The *Contractor* shall not be liable for damage or costs resulting from such errors, inconsistencies, or omissions in the *Contract Documents*, which the *Contractor* could not reasonably have discovered through the exercise of care and skill described in GC 3.13. Errors, inconsistencies and/or omissions in the *Drawings* and/or *Specifications*

		which do not allow completion of the *Work* of the *Contract* shall be brought to the *Consultant's* attention prior to the execution of the *Contract* by means of an *RFI*. Notwithstanding the foregoing, inconsistencies and omissions shall not include lack of reference on the drawings or in the specifications to labour and/or *Products* that are required or normally recognized within respective trade practices as being necessary for the complete execution of the *Work*."
SC8.3	1.1.5.1	Delete GC 1.1.5.1 and replace 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 *Specifications* .6 technical *Specifications;* .7 material and finishing schedules; and .8 the *Drawings*."
SC8.4	1.1.5.5	Delete GC 1.1.5.5 and replace with the following: ".5 Noted materials and annotations on the *Drawings* shall govern over the graphic representation of the *Drawings.*"
SC8.5	1.1.5.6 to 1.1.5.8	Add 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 *Drawings,* but not labelled. .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 *Consultant* or its sub-*Consultants* are to remain with each of the applicable drawing disciplines. .8 Should reference standards contained in the *Specifications* conflict with the *Specifications*, the *Specifications* shall govern. Should reference standards and *Specifications* conflict with each other or if certain requirements of the *Specifications* conflict with other requirements of the *Specifications*, the more stringent requirements shall govern."
SC8.6	1.1.9	Add the following to the end of GC 1.1.9: "The *Specifications* 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

		Contract Documents will be construed to place responsibility on the *Owner* or the *Consultant* to settle disputes among the *Subcontractors* and *Suppliers* with respect to such divisions. The *Drawings* are, in part, diagrammatic and are intended to convey the scope of the *Work* and indicate general and appropriate locations, arrangements and sizes of fixtures, equipment, outlets and other elements. The *Contractor* shall obtain more accurate information about the locations, arrangements and sizes from study and coordination of the *Drawings,* including *Shop Drawings* and shall become familiar with conditions and spaces affecting those matters before proceeding with the *Work.* Where site conditions require reasonable minor changes where the change requires only the additional labour two hours or less, the *Contractor* shall make such changes at no additional cost to the *Owner.* Similarly, where known conditions or existing conditions interfere with new installation and require relocation, the *Contractor* shall include such relocation in the *Work.* The *Contractor* 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 *Contract Documents*, wherever located and whenever issued, which compile information of similar content and may consist of drawings, tables and/or lists.”
SC8.7	1.1.12	Add new paragraphs 1.1.12 and 1.1.13 as follows: “1.1.12 The *Consultant*, on behalf of the *Owner* shall provide the *Contractor* without charge, one (1) PDF copy of the *Contract Documents*, exclusive of those required by jurisdictional authorities and the executed *Contract Documents*. Additional copies can be purchased by the *Contractor* at the *Consultant's* cost of reproduction, handling and sales tax. 1.1.13 The *Contractor* shall keep one copy of the current *Contract Documents*, *Supplemental Instructions*, contemplated *Change Orders*, *Change Orders*, *Change Directives*, cash allowance disbursement authorizations, reviewed *Shop Drawings*, submittals, reports and records of meeting at the *Place of the Work*, in good order and available to the *Owner* and *Consultant*.”

SC9 GC 1.3 RIGHTS AND REMEDIES

SC9.1	1.3.2	In paragraph 1.3.2 delete the word “No” from the beginning of the paragraph and replace 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	Add new GC 1.5 – EXAMINATION OF DOCUMENTS AND SITE as follows: “**GC 1.5 EXAMINATION OF DOCUMENTS AND SITE** 1.5.1 The *Contractor* declares and represents that in tendering for the *Work*, and in entering into a Contract with the *Owner* for the performance of the *Work*, it has investigated for itself the character of the *Work t*o be done,

		based on information generally available from a visit to the *Place of the Work* 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 *Contract Price* all reasonably known impacts and restrictions arising from the COVID-19 pandemic, including without limitation corresponding legislative changes that may impact performance of the *Project*, various weather conditions that may affect the *Work*, the availability of supplies and labour or other conditions or risks that the *Contractor* knew about or reasonably ought to have known about prior to the date of the *Contract.* The *Contractor* has assumed and does hereby assume all risk of known conditions now existing or arising in the course of the *Work* which might or could make the Work, or any items thereof more expensive in character, or more onerous to fulfil, than was contemplated or known when the tender was made or the *Contract* signed. 1.5.2 The *Contractor* also declares that prior to commencement of the *Work*, where in tendering for the *Work* and in entering into this *Contract*, the *Contractor* relied upon information furnished by the *Owner* or any of its agents or servants respecting the nature or confirmation of the ground at the site of the Work, the Contractor shall review to the standard specified in GC 3.14.1, the accuracy of the information furnished by the *Owner*. If a condition is materially different than what is stated in the information furnished by the *Owner*, the *Contractor* shall, no later than five (5) *Working Days* after the first observation of such condition(s), deliver to the *Owner* and to the *Consultant* a *Notice in Writing* specifying the materially different condition and the *Contractor* shall not proceed with the affected part of the Work until receiving written direction from the *Owner* or the *Consultant*. Where the *Contractor* fails to provide prompt *Notice in Writing* in accordance with this GC 1.5.2, the *Contractor* expressly waives and releases the *Owner* from all claims with respect to the said information with respect to the *Work*.

PART 2 ADMINISTRATION OF THE CONTRACT

SC11 GC 2.2 ROLE OF THE CONSULTANT

SC11.1	2.2.5	Delete paragraph 2.2.4 and replace it with the following: "2.2.4 Upon receipt of an application for payment that satisfies the requirement of a *Proper Invoice*, based on the *Consultant's* observations and evaluation of the *Contractor's* application for payment, the *Consultant* will determine the amounts owing to the *Contractor* under the *Contract* 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 *Consultant* determines that the amount payable to the *Contractor* differs from the amount stated in a *Proper Invoice*, the *Consultant* shall notify the *Owner* as provided in GC 5.3.1.2 and prepare a draft of the applicable *Notice of Non-Payment* for the amount in dispute."
SC11.2	2.2.6	In the first sentence of paragraph 2.2.6, delete the words "Except with respect to GC 5.1 – FINANCING INFORMATION REQUIRED OF THE OWNER".

SC11.3	2.2.8	Add the following to the end of paragraph 2.2.8: "The *Owner* and the *Contractor* shall waive any claims against the *Consultant* arising out of the making of such interpretations and findings made in accordance with paragraphs 2.2.6, 2.2.7, and 2.2.8, except for claims that arise as a result of the *Consultant*'s negligence, wilful misconduct, or fraud."
SC11.4	2.2.12	At paragraph 2.2.12, insert the following at end of that paragraph: "If, in the opinion of the *Contractor*, the *Supplemental Instruction* involves an adjustment in the *Contract Price* or in the *Contract Time*, it shall, within ten (10) *Working Days* of receipt of a *Supplemental Instruction*, provide the *Consultant* 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 *Supplemental Instruction* by the *Contractor*, without any adjustment in the *Contract Price* or *Contract Time*."
SC11.5	2.2.13	In paragraph 2.2.13 delete the comma after the word "submittals" and add the words "that are provided" before the words "by the Contractor".

SC12 GC 2.3 REVIEW AND INSPECTION OF THE WORK

SC12.1	2.3.2	Amend paragraph 2.3.2 by adding the words "and *Owner*" after the words "*Consultant*" in the second and third lines.
SC12.2	2.3.3	Delete paragraph 2.3.3 in its entirety and replace it with the following: "2.3.3 The *Contractor* shall furnish promptly two copies to the *Consultant* and one original digital copy to the *Owner* of all certificates and inspection reports relating to the *Work*."
SC12.3	2.3.4	In paragraph 2.3.4 add 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 "*Consultant*", add "or the *Owner*".
SC12.5	2.3.8	Add a new paragraph 2.3.8 as follows: "2.3.8 The *Consultant* will conduct periodic reviews of the *Work* in progress, to determine general conformance with the requirements of the *Contract Documents*. Such reviews, or lack thereof, shall not give rise to any claims by the *Contractor* in connection with construction means, methods, techniques, sequences and procedures, nor in connection with construction safety at the *Place of Work*, responsibility for which belongs exclusively to the *Contractor*."

SC13 GC 2.4 DEFECTIVE WORK

SC13.1	2.4.1	Amend GC 2.4.1 by: (a) adding the words "at their own expense," after "The *Contractor* Shall" in the first line;

		-and- (b) by inserting ", the *Owner* and/or its agent" in the first sentence following "rejected by the *Consultant*".
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 *Contractor* shall rectify, in a manner acceptable to the *Consultant* and to the *Owner through the Consultant* all defective work and deficiencies throughout the *Work*, whether or not they are specifically identified by the *Consultant*. 2.4.1.2 The *Contractor* shall prioritize the correction of any defective work, which, in the sole discretion of the *Owner through the Consultant*, adversely affects the day to day operations of the *Owner* or which, in the sole discretion of the *Consultant*, adversely affects the progress of the *Work*."
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 *Contractor* shall promptly pay the *Owner* for costs incurred by the *Owner*, the *Owner's* own forces or the *Owner's* other contractors, for work destroyed or damaged or any alterations necessitated by the *Contractor's* 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 *Work* by the *Consultant* or the *Owner*, nor any failure by the *Consultant* or the *Owner* to identify, observe or warn of defective *Work* or any deficiency in the *Work* shall relieve the *Contractor* from the sole responsibility for rectifying such defect or deficiency at the *Contractor's* sole cost, even where such failure to identify, observe or warn is negligent."

<u>PART 3 EXECUTION OF THE WORK</u>

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 *Contractor* shall verify at the *Place of the Work*, all relevant measurements and levels necessary for proper and complete fabrication, assembly and installation of the *Work* and shall further carefully compare such field measurements and conditions with the requirements of the *Contract Documents*. Where dimensions are not included or exact locations are not apparent, the *Contractor* shall immediately notify the *Consultant* in writing and obtain written instructions from the *Consultant* before proceedings with any part of the affected *Work*.

		3.1.4 Notwithstanding the provisions of paragraphs 3.1.1 and 3.1.2, the *Owner* 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 *Contractor* to fulfill its contractual obligations.”

SC15 GC 3.2 CONSTRUCTION BY OWNER OR OTHER CONTRACTORS

SC15.1	3.2.2.1	Delete subparagraph 3.2.2.1 and replace it with “[Intentionally left blank]”.
SC15.2	3.2.3.2	Delete subparagraph 3.2.3.2 and replace it with the following: “.2 co-ordinate and schedule the activities and work of other contractors and the *Owner's* own forces, including where other contractors or the Owner's own forces are used after the *Owner* and the *Contractor* cannot reach agreement on the value of a change, with the *Work* of the *Contractor* and connect as specified or shown in the *Contract Documents*.”
SC15.3	3.2.3.4	Delete the period at the end of subparagraph 3.2.3.4 and replace it with a semi-colon.
SC15.4	3.2.3.5	Add new subparagraph 3.2.3.5 as follows: “.5 Subject to GC 9.4 CONSTRUCTION SAFETY, for the *Owner's* 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 *Place of the Work*, including all of the responsibilities of the “constructor”, pursuant to the *OHSA*.”

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 *Consultant*”.

SC17 GC 3.4 CONSTRUCTION SCHEDULE

SC17.1	3.4.1	Delete GC 3.4.1 in its entirety and replace it with the following: “3.4.1 The *Contractor* shall: .1 within five (5) calendar days of receiving written confirmation of the award of the *Contract*, prepare and submit to the *Owner* and the *Consultant* for their review and approval, a construction schedule in the format indicated below that indicates the timing of the activities of the *Work* and provides sufficient detail of the critical events and their inter-relationship to demonstrate the *Work* will be performed in conformity with the *Contract Time* and in accordance with the *Contract Documents.* Such schedule is to include: (a) a delivery schedule for *Products* whose delivery is critical to the schedule for the *Work* or are required by the *Contract* to be included in a *Products* delivery schedule;

		(b) a schedule indicating times for items to be delivered or performed under cash allowances; and (c) a schedule for the installation of *Owner* purchased items to be installed by the *Contractor*. The *Contractor* shall employ construction scheduling software, being the latest version of "Microsoft Project", that permits the progress of the *Work* to be monitored in relation to the critical path established in the schedule. The *Contractor* shall provide such schedule and any successor or revised schedules in both original digital file format (*e.g.,* .mpp format for Microsoft Project), portable data file (PDF) format, and hard copy. Once accepted by the *Owner* and the *Consultant*, the construction schedule submitted by the *Contractor* 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 *Construction Schedule* or revised construction schedule accepted by the *Owner* pursuant to GC 3.4 CONSTRUCTION SCHEDULE, which includes without limitation, the *Contractor*'s use of all possible and, if necessary, extraordinary measures, to bring the progress of the *Work* into compliance with the *Construction Schedule*, such as (i) increasing the presence of its own forces at the *Place of the Work*; (ii) directing any *Subcontractors* or *Suppliers* to increase their labour forces and equipment; (iii) working overtime and extra shifts; and (iv) providing any additional supervision and coordination of the *Project*, all at the *Contractor's* 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 *Work* on a weekly basis relative to the baseline *Construction Schedule*, or any revised *Construction Schedule* accepted by the *Owner* pursuant to GC 3.4 CONSTRUCTION SCHEDULE, deliver a *Construction Schedule Update* to the *Consultant* and *Owner* with each application for payment, at a minimum, or as may be reasonably required by the *Consultant* and advise the *Consultant* and the *Owner* 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 *Contractor* forms the opinion that the slippage in schedule reported in paragraph 3.4.1.3 cannot be recovered by the *Contractor*, it shall, in the same notice provided under paragraph 3.4.1.3, indicate to the *Consultant* if the *Contractor* intends to apply for an extension of *Contract Time* as provided in PART 6 —CHANGES IN THE WORK; and, .5 ensure that the *Contract Price* shall include all costs required to phase or stage the *Work*."
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 *Owner* or the *Consultant* that the actual progress of the *Work* is behind schedule or is likely to become behind schedule, or if the *Contractor* has given notice of such to the *Owner* or the *Consultant*

		pursuant to GC 3.4.1.3, the *Contractor* shall, either at the request of the *Owner* or the *Consultant*, or following giving notice pursuant to GC 3.4.1.3, take appropriate steps to cause the actual progress of the *Work* to conform to the schedule or minimize the resulting delay. Within 5 calendar days of the request by the *Owner* or the *Consultant* or the notice being given pursuant to GC 3.4.1.3, the *Contractor* shall produce and present to the *Owner* and the *Consultant* a plan demonstrating how the *Contractor* will recover the performance of the *Work* to align with the currently approved *Construction Schedule*. 3.4.3 The *Contractor* shall not amend the *Construction Schedule* without the prior written consent of the *Owner*.. Any revisions to the *Construction Schedule* approved by the *Owner* shall not be deemed to be an extension of the *Contract Time*. All requests by the Contractor for a revision to the Construction Schedule that include an extension to the *Contract Time* must be approved by the *Owner* through an executed *Change Order*."

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: "3.5.1 The *Contractor* shall employ a competent full-time superintendent, acceptable to the *Owner* and *Consultant*, who shall be in full time attendance at the *Place of the Work* while the *Work* is being performed. The superintendent shall not be changed by the *Contractor* without valid reason which shall be provided in writing and shall not be changed without prior consultation with and agreement by the Owner and the *Consultant*. The *Contractor* shall replace the superintendent within 7 *Working Days* of the *Owner's* written notification, if the superintendent's performance is not acceptable to the *Owner*. The *Contractor* shall provide the *Owner* and the *Consultant* 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 *Contractor*, shall represent the *Contractor* at the *Place of the Work* and shall have full authority to act on written instructions given by the *Consultant* and/or the *Owner*. Instructions given to the superintendent or the project manager shall be deemed to have been given to the *Contractor* and both the superintendent and any project manager shall have full authority to act on behalf of the *Contractor* and bind the *Contractor* in matters related to the *Contract*."
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 *Owner* may, at any time during the course of the *Work*, request the replacement of the appointed representative(s). Immediately upon receipt of the request, the *Contractor* shall make arrangements to appoint an acceptable replacement, which is approved by the *Owner*.

		3.5.4 The supervisory staff assigned to the *Project* shall also be fully competent to implement efficiently all requirements for scheduling, coordination, field engineering, reviews, inspections and submittals defined in the *Specifications,* and have a minimum 5 years documented "Superintendent/Project Management" experience. 3.5.5 The *Consultant and Owner* shall reserve the right to review the record of experience and credentials of supervisory staff assigned to the *Project* prior to commencement of the *Work*. 3.5.6 A superintendent assigned to the *Work* 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 *Project* to the sole satisfaction of the *Owner*."

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 *Contract*."
SC19.2	3.6.1.2	In subparagraph 3.6.1.2 after the words "the *Contract Documents*" <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 *Subcontractor* and/or *Suppliers* after submission of the *Contractor's* bid will not be accepted unless a valid reason is given in writing to and approved by the *Owner*, whose approval may be arbitrarily withheld. The reason for substitution must be provided to the *Owner* and to the original *Subcontractor* and/or *Supplier* and the original *Subcontractor* and/or *Supplier* shall be given the opportunity to reply to the *Contractor* and *Owner.* The *Contractor* shall be fully aware of the capability of each *Subcontractor* and/or *Supplier* 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 *Contractor* represents and warrants that it has confirmed the availability of its *Subcontractors* for the *Project* and, in particular, for the performance of their respective portions of the *Work* to ensure completion of the *Project* within the *Contract Price* and the *Contract Time*. 3.6.8 The *Consultant* or the *Owner*, acting reasonably, may from time to time require the *Contractor* to remove from the *Project* any personnel of the *Contractor*, including project managers, superintendents or *Subcontractors*. Such persons shall be replaced by the *Contractor* in a timely fashion to the satisfaction of the *Consultant* or the *Owner*, as the case may be, at no cost to the *Owner*. 3.6.9 Where provided in the *Contract*, the *Owner* may assign to the *Contractor*, and the *Contractor* agrees to accept, any contract procured by the *Owner*

		for *Work* or services required on the *Project* that has been pre-tendered or pre-negotiated by the *Owner*, and upon such assignment, the *Owner* shall have no further liability to any party for such contract. 3.6.10 The *Contractor* covenants that each subcontract or supply contract which the *Contractor* enters into for the purpose of performing the *Work* shall expressly provide for the assignment thereof to the *Owner* (at the option of the *Owner*) and the assumption by the *Owner* of the obligations of the *Contractor* thereunder, upon the termination of the *Contract* and upon written notice by the *Owner* to the other parties to such subcontracts or supply contracts, without the imposition of further terms or conditions; provided, however, that until the *Owner* has given such notice, nothing herein contained shall be deemed to create any contractual or other liability upon the *Owner* for the performance of obligations under such subcontracts or supply contracts and the *Contractor* 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	Amend paragraph 3.7.1 by adding the words, "…, agents, *Subcontractors* and *Suppliers*…" after the word "employees" in the first line.
SC20.2	3.7.2	Delete paragraph 3.7.2 and substitute with the following: "3.7.2 *Products* provided shall be new and shall conform to all 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 *Place of the Work*, unless otherwise specified. *Products* which are not specified shall be of a quality consistent with those specified and their use acceptable to the *Consultant*. *Products* brought on to the *Place of the Work* by the *Contractor* shall be deemed to be the property of the *Owner*, but the *Owner* shall be under no liability for loss thereof or damage thereto arising from any cause whatsoever. The said *Products* shall be at the sole risk of the *Contractor*. Workmanship shall be, in every respect, first class and the *Work* shall be performed in accordance with the best modern industry practice."
SC20.3	3.7.4 to 3.7.9	Add new paragraphs 3.7.4, 3.7.5, 3.7.6, 3.7.7, and 3.7.9 as follows: "3.7.4 Upon receipt of a *Notice in Writing* from the *Owner,* the *Contractor* shall immediately remove from the *Place of the Work*, tradesmen and labourers or anyone whose conduct jeopardizes the safety of the *Owner's* operations or who are considered by the *Owner* or the *Consultant* to be unskilled or otherwise objectionable. Immediately upon receipt of the request, the *Contractor* shall make arrangements to appoint an acceptable replacement. . 3.7.5 The *Contractor* shall cooperate with the *Owner* and its representatives and shall take all reasonable and necessary actions to maintain stable and harmonious labour relations with respect to the *Work* at the *Place of the*

		Work, including cooperation to attempt to avoid *Work* stoppages, trade union jurisdictional disputes and other *Labour Disputes*. Any costs arising from labour disputes shall be at the sole expense of the *Contractor.* 3.7.6 The cost for overtime required beyond the normal *Working Day* to complete individual construction operations of a continuous nature, such as pouring or finishing of concrete or similar work, or *Work* that the *Contractor* elects to perform at overtime rates without the *Owner* requesting it, shall not be chargeable to the *Owner*. 3.7.7 All manufactured *Products* which are identified by their proprietary names or by part or catalogue number in the *Specifications* shall be used by the *Contractor.* No substitutes for such specified *Products* shall be used without the written approval of the *Owner* and the *Consultant*. Substitutes will only be considered by the *Consultant* when submitted in sufficient time to permit proper review and investigation. When requesting approval for the use of substitutes, the *Contractor* shall include in its submission any proposed change in the *Contract Price*. The *Contractor* shall use all proprietary *Products* in strict accordance with the manufacturer's directions. Where there is a choice of proprietary *Products* specified for one use, the *Contractor* may select any one of the *Products* so specified for this use. 3.7.8 Materials, appliances, equipment and other *Products* are sometimes specified by reference to brand names, proprietary names, trademarks or symbols. In such cases, the name of a manufacturer, distributor, *Supplier* or dealer is sometimes given to assist the *Contractor* to find a source *Supplier*. This shall not relieve the *Contractor* from its responsibility from finding its own source of supply even if the source names no longer supplies the *Product* specified. If the *Contractor* is unable to obtain the specified *Product*, the *Contractor* shall supply a substitute product equal to or better than the specified *Product,* as approved by the *Consultant* with no extra compensation. Should the *Contractor* be unable to obtain a substitute *Product* equal to or superior to the specified *Product* and the *Owner* accepts a different Product, the *Contract Price* shall be adjusted accordingly, as approved by the *Consultant*. 3.7.9 The *Contractor* is responsible for the safe on-site storage of *Products* and their protection (including *Products* supplied by the *Owner* and other contractors to be installed under the *Contract*) in such ways as to avoid dangerous conditions or contamination to the *Products* or other persons or property and in locations at the *Place of the Work* to the satisfaction of the *Owner* and the *Consultant*. The *Owner* shall provide all relevant information on the *Products* to be supplied by *Owner*."

SC21 GC 3.8 SHOP DRAWINGS

SC21.1	3.8	Amend the Title of GC 3.8 by adding the words "AND OTHER SUBMITTALS" after the words "SHOP DRAWINGS".
SC21.2	3.8.1	Delete paragraph 3.8.1 in its entirety and replace with the following:

		"3.8.1 The *Contractor* shall provide Shop Drawings as described in the *Contract Documents* and as the *Consultant* may reasonably request."
SC21.3	3.8.3	Delete paragraph 3.8.3 and replace it with the following: "3.8.3 The *Contractor* shall prepare a *Shop Drawings and Submittals* schedule acceptable to the *Owner* and the *Consultant* prior to the first application for payment. A draft of the proposed *Shop Drawings* schedule shall be submitted by the *Contractor* to the *Consultant* and the *Owner* for approval. The draft *Shop Drawings* schedule shall clearly indicate the phasing of *Shop Drawings* submissions. The *Contractor* shall periodically re-submit the *Shop Drawings* schedule to correspond to changes in the *Construction Schedule*."
SC21.4	3.8.5	Delete paragraph 3.8.5 in its entirety and substitute the following: "3.8.5 At the time of providing *Shop Drawings and Submittals*, the *Contractor* shall advise the *Consultant* in writing of any deviations in *Shop Drawings and Submittals* from the requirements of the *Contract Documents*. The *Consultant* 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."
SC21.5	3.8.8 to 3.8.12	Add new paragraphs 3.8.8, 3.8.9, 3.8.10, 3.8.11, and 3.8.12 as follows: "3.8.8 Reviewed *Shop Drawings and Submittals* shall not authorize a change in the *Contract Price* and/or the *Contract Time*. 3.8.9 Except where the parties have agreed to a different *Shop Drawings and Submittals* schedule pursuant to paragraph 3.10.3, the *Contractor* shall comply with the requirements for *Shop Drawings and Submittals* submissions stated in the *Specifications*. 3.8.10 The *Contractor* shall not use the term "by others" on *Shop Drawings* or other *Submittals*. The related trade, *Subcontractor* or *Supplier* shall be stated. 3.8.11 Certain *Specifications* sections require the *Shop Drawings and Submittals* to bear the seal and signature of a professional engineer. Such professional engineer must be registered in the jurisdiction of the *Place of the Work* and shall have expertise in the area of practice reflected in the *Shop Drawings*. 3.8.12 The *Consultant* will review and return *Shop Drawings* and submittals in accordance with the schedule agreed upon in paragraph 3.10.3, The *Contractor* shall allow the *Consultant* a minimum of 10 *Working Days* to review *Shop Drawings* from the date of receipt. If resubmission of *Shop Drawings* is required, a further 10 *Working Day* period is required for the *Consultant's* review."

SC22 *NEW* GC 3.9 USE OF THE WORK

SC22.1	GC 3.9	Add new GC 3.9 – USE OF THE WORK as follows: "**GC 3.9 USE OF THE WORK** 3.9.1 The *Contractor* shall confine *Construction Equipment*, *Temporary Work*, storage of *Products*, waste products and debris, and operations of employees and *Subcontractors* to limits indicated by laws, ordinances, permits, by the direction of the *Owner* or the *Consultant*, or the *Contract Documents* and shall not unreasonably encumber the *Place of the Work*. 3.9.2 The *Contractor* shall not load or permit to be loaded any part of the *Work* with a weight or force that will endanger the safety of the *Work*. 3.9.3 The *Owner* shall have the right to enter or occupy the *Place of the Work* in whole or in part for the purpose of placing fittings and equipment, or for other use before *Substantial Performance of the Work*, if, in the opinion of the *Consultant*, such entry and occupation does not prevent or substantially interfere with the *Contractor* in the performance of the *Contract* within the *Contract Time.* Such entry or occupation shall neither be considered as acceptance of the *Work* or in any way relieves the *Contractor* from its responsibility to complete the *Contract*."

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 *Contractor* shall perform the cutting and remedial work required to make the affected parts of the *Work* come together properly. Such cutting and remedial work shall be performed by specialists familiar with the *Products* affected and shall be performed in a manner to neither damage nor endanger the *Work*. 3.10.2 The *Contractor* shall coordinate the *Work* to ensure all cutting and remedial work required is kept to a minimum. 3.10.3 Unless specifically stated otherwise in the *Specifications*, the *Contractor* shall do all cutting and making good necessary for the proper installation and performance of the *Work.* 3.10.4 To avoid unnecessary cutting, the *Contractor* shall lay out its work and advise the *Subcontractors,* 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 *Contractor* shall maintain the *Work* in a safe and tidy condition and free rom the accumulation of waste products and debris, other than that caused by the *Owner*, other contractors or their employees. The *Contractor* shall remove accumulated waste and debris at least once a week as a minimum or as required by the nature of the *Work*. 3.11.2 Before applying for *Substantial Performance of the Work*, the *Contractor* shall remove waste products and debris, other than that resulting from the work of the *Owner*, other contractors or their employees, and shall leave the *Place of the Work* clean and suitable for use or occupancy by the *Owner*. The *Contractor* shall remove products, tools, materials, *Construction Equipment,* and *Temporary Work* not required for the performance of the remaining work. 3.11.3 As a condition precedent to submitting its application for final payment, the *Contractor* shall remove any remaining products, tools, materials, *Construction Equipment*, *Temporary Work*, and waste products and debris, other than those resulting from the work of the *Owner*, other contractors or their employees. 3.11.4 The *Contractor* shall clean up garbage during and after construction and maintain the *Place of the Work* in a neat and orderly condition on a daily basis. Prior to leaving the *Place of the Work* and following completion of the *Work*, the *Contractor* shall make good all damage to the building and its components caused by the performance of the *Work* or by any *Subcontractor* or *Supplier*. The *Contractor* shall leave the *Place of the Work* in a clean and finished state; remove all *Construction Equipment* and materials; remove all paint, stains, labels, dirt, etc. from the *Place of the Work*; and touch up all damaged painted areas (if applicable). The *Contractor* shall be responsible for restoring those areas of the *Place of the Work*, impacted by the *Work*, to their original condition or better. 3.11.5 Without limitation to or waiver of the *Owner's* other rights and remedies, the *Owner* shall have the right to back charge to the *Contractor* the cost of damage to the site caused by transportation in and out of the *Place of the Work* by the *Contractor*, *Subcontractors* or *Suppliers,* if not repaired before final payment. 3.11.6 The *Contractor* shall dispose of debris at a location and in a manner acceptable to the *Owner* (and to the authorities having jurisdiction at the *Place of the Work* and at the disposal area). <u>3.11.7 In the event of any dispute regarding the removal of waste products and debris, the *Owner* may remove the waste and debris and charge the cost to the *Contractor* to the extent that the *Consultant* shall determine to be reasonable."</u>

SC25 *NEW* GC 3.12 EXCESS SOIL MANAGEMENT

SC25.1	GC 3.12	Add new GC 3.12 – EXCESS SOIL MANAGEMENT as follows: "**GC 3.12 EXCESS SOIL MANAGEMENT** 3.12.1 The *Contractor* shall be solely responsible for the proper management of all *Excess Soil* at the *Place of the Work* and for performance of the *Work* in compliance with the rules, regulations and practices required by the *Excess Soil Regulation* until such time as *Ready-for-Takeover* is achieved. Without restricting the generality of the previous sentence, the *Contractor*'s responsibility under this GC 3.12 includes the designation, transportation, tracking, temporary and/or final placement, record keeping, and reporting of all *Excess Soil* in connection with the Work all in compliance with the *Excess Soil Regulation*. 3.12.3 The *Contractor* shall indemnify and save harmless the *Owner*, 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 *Contractor*, or those for whom it is responsible at law, under the *Excess Soil Regulation*, 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 *Owner* is not covered by insurance."

SC26 *NEW* GC 3.13 CONTRACTOR STANDARD OF CARE

SC26.1	3.13	Add 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 *Contract*, the *Contractor* 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 *Contractor* acknowledges and agrees that throughout the *Contract,* the performance of the *Contractor's* obligations, duties and responsibilities shall be interpreted in accordance with this standard. The *Contractor* shall exercise the same standard of care, skill and diligence in respect of any *Products*, personnel or procedures which it may recommend to the *Owner* or employ on the *Project*. 3.13.2 The *Contractor* further represents, covenants and warrants to the *Owner* that: .1 the personnel it assigns to the *Project* are appropriately experienced; .2 it has a sufficient staff of qualified and competent personnel to replace any of its appointed representatives, subject to the *Owner's* approval, in the event of death, incapacity, removal or resignation; and

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

PART 4 ALLOWANCES

SC27 GC 4.1 CASH ALLOWANCES

SC27.1	4.1.3	Amend the clause 4.1.3 by adding the words "in writing" after the words "through the *Consultant*".
SC27.2	4.1.4	Delete GC 4.1.4 in its entirety and replace it with the following: "4.1.4 Where the actual cost of the *Work* under any cash allowance exceeds the amount of the allowance, any unexpended amounts from other cash allowances shall be reallocated, by the *Consultant* at the *Owner*'s direction, to cover the shortfall, and, in that case, there shall be no additional amount added to the *Contract Price* for overhead and profit. Only where the actual cost of the *Work* under all cash allowances exceeds the total amount of all cash allowances shall the *Contractor* be compensated for the excess incurred and substantiated, plus an amount for overhead and profit on the excess only, as set out in the *Contract Documents.*"
SC27.3	4.1.7	Delete GC 4.1.7 in its entirety and replace 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 *Contract Price* by *Change Order* without any adjustment for the *Contractor's* overhead and profit on such amount."
SC27.4	4.1.8, 4.1.9 & 4.1.10	Add new GC 4.1.8, 4.1.9, and 4.1.10 as follows: "4.1.8 The *Owner* reserves the right to call, or to have the *Contractor* call, for competitive bids for portions of the *Work* to be paid for from cash allowances. 4.1.9 Cash allowances cover the net cost to the *Contractor* of services, *Products*, *Construction Equipment*, freight, unloading, handling, storage, installation, provincial sales tax, and other authorized expenses incurred in performing any *Work* stipulated under the cash allowances but does not include any *Value Added Taxes* payable by the *Owner* and the *Contractor.* 4.1.10 Purchases from cash allowances must be authorized by written instructions issued by the *Consultant*. The form and method of accounting for costs shall be agreed to by the *Consultant* and *Contractor* before proceeding with the purchase."

PART 5 PAYMENT

SC28 GC 5.1 FINANCING INFORMATION REQUIRED OF THE OWNER

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

SC29 GC 5.2 APPLICATIONS FOR PAYMENT

SC29.1	5.2.1	Delete GC 5.2.1 and replace it with the following: "5.2.1 Upon execution of the *Contract*, and in any event prior to the *Contractor* submitting its first application for payment, the *Owner* shall issue a purchase order to the *Contractor* for the performance of the *Contract*. The number indicated on such purchase order must be clearly identifiable on all applications for payment. Applications for payment shall be dated the last day of each month or an alternative day of each month agreed to in writing by the parties, with each month representing one payment period under the *Contract* (each a "**Payment Period**"). Within 3 calendar days of the end of each *Payment Period*, the *Contractor* will submit a draft application for payment to the *Owner* and the *Consultant*. Upon receipt of the draft application for payment, and within 7 *Working Days*, a representative of each of the *Contractor*, *Owner*, and the *Consultant* shall attend a meeting to discuss and review the work completed during the *Payment Period*, including quantities, if applicable (the "**Pre-Invoice Submission Meeting**"). In the event that the scheduled date for the *Pre-Invoice Submission Meeting* is not a *Working Day*, the *Pre-Invoice Submission Meeting* shall occur on the next *Working Day*. The *Contractor* shall bring with it to the *Pre-Invoice Submission Meeting* the following: .1 a copy of the draft application for payment; .2 any documents the *Contractor* is required to bring to the *Pre-Invoice Submission Meeting* as stipulated in the *Contract Documents* or as reasonably requested by the *Owner*; and .3 any other documents reasonably requested, in advance, by the *Owner* or the *Consultant*."
SC29.2	5.2.2	Delete GC 5.2.2 in its entirety and replace 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 *Pre-Invoice Submission Meeting*, the *Contractor* shall deliver its application for payment to the *Owner* and to the *Consultant* for *Work* performed during the *Payment Period* ("**Proper Invoice Submission Date**") subject to the following: .1 if the fifth calendar day following the *Pre-Invoice Submission Meeting*, to which an invoice relates falls on a day that is not a *Working Day*, the *Proper Invoice Submission Date* shall be deemed to fall on the next *Working Day*.

		.2 The application for payment must be delivered to the *Owner* and to the *Consultant* in the same manner as a *Notice in Writing* during the hours of 9:00 am to 4:00pm (EST) on the *Proper Invoice Submission Date*. Delivery to the *Owner* shall be to the following email address: Algonquin & Lakeshore Catholic District School Board 151 Dairy Avenue, Napanee Ontario K7R 4B2 bhurdis@alcdsb.on.ca Delivery to the *Consultant* shall be to the following email address: Salter Pilon Architecture Inc. 151 Ferris Lane, Suite #400, Barrie Ontario L4M 6C1 jjeffery@salterpilon.ca .3 If an application for payment is received after 4:00 p.m. (EST) on the applicable *Proper Invoice Submission Date*, the application for payment will not be considered or reviewed by the *Owner* and *Consultant* until the next *Proper Invoice Submission Date.* Notwithstanding the foregoing, the *Owner* in its sole and absolute discretion may elect to accept an application for payment submitted after 4:00 p.m. on the applicable *Proper Invoice Submission Date*; however, such acceptance shall not be construed as a waiver of any of its rights or waive or release the *Contractor*'s 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 *Owner* prior to the *Proper Invoice Submission Date*. .5 All applications for payment shall include all of the requirements for a *Proper Invoice* prescribed by the *Construction Act* and this *Contract* and be dated the last day of the applicable *Payment Period*."
SC29.3	5.2.3	Delete GC 5.2.3 and replace it with the following: "5.2.3 The amount claimed shall be for the value, proportionate to the amount of the *Contract*, of *Work* performed and *Products* delivered and incorporated into the *Work* as of the last date of the applicable *Payment Period*. Materials may also be deemed to be supplied to an improvement, for payment purposes, when, in the *Owner's* opinion, they are placed and properly secured on the land on which the improvement is made, or placed upon land designated by the *Owner* or agent of the *Owner*, 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 *Products* delivered to the *Place of the Work* unless the *Products* are free and clear of all security interests, liens, and other claims of third parties."
SC29.4	5.2.4	After the word "*Consultant*" in GC 5.2.4 add the words "and the *Owner*"
SC29.5	5.2.5	After the word "*Consultant*" in GC 5.2.5 add the words "or the *Owner*".

SC29.6	5.2.6	In GC 5.2.6, delete the word "*Consultant*" and replace it with "*Owner*".
SC29.7	5.2.9	Add new 5.2.9 as follows: "5.2.9 The *Contractor* shall prepare and maintain current as-built drawings which shall consist of the *Drawings* and *Specifications* revised by the *Contractor* during the *Work*, showing changes to the *Drawings* and *Specifications*, which current as-built drawings shall be maintained by the *Contractor* and made available to the *Consultant* for review with each application for progress payment. The *Consultant* shall recommend to the *Owner* that the *Owner* 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	Delete GC 5.3.1 in its entirety, including all subparagraphs thereunder, and replace it with the following: "5.3.1 After receipt by the *Owner* and the *Consultant* of an application for payment submitted by the *Contractor* in accordance with GC 5.2 - APPLICATIONS FOR PAYMENT: .1 the *Consultant* will either: (a) issue to the *Owner* with a copy to the *Contractor*, a progress payment certificate in the amount applied for by the *Contractor* in the *Proper Invoice*, or (b) issue to the *Owner*, with a copy to the *Contractor*, a certificate for payment for an amount determined by the *Consultant* to be properly due to the *Contractor* after applying any credits, withheld amounts, or other set-offs which the *Consultant* has determined that the *Owner* is entitled to notwithstanding any notice of dispute or disagreement that the *Contractor* may have served, along with the *Consultant's* reasons why an amount other than what is claimed in the *Proper Invoice* is properly due to the *Contractor*, which finding the *Owner* may accept or amend prior to the *Owner* issuing a *Notice of Non-Payment*, if any, in accordance with GC 5.3.2; .2 the *Owner* shall make payment to the *Contractor* 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 *Owner's Notice of Non-Payment* issued pursuant to GC 5.3.3, on the 28th calendar day after receipt of a *Proper Invoice*, unless such 28th calendar day lands on a day that is other than a *Working Day*, in which case payment shall be made on the next *Working Day* 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 *Contractor* shall be processed using electronic funds transfer ("**EFT**") and deposited directly to the *Contractor's* bank account unless agreed to otherwise by the *Contractor* and the *Owner* in writing. Prior to the *Contractor* submitting its first application for payment, the *Owner* and the *Contractor* 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 *Contractor* pursuant to GC 5.2 - APPLICATIONS FOR PAYMENT does not include the requirements for a *Proper Invoice* or where the *Owner* disputes the amount claimed as payable in the *Proper Invoice*, then the *Owner* shall within 14 calendar days of receipt of the application for payment, issue a *Notice of Non-Payment* (Form 1.1). 5.3.4 Where the *Owner* has delivered a *Notice of Non-Payment*, the *Owner* and the *Contractor* shall first engage in good faith negotiations to resolve the dispute. If within 5 calendar days following the issuance of a *Notice of Non-Payment*, despite good faith efforts by both parties and the assistance of the *Consultant*, the *Owner* and the *Contractor* cannot resolve the dispute, either party may commence an *Adjudication* in accordance with the procedures set out in the *Construction Act.* Any portion of the *Proper Invoice* which is not the subject of the *Notice of Non-Payment* shall be payable within the time period set out in GC 5.3.1.2. 5.3.5 Provided that the *Owner* complies with its obligations under the *Construction Act*, and subject to any interim determination of an adjudicator in accordance with any *Adjudication*, and where applicable, a final determination made in accordance with the dispute resolution processes prescribed by this *Contract*, the *Owner* shall be entitled to claim in a *Notice of Non-Payment* a right to deduct from or, set off against, any payment of the *Contract Price*: .1 any amount expended by the *Owner* in exercising the *Owner's* rights under this *Contract* to perform any of the *Contractor's* obligations that the *Contractor* has failed to perform; .2 any damages, costs or expenses (including, without limitation, reasonable legal fees and expenses) incurred by the *Owner* as a result of the failure of the *Contractor* to perform any of its obligations under the *Contract*; .3 any other amount owing from the *Contractor* to the *Owner* under this *Contract*. 5.3.6 The amounts disputed and described under the *Notice of Non-Payment* shall be held by the *Owner* until all disputed amounts of the *Proper Invoice* have been resolved pursuant to PART 8 – DISPUTE RESOLUTION. 5.3.7 The *Contractor* represents, warrants, and covenants to the *Owner* that it is familiar with its prompt payment and trust obligations under the *Construction Act* and will take all required steps and measures to ensure that it complies with the applicable prompt payment and trust provisions under the

		Construction Act including, without limitation, section 8.1 of the *Construction Act*. Evidence of the *Contractor's* compliance under this GC 5.3.7, including evidence demonstrating that all *EFTs* by the *Owner* to the *Contractor* are kept in a bank account in the *Contractor's* name will be made available to the *Owner* within 5 *Working Days* following receipt by the *Contractor* of a *Notice in Writing* 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 replace it with the following: "**GC 5.4 SUBSTANTIAL PERFORMANCE OF THE WORK AND PAYMENT OF HOLDBACK** 5.4.1 When the *Contractor* considers that *Substantial Performance of the Work* has been achieved, the *Contractor* shall prepare and submit to the *Consultant* and the *Owner* a comprehensive deficiency list of items to be completed or corrected, including any incomplete *Close-Out Documentation*, and apply for a review by the *Consultant* and the *Owner* to establish *Substantial Performance of the Work*. Failure to include an item on the list does not alter the responsibility of the *Contractor* to complete the *Contract*. 5.4.2 Prior to, or as part of its written application for *Substantial Performance of the Work* the *Contractor* shall submit to the *Consultant* submit to the *Consultant* all closeout documentation required by the *Contract Documents*, 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 *Specifications*; .9 reviewed *Shop Drawings*; .10 coordination drawings; .11 testing and balancing results and reports; .12 *Commissioning* and quality assurance documentation; .13 distribution system diagrams; .14 spare parts; .15 samples; .16 existing reports and correspondence from authorities having jurisdiction in the *Place of the Work*;

		.17 inspection certificates; .18 red-lined record drawings from the construction trailer in one copy and .19 other materials or documentation required to be submitted under the *Contract* including, but not limited to the occupancy checklist, as per the Ontario Building Code. 5.4.3 The *Consultant* will review the *Work* to verify the validity of the application and shall promptly, and in any event, no later than 30 calendar days after receipt of the *Contractor's* complete deficiency list and application: .1 prepare a final deficiency list incorporating all items to be completed or corrected, including any incomplete or unsubmitted *Close-Out Documentation*. 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 *Consultant's* draft verification and shall be reviewed with the *Owner* prior to the *Consultant* 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 *Consultant* shall advise the *Contractor* in writing that the *Work* or the designated portion of the *Work* is not substantially performed and give reasons why, or (b) the *Consultant* shall state the date of *Substantial Performance of the Work* in a certificate and issue a copy of that certificate to each the *Owner* and the *Contractor.* 5.4.4 Following the issuance of the certificate of *Substantial Performance of the Work* referred to in subparagraph 5.4.3.2(b): .1 The Contractor shall publish, in a construction trade newspaper in the area of the location of the Work, a copy of the certificate of S*ubstantial Performance of the Work* referred to in GC 5.4.2.2(b) within seven (7) calendar days of receiving a copy of the certificate signed by the *Consultant*, and the *Contractor* shall provide suitable evidence of the publication to the *Consultant* and the *Owner*. If the Contractor fails to publish such notice, the Owner shall be at liberty to publish said certificate and back-charge the Contractor its reasonable costs for doing so; .2 The *Contractor* shall complete the *Work* within forty (40) calendar days of the date certified as the date of *Substantial Performance of the Work*; .3 Notwithstanding any other provisions of the *Contract,* no payments will be processed between *Substantial Performance of the Work* and *Ready-for-Takeover*; .4 The *Owner* reserves the right to contract out any or all unfinished *Work* if it has not been completed within forty (40) days of *Substantial*

Performance of the Work 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 *Owner* of completing the *Work* including *Owner* and *Consultant* wages and materials shall be deducted from the *Contract Price.*

5.4.5 After publication of the certificate of the *Substantial Performance of the Work*, and provided that the *Contractor* has completed performance of the *Work* within the 40 calendar days following certification of *Substantial Performance of the Work*, the *Contractor* may submit an application for payment of the outstanding *Construction Act* 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 *Contractor* has not received any written notices of lien or any claims for liens from any *Subcontractor* or *Supplier.*

5.4.6 The *Construction Act* holdback amount shall become due and payable the day immediately following the expiration of the holdback period prescribed by the *Construction Act* (in most cases being the 61st calendar day following the publication of the certificate of *Substantial Performance of the Work* 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 *Project* that has not been satisfied, discharged or otherwise provided for in accordance with the *Construction Act*;

.2 receipt by the *Owner* of a written notice of lien that has not been satisfied, discharged or otherwise provided for in accordance with the *Construction Act*; or

.3 prior to the expiry of 40 calendar days following the publication of the certificate of *Substantial Performance of the Work,* the *Owner* publishes a *Notice of Non-Payment* of holdback in accordance with the *Construction Act* (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 *Work*.

5.4.7 Notwithstanding the *Owner's* obligation to make payment of the holdback amount in accordance with GC 5.4.6, the processing of such payment remains subject to the *Owner's* internal *EFT* timing limitations. The *Owner* covenants, and the *Contractor* agrees, that payment of the holdback shall be made by *EFT* at the first opportunity during the *Owner's* normal processing of *EFTs* upon the holdback becoming due in accordance with GC 5.4.6..

SC32 GC 5.5 FINAL PAYMENT

SC32.1	GC 5.5	Delete GC 5.5 in its entirety, including all subparagraphs thereunder and replace it with the following: "5.5.1 When *Ready-for-Takeover* has been achieved in accordance with GC 12.1 – READY-FOR-TAKEOVER and the *Contractor* considers the *Work* is complete, and after the *Contractor*, the *Owner*, and the *Consultant* have attended a *Pre-Invoice Submission Meeting* analogous to the requirement in GC 5.2.1 (the "***Final Pre-Invoice Submission Meeting***"), the *Contractor* may submit an application for final payment to the *Owner* and to the *Consultant*, 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 *Consultant* or written confirmation from the *Owner* that the deficiencies or incomplete *Work* waived by the *Owner* pursuant to GC 12.1.2 have been fully rectified as of the date of the *Contractor's* application for final payment, and/or (b) written confirmation, signed by the *Owner* and the *Contractor,* that the *Contract Price* has been reduced by a specified amount in exchange for the *Owner* releasing the *Contractor* of its obligation to rectify the certain outstanding deficiencies and/or incomplete *Work* waived by the *Owner* pursuant to GC 12.1.2, as detailed in such written confirmation. 5.5.2 No later than 5 calendar days prior to the *Final Pre-Invoice Submission Meeting*, the *Contractor* will, if not already provided, submit to the *Consultant* all *Close-Out Documentation*. 5.5.3 Delivery of all *Close-Out Documentation* is a requirement for the *Proper Invoice* for final payment. 5.5.4 After receipt by the *Owner* and the *Consultant* of an application for payment submitted by the *Contractor* that is a *Proper Invoice* and by no later than 10 calendar days after the receipt of the *Proper Invoice*: .1 the *Consultant* will either: (a) issue to the *Owner* with a copy to the *Contractor*, a progress payment certificate in the amount applied for by the *Contractor* in the *Proper Invoice*, or (b) deliver a finding to the *Owner* with reasons why an amount other than what is claimed in the *Proper Invoice* is properly due to the *Contractor*, which finding the *Owner* may accept or amend prior to issuing a *Notice of Non-Payment* (Form 1.1), if any, in accordance with GC 5.5.2; .2 the *Owner* shall make payment to the *Contractor* 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 *Owner's Notice of Non-Payment* issued pursuant to GC 5.5.5, on the 28th calendar day after receipt of a *Proper Invoice*, unless such 28th calendar day lands on a day that is other than a *Working Day*, in which case payment shall be made on the next *Working Day* after such 28th day. 5.5.5 In the event that the application for final payment delivered by the *Contractor* does not include the requirements of GC 5.5.1 (including the requirements for a *Proper Invoice*) and GC 5.5.2 or where the *Owner* disputes the amount claimed as payable in the *Proper Invoice*, then the *Owner* shall within 14 calendar days of receipt of the application for payment, issue a *Notice of Non-Payment*. Where the *Owner* has delivered a *Notice of Non-Payment*, as specified under this GC 5.5.5, the *Owner* and the *Contractor* shall first engage in good faith negotiations to resolve the dispute. If within 5 calendar days following the issuance of a *Notice of Non-Payment*, despite good faith efforts by both parties with the assistance of the *Consultant*, the *Owner* and the *Contractor* cannot resolve the dispute, either party may commence an *Adjudication* in accordance with the procedures set out in the *Construction Act*. Any portion of the *Proper Invoice* which is not the subject of the *Notice of Non-Payment* shall be payable within the time period set out in GC 5.5.4.2. 5.5.6 Subject to the provisions of the *Construction Act* and any other rights conferred on the *Owner* at law or under this *Contrac*t to withhold payment or backcharge or set-off against payment, the *Owner* shall pay the amount payable under a *Proper Invoice* for final payment in accordance with the *Construction Act*. 5.5.7 When the *Consultant* issues certificate of completion in accordance with GC 5.5.4.1, the *Consultant* shall also issue a certificate for release of any holdback for finishing work amount. In accordance with the *Construction Act,* the *Owner* may retain any amounts which are required by law to satisfy any liens against the *Work*, in respect of any third party claims made to the *Owner* in respect of the *Contract* or the *Work*, and in respect of any claims the *Owner* may have against the *Contractor*. Subject to the foregoing, the *Owner* shall release the holdback in accordance with the *Construction Act.*"

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 *Contractor*, there are items of work that cannot be performed, payment in full for that portion of the *Work* which has been performed as certified by the *Consultant* shall not be withheld or delayed by the *Owner* on account thereof, but the *Owner* may withhold, subject to its requirement to issue a *Notice of Non-*

		Payment under the *Construction Act*, until the remaining portion of the *Work* is finished, only such an amount that the *Consultant* 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	Add new GC 5.8 – DEFICIENCY HOLDBACK as follows: "**GC 5.8 DEFICIENCY HOLDBACK** 5.8.1 Notwithstanding any provisions contained in the *Contract Documents* concerning certification and release of monies to the *Contractor*, the *Owner* reserves the right to establish a deficiency holdback, at the time of the review for *Substantial Performance of the Work,* based on a 200% dollar value of the deficiencies listed by the *Consultant*. 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 *Close-Out Documentation* not submitted in advance of or as part of the *Contractor's* application for *Substantial Performance of the Work*, an amount shall be retained by the *Owner* 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 *Close-Out Documentation*, as determined by the *Consultant*, until such time as the applicable *Close-Out Documentation* is submitted and approved. 5.8.3 The deficiency holdback shall be due and payable to the *Contractor* on the 61st day following completion of all of the deficiencies listed by the *Consultant*, there being no claims for lien registered against the title to the *Place of the Work* issued in accordance with the *Construction Act*, and less any amounts disputed under an *Owner*'s *Notice of Non-Payment* (Form 1.1)."

PART 6 CHANGES IN THE WORK

SC35 GC 6.1 OWNER'S RIGHT TO MAKE CHANGES

SC35.1	6.1.2	Add the following to the end of GC 6.1.2: "This requirement is of the essence and it is the express intention of the parties that any claims by the *Contractor* for a change in the *Contract Price* and/or *Contract Time* 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 *Work* and no claims that the *Owner* has been unjustly enriched by any alteration or addition to the *Work*, whether in fact there is any such unjust enrichment or not, shall be the basis of a claim for additional payment under this *Contract,* an increase to the *Contract Price*, or a claim for any

		extension of the *Contract Time*."
SC35.2	6.1.3 to 6.1.7	<u>Add</u> new paragraphs 6.1.3, 6.1.4, 6.1.5, 6.1.6, and 6.1.7 as follows: "6.1.3 The *Contractor* agrees that changes resulting from construction coordination, including but not limited to, site surface conditions, site coordination, and *Subcontractor and Supplier* coordination are included in the *Contract Price* and the *Contractor* shall be barred from making any claim for a change in the *Contract Price* as a result of such changes. 6.1.4 Quotations for changes to the *Work* shall only include costs listed in 6.3.7 and be accompanied by itemized breakdowns including Mark-Up as per 6.2.3 together with detailed, substantiating quotations or cost vouchers from *Subcontractors* and *Suppliers,* submitted in a format acceptable to the *Consultant* and shall include any costs listed in 6.3.7 associated with extensions in *Contract Time.*6.1.5 Subject to other provisions of the *Contract*, no extension to the *Contract Time* shall be granted for changes in the *Work* unless the *Contractor* can clearly demonstrate that such changes significantly alter the overall *Construction Schedule*. Extensions of *Contract Time* and all associated costs, if approved by the *Owner*, shall be included in the relevant *Change Order*. 6.1.6 When a change in the *Work* is proposed or required by the *Owner*, the *Contractor* shall within 10 calendar days submit to the *Consultant* and the *Owner* for review a change estimate setting out the proposed change in *Contract Price* and/or *Contract Time* (a "**Change Estimate**"). Should 10 calendar days be insufficient to prepare the *Change Estimate*, the *Contractor* shall within 5 calendar days of receipt of *Owner*'s proposed change, advise the *Consultant* and the *Owner* in writing of the proposed date of the *Change Estimate*. *Change Estimates* submitted after the date prescribed herein will not be considered by the *Owner*. 6.1.7 A *Change Estimate* submitted pursuant to GC 6.1.6 shall include the following: .1 a breakdown of all items and quantities on which costs are based, including without limitation: (a) unit costs for labour and wage burdens; (b) unit costs for material,; (c) quantities of required materials and respective unit costs; (d) direct and actual costs (as set out in GC 6.3.7); .2 separate line items showing the permitted markup as set out in GC 6.2.5; .3 for work to be performed by a *Subcontractor* or a *Supplier*, quotations from each *Subcontractor* or *Supplier* supporting the estimate and adjustments to the *Contract Price* and/or *Contract Time*, which shall be separated and broken down in accordance with GC 6.1.7.1;

		.4 any other information requested by the *Consultant* or the *Owner*."

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 *Contract Time* and the *Contract Price* shall include an adjustment, if any, for delay or for the impact that the change in the *Work* has on the *Work* of the *Contractor*, and once such adjustment is made, the *Contractor* shall be precluded from making any further claims for delay or impact with respect to the change in the *Work.*"
SC36.2	6.2.3 to 6.2.11	<u>Add</u> new paragraphs 6.2.3 to 6.2.11 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 *Consultant*: .1 by estimate and acceptance of a lump sum; .2 by negotiated unit prices. The unit prices shall include the permitted markup for the changes in the *Work* as set out in GC 6.2.4, and shall be the total cost to the *Owner*. Adjustment to the *Contract Price* shall be based on a net quantity difference from the original quantity; .3 by the actual costs to the *Owner,* such costs to be the actual cost of items as listed in GC 6.3.7, and after all credits included in the change have been deducted, plus the permitted markup for changes in the *Work* as set out in GC 6.2.4. 6.2.4 The permitted markup set out in this GC 6.2.5, to be identified and included in the *Contractor*'s quotation and breakdown submitted in response to an *Owner*'s request for a change in the *Work* is intended to cover all overhead and profit incurred by the *Contractor*, *Subcontractors*, and *Suppliers* in relation to a proposed change. The following markups (for overhead, profit, and general expenses combined) and only such markups are permitted for any change under GC 6.1 OWNER'S RIGHT TO MAKE CHANGES: .1 for changes in the *Work* with a value of $0 to $15,000 the total *Subcontractor/Supplier* mark-up including overhead and profit shall be 10% and the total *Contractor* mark-up including overhead and profit shall be 5%. .2 for changes in the *Work* with a value in excess of $15,000, the total *Subcontractor/Supplier* mark-up including overhead and profit shall be 5% and the total *Contractor* mark-up including overhead and profit shall be 3%. 6.2.5 The *Contractor* is obliged to review and consider the value and validity of *Subcontractors* and *Suppliers* quotations to be included in its *Change Estimate* before submission to the *Consultant*. *The Contractor* shall ensure that only valid, direct, fair and reasonable costs related to the change in

		the *Work* are submitted to the *Consultant*. The *Consultant* will not directly negotiate with *Subcontractors* and *Suppliers* on behalf of the *Contractor*. The *Contractor* shall maintain financial oversight of its *Subcontractors* and *Suppliers* and be responsible for addressing unjustifiable and unreasonable claims. 6.2.6 Unit prices (as agreed to pursuant to GC 6.2.3.2) shall include supply, installation, *Products, Construction Equipment*, services, materials, labour, but exclude *Value Added Taxes*. 6.2.7 The *Owner* and the *Consultant* will not be responsible for delays to the *Work* resulting from late, incomplete or inadequately broken-down valuations submitted by the *Contractor* 6.2.8 The *Owner*, through the *Consultant*, reserves the right to authorize payment for changes in the *Work* by means of cash allowance disbursement authorizations pursuant to GC 4.1.4. 6.2.9 If any change, deviation in, or omission from the *Work* is made by which the amount of *Work* to be performed is decreased, or if the whole or a portion of the *Work* is dispensed with, no compensation is claimable by the *Contractor* for any loss of anticipated profit in respect thereof. 6.2.10 Should the *Contractor* proceed with any change in the method of construction, volume, or location of the *Work* which has not been both ordered and valued as set out in this GC 6.2, or ordered to be performed pursuant to a *Change Directive*, it shall be conclusively presumed that the parties were in agreement that such change should be made at no additional cost to the *Owner*. 6.2.11 A *Change Order* signed by the *Contractor* indicates the *Contractor*'s complete agreement therewith, including the adjustment if any, in the *Contract Price* and the *Contract Time*. Unless otherwise expressed in the *Change Order*, the *Contractor* acknowledges and agrees that a *Change Order* shall be full and final settlement of any and all claims, and releases all other claims, if any, arising from the *Change Order*. For greater certainty, Contractor agrees that in no event shall the *Contractor* make any subsequent claim relating to the items covered by such *Change Order*, including without limitation with respect to the *Contract Price*, the *Contract Time*, consequential, indirect, or special damages."

SC37 GC 6.3 CHANGE DIRECTIVE

SC37.1	6.3.7.1	<u>Delete</u> GC 6.3.7.1 in its entirety and <u>replace</u> it with the following: ".1 labour costs shall be the actual rates paid to the workers plus a documented markup (not exceeding 60% of actual wage rates) to cover contributions, assessments, or taxes incurred for such items as unemployment and other insurance, provincial health insurance, Workers' Compensation, Canada or Quebec Pension Plan, Holiday & Vacation Pay, traveling Time, Travel and Parking, Welfare, Union, Industry training and Pension Funds, rest periods, down time, personal hygiene, and personal protection."

SC37.2	6.3.7.6	Add the following to the end of GC 6.3.7.6: "provided that they are not caused by negligent acts or omissions of the of the *Contractor* or the *Subcontractor*;"
SC37.3	6.3.7.10	Add the following at the end of the sentence in GC 6.3.7.10: "provided that they are not caused by negligent acts or omissions of the *Contractor*".
SC37.4	6.3.7.13	Delete GC 6.3.7.13 in its entirety.
SC37.5	6.3.7.17	Delete GC 6.3.7.17 in its entirety.
SC37.6	6.3.11	Delete GC 6.3.11 and replace it with the following: "6.3.11 The value of the *Work* performed as a result of a *Change Directive* shall not be eligible to be included in progress payments until the amount, including the method for determining the amount, of such *Change Directive* has been determined."

SC38 GC 6.4 CONCEALED OR UNKNOWN CONDITIONS

SC38.1	6.4.1	Delete paragraph 6.4.1 in its entirety and replace 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 *Contractor* will be considered by the *Owner* or the *Consultant* in connection with conditions which could reasonably have been ascertained by such investigation or other due diligence undertaken prior to the execution of the *Contract*.
SC38.2	6.4.2	Amend paragraph 6.4.2 by adding a new first sentence as follows: "Having regard to paragraph 6.4.1, if the *Contractor* believes that the conditions of the *Place of the Work* differ substantially from those reasonably anticipated, differ substantially from those indicated in the *Contract Documents* or were concealed from discovery notwithstanding the conduct of the investigation described in paragraph 6.4.1, it shall provide the *Owner* and the *Consultant* with *Notice in Writing* no later than five (5) *Working Days* after the first observation of such conditions." -and- amend the existing second sentence of paragraph 6.4.2 in the second line, following the word "substantially" by adding the words "or were concealed from discovery notwithstanding the conduct of the investigation described in paragraph 6.4.1,".
SC38.3	6.4.3	Delete paragraph 6.4.3 in its entirety and substitute the following:

		"6.4.3 If the *Consultant* makes a finding pursuant to paragraph 6.4.2 that no change in the *Contract Price* or the *Contract Time* is justified, the *Consultant* shall report in writing the reasons for this finding to the *Owner* and the *Contractor*."
SC38.4	6.4.5	Add new paragraph 6.4.5 as follows: "6.4.5 No claims for additional compensation or for an extension of *Contract Time* shall be allowed if the *Contractor* fails to give *Notice in Writing* to the *Owner* or *Consultant,* as required by paragraph 6.4.2."

SC39 GC 6.5 DELAYS

SC39.1	6.5.1	In paragraph 6.5.1 delete the words after the word "for" in the fourth line and replace them with the words "…reasonable costs listed in 6.3.7 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	Delete GC 6.5.2 in its entirety and replace it with the following: "6.5.2 If the *Contractor* is delayed in the performance of the *Work* 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 *Owner*, *Other Contractor(s)*, or the *Consultant*, and relating to the *Work* or the *Place of the Work*, then the *Contract Time* shall be extended for such reasonable time as the *Consultant* may determine. The *Contractor* shall be reimbursed by the *Owner* for reasonable costs listed in 6.3.7 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	Delete paragraph 6.5.3 in its entirety and replace with the following: "6.5.3 If either party is delayed in the performance of their obligations under this *Contract* by *Force Majeure*, then the *Contract Time* shall be extended for such reasonable time as the *Owner* and the *Contractor* shall agree. The extension of time shall not be less than the time lost as a result of the event causing the delay, unless the parties agree to a shorter extension. Neither party shall be entitled to payment for costs incurred by such delays. Upon reaching agreement on the extension of the *Contract Time* attributable to the *Force Majeure* event, the *Owner* and the *Contractor* shall execute a *Change Order* indicating the length of the extension to the *Contract Time* and confirming that there are no costs payable by the either party for the extension of *Contract Time*. However, if at the time an event of *Force Majeure* arises a party is in default of its obligations under the *Contract* and has received a notice of default 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 *Force Majeure*."

SC39.4	6.5.4	Delete paragraph 6.5.4 in its entirety and replace it with the following: "6.5.4 No extension or compensation shall be made for delay or impact on the *Work* unless notice in writing of a claim is given to the *Consultant* not later than ten (10) *Working Days* after the commencement of the delays or impact on the *Work*, provided however, that, in the case of a continuing cause of delay or impact on the *Work*, only one notice of claim shall be necessary."
SC39.5	6.5.6 to 6.5.8	Add new paragraphs 6.5.6, 6.5.7 and 6.5.8 as follows: "6.5.6 If the *Contractor* is delayed in the performance of the *Work* by an act or omission of the *Contractor* or anyone directly or indirectly employed or engaged by the *Contractor,* or by any cause within the *Contractor's* control, then (i) firstly, at its expense, and to the extent possible, the *Contractor* 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 *Contractor* to recover the time lost by implementing acceleration measures and/or overtime work, the *Contract Time* may be extended for such reasonable time as the *Owner* may decide in consultation with the *Consultant* and the *Contractor*. The *Owner* shall be reimbursed by the *Contractor* for all reasonable costs incurred by the *Owner* as the result of such delay, including, but not limited to, Owner's staff costs, the cost of all additional services required by the *Owner* from the *Consultant* or any sub-consultants, project managers, or others employed or engaged by the *Owner*, and in particular, the costs of the *Consultant's* services during the period between the date of *Substantial Performance of the Work* 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 *Substantial Performance of the Work* achieved by the *Contractor*. 6.5.7 Without limiting the obligations of the *Contractor* described in GC 3.2 – CONSTRUCTION BY OWNER OR OTHER CONTRACTORS or GC 9.4 – CONSTRUCTION SAFETY, the *Owner* or *Consultant* may, by *Notice in Writing*, direct the *Contractor* to stop the *Work* where the *Owner* or *Consultant* determines that there is an imminent risk to the safety of persons or property at the *Place of the Work*. In the event that the *Contractor* receives such notice, it shall immediately stop the *Work* and secure the site. The *Contractor* shall not be entitled to an extension of the *Contract Time* or to an increase in the *Contract Price* unless the resulting delay, if any, would entitle the *Contractor* to an extension of the *Contact Time* or the reimbursement of the *Contractor'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 *Contractor* and the *Contract Time* shall not be extended due to climatic conditions or arising from the *Contractor's* efforts to maintain the *Construction Schedule*."

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 *Consultant* has given a written statement to the *Owner* and *Contractor* which provides the detail of such neglect to perform the *Work* properly or such failure to comply with the requirements of the *Contract* to a substantial degree".
SC40.2	7.1.3.4	Add 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 *Consultant* and the *Owner* wherein the default can be corrected within the balance of the *Contract Time* and shall not cause delay to any other aspect of the *Work* or the work of other contractors, and in no event shall it be deemed to give a right to extend the *Contract Time*."
SC40.3	7.1.4.1	Delete subparagraph 7.1.4.1 and replace it with the following: ".1 correct such default and deduct the cost, including *Owner's* expenses, thereof from any payment then or thereafter due the *Contractor*."
SC40.4	7.1.4.2	Delete subparagraph 7.1.4.2 and replace it with the following: ".2 by providing *Notice in Writing* to the *Contractor*, terminate the *Contractor's* right to continue with the *Work* in whole or in part or terminate the *Contract*, and publish a notice of termination (Form 8) in accordance with the *Act*."
SC40.5	7.1.5.3	In subparagraph 7.1.5.3 delete the words: "however, if such cost of finishing the *Work* is less than the unpaid balance of the *Contract Price*, the *Owner* shall pay the *Contractor* the difference"
SC40.6	7.1.6 to 7.1.10	Delete GC 7.1.6 and replace 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 *Contract* set out herein, the *Owner* may terminate this *Contract* at any time for any other reason and without cause upon giving the *Contractor* fifteen (15) *Working Days Notice in Writing* to that effect. In such event, the *Contractor* shall be entitled to be paid for all *Work* performed including reasonable profit, for loss sustained upon *Products* and *Construction Equipment*, and such other damages as the *Contractor* may have sustained as a result of the termination of the *Contract*, but in no event shall the *Contractor* be entitled to be compensated for any loss of profit on unperformed portions of the *Work*, or indirect, special, or consequential damages incurred. 7.1.7 The *Owner* may suspend *Work* under this *Contract* at any time for any reason and without cause upon giving the *Contractor Notice in Writing* to that effect. In such event, the *Contractor* shall be entitled to be paid for all *Work* 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 *Products* and *Construction Equipment*, and such other

		damages as the *Contractor* may have sustained as a result of the suspension of the *Work*, but in no event shall the *Contractor* 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 *Contract* 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 *Contract* or a suspension of the *Work* 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 *Contractor* shall use its best commercial efforts to mitigate the financial consequences to the *Owner* arising out of the termination or suspension, as the case may be. 7.1.9 Upon the resumption of the *Work* 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 *Contractor* will endeavour to minimize the delay and financial consequences arising out of the suspension. 7.1.10 The *Contractor's* obligations under the *Contract* as to quality, correction, and warranty of the *Work* performed by the *Contractor* up to the time of termination or suspension shall continue after such termination of the *Contract* or suspension of the *Work*."

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 *Work* is suspended or otherwise delayed for a period of 40 consecutive *Working Days* 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 *Owner*, the *Owner's* other contractor(s), or the *Consultant*, and relating to the *Work* or the *Place of the Work*, the *Contractor* may, without prejudice to any other right or remedy the *Contractor* may have, terminate the *Contract* by giving the *Owner* Notice in *Writing* 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 *Working Days* specified in paragraph 7.2.4, the *Owner* shall be deemed to have cured the default if it: .1 commences correction of the default within the specified time; .2 provides the *Contractor* 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 *Contractor* terminates the *Contract* under the conditions described in GC 7.2 – CONTRACTOR'S RIGHT TO SUSPEND THE WORK OR TERMINATE THE CONTRACT, the *Contractor* shall be entitled to be paid for all *Work* performed to the date of termination, as determined by the *Consultant*. The *Contractor* shall also be entitled to recover the costs listed in 6.3.7 associated with termination, including the costs of demobilization and losses sustained on *Products* and *Construction Equipment*. The *Contractor* shall not be entitled to any recovery for any special, indirect or consequential losses, including loss of profit. 7.2.7 The *Contractor* shall not be entitled to give notice of the *Owner's* default or terminate the *Contract* in the event the *Owner* withholds certificates or payment or both in accordance with the *Contract* because of: .1 the *Contractor's* failure to pay all legitimate claims promptly, or .2 the failure of the *Contractor* to discharge construction liens which are registered against the title to the *Place of the Work.* 7.2.8 The *Contractor's* obligations under the *Contract* as to quality, correction and warranty of the *Work* performed by the *Contractor* up to the effective date of termination shall continue in force and shall survive termination of this *Contract* by the *Contractor*. 7.2.9 If the *Contractor* suspends the *Work* or terminates the *Contract* as provided for in GC 7.2 – CONTRACTOR'S RIGHT TO SUSPEND THE WORK OR TERMINATE THE CONTRACT, the *Contractor* shall ensure the site and the *Work* are left in a safe, secure condition as required by authorities having jurisdiction at the *Place of the Work* and the *Contract Documents*."

PART 8 DISPUTE RESOLUTION

SC42 GC 8.1 AUTHORITY OF THE CONSULTANT

SC42.1	8.1.3	Delete paragraph 8.1.3 in its entirety and substitute as follows: "8.1.3 If a dispute is not resolved promptly, the *Consultant* will give such instruction as in the *Consultant's* opinion are necessary for the proper performance of the *Work* 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

SC43.1	8.2.2 to 8.2.7	Add 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 *Contractor* has given an undertaking, in accordance with the *Act*, to refer a dispute to *Adjudication*, prior to delivering a notice of *Adjudication* in a form prescribed by the *Act*, the parties agree to first address all disputes with at least one in-person meeting with the *Owner's* representative, the *Consultant's* representative, and the *Contractor's* 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 *Adjudication* proceedings as required by, and in accordance with, the *Construction Act*. 8.2.4 The following procedures shall apply to any *Adjudication* the parties engage in under the *Construction Act*: .1 any hearings shall be held at a venue within the jurisdiction of the *Place of the Work* or such other venue as the parties may agree and which is acceptable to the adjudicator; .2 the *Adjudication* shall be conducted in English; .3 each party may be represented by counsel throughout an *Adjudication*; .4 there shall not be any oral communications with respect to issues in dispute that are the subject of an *Adjudication* between a party and the adjudicator unless it is made in the presence of both parties or their legal representatives; and .5 a copy of all written communications between the adjudicator and a party shall be given to the other party at the same time. 8.2.5 Any documents or information disclosed by the parties during an *Adjudication* are confidential and the parties shall not use such documents or information for any purpose other than the *Adjudication* 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 *Contractor* fails to comply with any of the notice requirements set out in the *Contract*, 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 *Contractor* shall have no entitlement whatsoever (including to an increase in the *Contract Price*, or an extension of *Contract Time*) in the context of an *Adjudication* under the *Construction Act* and waives the right to make any such claims or disputes in an *Adjudication*. This GC 8.2.6 shall operate conclusively as an estoppel and bar in the event such claims or disputes are brought in an *Adjudication* and the *Owner* 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 *Owner* to withhold, deduct or retain from monies otherwise owed to the *Contractor* under the *Contract* may be referred to, and included as part of, *Adjudications* under the *Construction Act*;
.2 that disputes related to the termination or abandonment of the *Contract*, as well as any disputes that arise or are advanced following the termination or abandonment of the *Contract*, shall not be referred to *Adjudication* under the *Construction Act*;
.3 that notice(s) of *Adjudication,* with respect to any dispute or claim relating to the *Project,* shall not be given, and no *Adjudication* shall be commenced following *Contract* completion, *Contract* abandonment, or termination of the *Contract*;
.4 that any *Adjudication* between the *Contractor* and a *Subcontractor* or a supplier that relates to an *Adjudication* between the *Owner* and the *Contractor* shall be joined together to be adjudicated by a single adjudicator, provided that the adjudicator agrees to do so, and the *Contractor* 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 *Contractor* is obliged to commence an *Adjudication* pursuant to an undertaking under the *Construction Act,* neither the *Owner* nor the *Contractor* shall commence an *Adjudication* during the *Restricted Period*.

8.2.8 The parties acknowledge and agree that no *Adjudication*, arbitration, action, suit or other proceeding may be brought by the *Contractor* against the *Owner* in respect of a claim for an increase to the *Contract Price* as set out in GC 6.6, before the *Consultant* 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 *Proper Invoice* shall not include any amounts pertaining to the *Contractor's* claim for an increase in *Contract Price* unless

		and until the *Consultant* has issued a written notice to the *Contractor* 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 *Contractor* from commencing an *Adjudicatio*n where, pursuant to the *Construction Act*, the *Contractor* is required to give an undertaking to a *Subcontractor* to commence an *Adjudication* following delivery of a *Notice of Non-Payment*."

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 *Project Mediator*" to "may appoint a *Project Mediator,* except that such an appointment shall only be made if both the *Owner* and the *Contractor* agree."
SC44.2	8.3.4	Amend paragraph 8.3.4 by changing part of the second line from "the parties shall request the *Project Mediator"* to "and subject to paragraph 8.3.1 the parties may request the *Project Mediator".*
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 replace 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 *Contractor* and the *Owner* agree. If the *Contractor* and the *Owner* agree to resolve the dispute by arbitration, the arbitration shall be conducted in the jurisdiction of the *Place of the Work*. 8.3.7 Prior to delivering a notice of *Adjudication* in a form prescribed by the *Act*, the parties agree to first address all disputes by attending at least one meeting with the *Owner*'s representative, the *Consultant*'s representative, and the *Contractor*'s representative, prior to commencing an *Adjudication*. 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 *Adjudication* shall provide the other party with 5 *Working Days' Notice in Writing* of its intention to issue a notice of *Adjudication*. 8.3.8 Other than where the *Contractor* is obliged to commence an *Adjudication* pursuant to an undertaking under the *Construction Act*, neither the *Owner* nor the *Contractor* shall commence an *Adjudication* during the *Restricted Period*. 8.3.9 Where either party has delivered a notice of *Adjudication* in a form prescribed by the *Act*, the procedures and rules set out under the *Construction Act* and the regulations thereto shall govern the *Adjudication*."
SC44.4	8.3.10 to 8.3.14	Add new GC 8.3.10, 8.3.11, 8.3.12, 8.3.13, and 8.3.14 as follows: 8.3.10 Within five days of receipt of the notice of arbitration by the responding party under paragraph 8.3.6, the *Owner* and the *Contractor* shall give the *Consultant* a written notice containing: .1 a copy of the notice of arbitration;

		.2 a copy of supplementary conditions 8.3.9 to 8.3.14 of this *Contract*, and; .3 any claims or issues which the *Contractor* or the *Owner*, as the case may be, wishes to raise in relation to the *Consultant* arising out of the issues in dispute in the arbitration. 8.3.11 The *Owner* and the *Contractor* agree that the *Consultant* may elect, within ten days of receipt of the notice under paragraph 8.3.10, to become a full party to the arbitration under paragraph 8.3.6 if the *Consultant*: .1 has a vested or contingent financial interest in the outcome of the arbitration; .2 gives the notice of election to the *Owner* and the *Contractor* before the arbitrator is appointed; .3 agrees to be a party to the arbitration within the meaning of the rules referred to in paragraph 8.3.6, and, .4 agrees to be bound by the arbitral award made in the arbitration. 8.3.12 Without limiting and subject to the *Owner* and *Contractor*'s rights under paragraph 8.3.13 to challenge whether the *Consultant* has satisfied the requirements of paragraph 8.3.11, if an election is made under paragraph 8.3.11: .1 the *Owner* or *Contractor* may request particulars and evidence of the *Consultant*'s vested or contingent financial interest in the outcome of the arbitration; .2 the *Consultant* shall participate in the appointment of the arbitrator; and, .3 notwithstanding the rules referred to in paragraph 8.3.6, the time period for reaching agreement on the appointment of the arbitrator shall begin to run from the date the respondent receives a copy of the notice of arbitration. 8.3.13 The arbitrator in the arbitration in which the *Consultant* has elected under paragraph 8.3.11 to become a full party may: .1 on application of the *Owner* or the *Contractor*, determine whether the *Consultant* has satisfied the requirements of paragraph 8.3.11, and; .2 make any procedural order considered necessary to facilitate the addition of the *Consultant* as a party to the arbitration. 8.3.14 The provisions of paragraph 8.3.10 shall apply (with all appropriate changes being made) to written notice to be given by the *Consultant* to any sub-consultant;

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 substitute the following: ".1 errors in the *Contract Documents* which the *Contractor* 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 substitute as follows: "9.1.2 Before commencing any *Work*, the *Contractor* shall determine the locations of all underground or hidden utilities and structures indicated in or inferable from the *Contract Documents*, or that are inferable from an inspection of the *Place of the Work* 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: "9.1.5 With respect to any damage to which paragraphs 9.1.3 or 9.1.4 apply, the *Contractor* 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 *Contractor*, without first consulting the *Owner* and receiving written instructions as to the course of action to be followed from either the *Owner* or the *Consultant*. Where, however, there is danger to life, the environment, or public safety, the *Contractor* 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 inserting the following to the end of the paragraph: "For the purposes of GC 9.2 – TOXIC AND HAZARDOUS SUBSTANCES, *Excess Soil* 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	Amend GC 9.2.6 by adding the following words after the word "responsible" in the second line: "or whether any toxic or hazardous substances or materials already at the *Place of the Work* (and which were then harmless or stored, contained or otherwise dealt with in accordance with legal and regulatory requirements) were dealt with by the *Contractor* or anyone for whom the *Contractor* is responsible in a manner which does not comply with legal and regulatory requirements, or which threatens human health and safety or the environment, or material damages to the property of the *Owner* or others,".

SC46.4	9.2.7	Amend GC 9.2.7.4 by adding "and the *Consultant*" after the word "*Contractor*".
SC46.5	9.2.8	Amend GC 9.2.8 by adding the following words after the word "responsible" in the second line: "or whether any toxic or hazardous substances or materials already at the *Place of the Work* (and which were then harmless or stored, contained or otherwise dealt with in accordance with legal and regulatory requirements) were dealt with by the *Contractor* or anyone for whom the *Contractor* is responsible in a manner which does not comply with legal and regulatory requirements, or which threatens human health and safety or the environment, or material damages to the property of the *Owner* or others,".
SC46.6	9.2.10	Add new paragraph 9.2.10 as follows: "9.2.10 The *Contractor*, *Subcontractors* and *Suppliers* shall not bring on to the *Place of the Work* any toxic or hazardous substances and materials except as required in order to perform the *Work*. 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 *Place of the Work*."

SC47 GC 9.4 CONSTRUCTION SAFETY

SC47.1	9.4.1	Delete GC 9.4.1 in its entirety and replace it with the following: "9.4.1 The *Contractor* shall be solely responsible for construction safety at the *Place of the Work* and for compliance with the rules, regulations, and practices required by the *OHSA*, 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 *Work*. The *Contractor*'s health and safety program documentation shall be made available for review by the *Owner* or *Consultant* immediately upon request. Without limiting the foregoing, the *Contractor* shall be solely responsible for construction safety in respect of the *Consultant*, *Subcontractors* and *Suppliers*, the *Owner's* own forces, *Other Contractors*, and all persons attending the *Place of the Work* during the course of the *Project*."
SC47.2	9.4.2	Amend GC 9.4.2 by adding the following words after "and the *Contractor*": ", *Subcontractors* and *Suppliers*".
SC47.3	9.4.3	Amend GC 9.4.3 by adding the following words after "and the *Contractor*": ", *Subcontractors* and *Suppliers*".
SC47.4	9.4.4	Delete GC 9.4.4 and replace it with the following: "9.4.4 The *Owner* 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 *Contractor* 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 *Work*, the *Contractor* shall submit to the *Owner*: .1 a current WSIB clearance certificate; .2 copies of the *Contractor*'s insurance policies having application to the *Project* or certificates of insurance, at the option of the *Owner*; .3 documentation setting out the *Contractor*'s in-house safety programs; .4 a copy of the Notice of Project filed with the Ministry of Labour naming itself as "constructor" under the *OHSA*; 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 *Place of the Work*;"
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 *Contractor* shall indemnify and save harmless the *Owner*, 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 *Contractor* under *OHSA* and any other occupational health and safety legislation in force at the *Place of the Work* including the payment of legal fees and disbursements on a solicitor and client basis. Such indemnity shall apply to the extent to which the *Owner* is not covered by insurance. 9.4.7 If the *Owner* is of the reasonable opinion that the *Contractor* has not taken such precautions as are necessary to ensure compliance with the requirements of paragraph 9.4.1, the *Owner* may take any remedial measures which it deems necessary, including stopping the performance of all or any portion of the *Work,* and the *Owner* may use its employees, the *Contractor*, any *Subcontractor* or any other contractors to perform such remedial measures. 9.4.8 The *Contractor* shall file any notices or any similar document required pursuant to the *Contract* or the safety regulations in force at the *Place of the Work*. This duty of the *Contractor* will be considered to be included in the *Work* and no separate payment therefore will be made to the *Contractor*. 9.4.9 Unless otherwise provided in the *Contract Documents*, the *Contactor* shall develop, maintain and supervise for the duration of the *Work* 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 *Owner* and any workers' compensation or occupational health and safety statutes or regulations in force at the *Place of the Work*. 9.4.10 The *Contractor* shall provide a copy of the safety program described in GC 9.4.9 hereof to the *Consultant* for delivery to the *Owner* prior to the commencement of the *Work*, and shall, ensure, as far as it is reasonably practical to do so, that every employer and worker performing work in respect of the *Project* complies with such program. 9.4.11 The *Contractor* 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 *Place of the Work*, including, without limitation, articles necessary for administering first-aid to any person and an emergency procedure for the immediate removal of any inured person to a hospital or a doctor's care. 9.4.12 The *Contractor* shall promptly report in writing to the *Owner* and the *Consultant* all accidents of any sort arising out of or in connection with the performance of the *Work*, 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 *Contractor* to the *Owner* and the *Consultant* by telephone or messenger in addition to any reporting required under the applicable safety regulations.”.”

SC48 GC 9.5 MOULD

SC48.1	9.5.3.4	In paragraph 9.5.3.4, after the word "*Contractor*" add the words "and the *Consultant*".

SC49 PART 10 GOVERNING REGULATIONS

SC50 GC 10.1 TAXES AND DUTIES

SC50.1	10.1.2	Amend paragraph 10.1.2 by adding the following sentence to the end of the paragraph: "For greater certainty, the *Contractor* shall not be entitled to any mark-up for overhead or profit on any increase in such taxes and duties and the *Owner* shall not be entitled to any credit relating to mark-up for overhead or profit on any decrease in such taxes. The *Contractor* shall provide a detailed breakdown of Additional taxes if requested by the *Owner* in a form satisfactory to the *Owner*."
SC50.2	10.1.3	Add new paragraph 10.1.3 as follows: "10.1.3 Where the *Owner* is entitled to an exemption or a recovery of sales taxes, customs duties, excise taxes or *Value Added Taxes* applicable to the *Contract*, the *Contractor* shall, at the request of the *Owner*, assist with the

		application for any exemption, recovery or refund of all such taxes and duties and all amounts recovered or exemptions obtained shall be for the sole benefit of the *Owner*. The *Contractor* agrees to endorse over to the *Owner* any cheques received from the federal or provincial governments, or any other taxing authority, as may be required to give effect to this paragraph."

SC51 GC 10.2 LAWS, NOTICES, PERMITS, AND FEES

SC51.1	10.2.5	Amend paragraph 10.2.5 by adding the words "Subject to paragraph 3.4" at the beginning of the paragraph. -and- Add the following to the end of the second sentence: "…and no further *Work* on the affected components of the *Contract* shall proceed until these directives have been obtained by the *Contractor* from the *Consultant*."
SC51.2	10.2.6	Amend paragraph 10.2.6 by adding the following sentence to the end of the paragraph: "In the event the *Owner* suffers loss or damage as a result of the *Contractor's* failure to comply with paragraph 10.2.5 and notwithstanding any limitations described in paragraph 12.1.1, the *Contractor* agrees to indemnify and to hold harmless the *Owner* and the *Consultant* from and against any claims, demands, losses, costs, damages, actions suits or proceedings resulting from such failure by the *Contractor*."
SC51.3	10.2.7	Amend paragraph 10.2.7 by inserting the words "which changes were not, or could not have reasonably been known to the *Owner* or to the *Contractor*, as applicable, at the time of bid closing and which changes did not arise as a result of a public emergency or other *Force Majeure* event" to the second line, after the words "authorities having jurisdiction".
SC51.4	10.2.8	Add new paragraph 10.2.8 as follows: "10.2.8 The *Contractor* shall furnish all certificates that are required or given by the appropriate governmental authorities as evidence that the *Work* as installed conforms with the laws and regulations of authorities having jurisdiction, including certificates of compliance for the *Owner's* occupancy or partial occupancy. The certificates are to be final certificates giving complete clearance of the *Work*, in the event that such governmental authorities furnish such certificates."

SC52 GC 10.4 WORKERS' COMPENSATION

SC52.1	10.4.1	Delete paragraph 10.4.1 and replace with the following: "10.4.1 Prior to commencing the *Work*, and with each and every application for payment thereafter, including the *Contractor's* application for payment of the holdback amount following *Substantial Performance of the Work* and

		again with the *Contractor's* application for final payment, the *Contractor* shall provide evidence of compliance with workers' compensation legislation in force at the *Place of the Work*, including payments due thereunder."

SC53 GC 11.1 INSURANCE

SC53.1	11.1	Delete entirety of GC 11.1 and replace with the following: "**GC 11.1 INSURANCE** 11.1.1 Without restricting the generality of GC 12 – INDEMNIFICATION, the *Contractor* 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 *Work* until the expiration of the warranty periods set out in the *Contract Documents*. Prior to commencement of the *Work* and upon the placement, renewal, amendment, or extension of all or any part of the insurance, the *Contractor* shall promptly provide the *Owner* 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 amending endorsements. .1 **General Liability Insurance** General liability insurance shall be in the name of the *Contractor,* with the *Owner* and the *Consultant* named as Additional 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, *Subcontractors* and/or agents. The insurance coverage shall not be less than the insurance required by IBC Form 2100, or its equivalent replacement, 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 *Ready-for-Takeover*, as set out in the certificate of *Ready-for-Takeover,* on an ongoing basis for a period of 6 years following *Ready-for-Takeover*. Where the *Contractor* maintains a single, blanket policy, the Addition of the *Owner* and the *Consultant* is limited to liability arising out of the *Project* and all operations necessary or incidental thereto. The policy shall be endorsed to provide the *Owner* with not less than 30 days' notice, in writing, in advance of any cancellation and of change or amendment restricting coverage. .2 **Automobile Liability Insurance** Automobile liability insurance in respect of licensed vehicles shall limits of not less than $5,000,000.00 inclusive per occurrence for bodily injury, death and damage to property, covering all licensed vehicles *owned* or leased by the *Contractor*, and endorsed to provide the *Owner* with not less than 30 days' notice, in writing, in advance of any cancellation, change or amendment restricting coverage. Where the policy has been issued pursuant to a government-operated automobile insurance system, the

		Contractor shall provide the *Owner* with confirmation of automobile insurance coverage for all automobiles registered in the name of the *Contractor.* .3 **Aircraft and Watercraft Liability Insurance** Where determined necessary by the *Contractor*, acting reasonably, aircraft and watercraft liability insurance will be obtained in accordance with the provisions of paragraph 11.1.3. Aircraft and watercraft liability insurance with respect to owned or non-owed aircraft and watercraft if used directly or indirectly in the performance of the *Work*, including use of Additional premises, shall be subject to limits of not less than $2,000,000.00 inclusive per occurrence for bodily injury, death and damage to property, including loss of use thereof and limits of not less than $2,000,000.00 for aircraft passenger hazard. Such insurance shall be in a form acceptable to the *Owner*. The policies shall be endorsed to provide the *Owner* with not less than 30 days' notice, in writing, in advance of cancellation, change or amendment restricting coverage. **.4 Property and Boiler and Machinery Insurance** (1) Builder's Risk property insurance shall be in the name of the *Contractor* with the *Owner* and the *Consultant* named as Additional insureds. The policy shall insure against all risks of direct physical loss or damage to the property insured which shall include all property included in the *Work*, whether owned by the *Contractor* or the owner or owned by others, so long as the property forms part of the *Work*. 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 replacement provided that the IBC Form 4042 shall include the latest Addition 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 *Contractor*, with the *Owner* and the *Consultant* named as Additional insureds, for not less than the replacement value of the boilers, pressure vessels and other insurable objects forming part of the *Work*. 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 *Work.*

		(4) The policies shall provide that, in the case of a loss or damage, payment shall be made to the *Owner* and the *Contractor* as their respective interests may appear. The *Contractor* shall act on behalf of the *Owner* for the purpose of adjusting the amount of such loss or damage payment with the insurers. When the extent of the loss or damage is determined, the *Contractor* shall proceed to restore the *Work*. Loss or damage shall not affect the rights and obligations of either party under the *Contract* except that the *Contractor* shall be entitled to such reasonable extension of the *Contract Time,* relative to the extent of the loss or damage, as determined by the *Owner*, in its sole discretion. (5) The *Contractor* shall be entitled to receive from the *Owner*, in Addition to the amount due under the *Contract*, the amount at which the *Owner's* interest in restoration of the *Work* has been appraised, such amount to be paid as the restoration of the *Work* proceeds and as provided in GC 5.2 – APPLICATIONS FOR PROGRESS PAYMENT and GC 5.3 – PROGRESS PAYMENT. In Addition, the *Contractor* shall be entitled to receive from the payments made by the insurer the amount of the *Contractor's* interest in the restoration of the *Work*. (6) In the case of loss or damage to the *Work* arising from the work of other contractors, or the *Owner's* own forces, the *Owner*, in accordance with the *Owner's* obligations under paragraph 3.2.2.4 of GC 3.2 – CONSTRUCTION BY OWNER OR OTHER CONTRACTORS, shall pay the *Contractor* the cost of restoring the *Work* as the restoration of the *Work* proceeds and as provided in GC 5.2 – APPLICATIONS FOR PROGRESS PAYMENT and GC 5.3 – PROGRESS PAYMENT. **.5 Contractors' Equipment Insurance** "All risks" contractors' equipment insurance covering construction machinery and equipment used by the *Contractor* for the performance of the *Work*, excluding boiler insurance, shall be in a form acceptable to the *Owner* and shall not allow subrogation claims by the insurer against the *Owner.* The policies shall be endorsed to provide the *Owner* with not less than 30 days' notice, in writing, in advance of cancellation, change or amendment restricting coverage. Subject to satisfactory proof of financial capability by the *Contractor* for self-insurance of his equipment, the *Owner* agrees to waive the equipment insurance requirement. 11.1.2 The *Contractor* shall be responsible for deductible amounts under the policies except where such amounts may be excluded from the *Contractor's* responsibility by the terms of GC 9.1 - PROTECTION OF WORK AND PROPERTY and GC 9.2 - DAMAGES AND MUTUAL RESPONSIBILITY. 11.1.3 Where the full insurable value of the *Work* is substantially less than the *Contract Price*, the *Owner* may reduce the amount of insurance required to waive the course of construction insurance requirement. 11.1.4 If the *Contractor* fails to provide or maintain insurance as required by the *Contract Documents*, then the *Owner* shall have the right to provide and maintain such insurance and provide evidence of same to the *Contractor*. The *Contractor* shall pay the costs thereof to the *Owner* on demand, or the

		Owner may deduct the amount that is due or may become due to the *Contractor*. 11.1.5 All required insurance policies shall be with insurers licensed to underwrite insurance in the jurisdiction of the *Place of the Work*."

SC54 *NEW* GC 11.2 CONTRACT SECURITY

SC54.1	GC 11.2	Add new GC 11.2 – CONTRACT SECURITY as follows: "**GC 11.2 CONTRACT SECURITY** 11.2.1 The *Contractor* shall, prior to the execution of the *Contract*, 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 *Owner* and is permitted under the *Construction Act*, .2 be issued by an insurer licensed under the *Insurance Act* (Ontario) and authorized to transact a business of suretyship in the Province of Ontario; .3 shall be in the form prescribed by the *Construction Act*; .4 have a coverage limit of at least 50 per cent of the *Contract Price*, or such other percentage of the *Contract Price* as stated in the *Contract Documents*; .5 extends protection to *Subcontractors*, *Suppliers,* and any other persons supplying labour or materials to the *Project*; and .6 shall be maintained in good standing until the fulfillment of the *Contract*, including all warranty and maintenance periods set out in the *Contract Documents.* 11.2.3 It is the intention of the parties that the performance bond shall be applicable to all of the *Contractor's* obligations in the *Contract Document* and, wherever a performance bond is provided with language which conflicts with this intention, it shall be deemed to be amended to comply. The *Contractor* represents and warrants to the *Owner* that it has provided its surety with a copy of the *Contract Documents* prior to the issuance of such bonds. 11.2.4 Without limiting the foregoing in any way, the bonds shall indemnify and hold harmless the *Owner* for and against costs and expenses (including legal and *Consultant* services and court costs) arising out of or as a consequence of any default of the *Contractor* under this *Contract*. 11.2.4 The *Contractor* shall be responsible for notifying the surety company of any changes made to the *Contract* during the course of construction.

		11.2.5 The premiums for bonds required by the *Contract Documents* shall be included in the *Contract Price*. 11.2.6 Should the *Owner* require additional bonds by the *Contractor* or any of his *Subcontractors*, after the receipt of bids for the *Work*, the *Contract Price* shall be increased by all costs listed in 6.3.7 attributable to providing such bonds. The *Contractor* shall promptly provide the *Owner*, through the *Consultant*, with any such bonds that may be required."

PART 12 OWNER TAKEOVER

SC55 GC 12.1 READY-FOR-TAKEOVER

SC55.1	12.1.1	Delete GC 12.1.1 in its entirety and replace it with the following: "12.1.1 *Ready-for-Takeover* shall be achieved when all of the following has occurred, as verified and approved by the *Owner*: .1 *Substantial Performance of the Work* has been achieved, as certified by the *Consultant*; .2 a permit for occupancy of the *Place of the Work* has been obtained from the authorities having jurisdiction; .3 the *Work* to be performed under the *Contract* has satisfied the requirements for deemed completion in accordance with Section 2(3) of the *Construction Act*, .4 final cleaning and waste removal, as required by the *Contract Documents*; .5 the *Contractor* has delivered to the *Consultant* and the *Owner* all inspection certificates from authorities having jurisdiction with respect to any component of the *Work* which has been completed; .6 subject only to GC 12.1.2, the entire *Work* has been completed to the requirements of the *Contract Documents*, including completion of all items on the punch list prepared at the time of *Substantial Performance of the Work* and the *Work* is being used for its intended purpose, and is so certified by the *Consultant*; .7 subject only to GC 12.1.2, the *Contractor* has submitted to the *Owner* and the *Consultant* in a collated and organized matter, all *Close-Out Documentation* and any other materials or documentation required by the *Contract Documents*; .8 subject only to GC 12.1.2, all *Products*, systems and components of the *Project* have been commissioned and certified for operation and accepted by the *Owner* and *Consultant*, and .9 subject only to GC 12.1.2, the *Contractor* has submitted to the *Owner* and the *Consultant* full and complete as-built drawings and

		Specifications revised by the *Contractor* to reflect the as-built state of the *Work*, clearly showing changes to the *Drawings* and *Specifications* from the original *Contract Documents*, all of which have been approved by the *Owner* acting reasonably."
SC55.2	12.1.2	Delete GC 12.1.2 in its entirety and replace it with the following: "12.1.2 The *Owner* may, in its sole, absolute, and unfettered discretion, waive compliance with a requirement, or a part thereof, for achieving *Ready-for-Takeover* set out in GC 12.1.1.6 to 12.1.1.9 (inclusive). Where the *Owner* exercises the discretion afforded under this GC 12.1.2, the *Contractor* shall be required to comply with GC 5.5.1.2 as part of its application for final payment and the *Owner* and the *Contractor*, in consultation with the *Consultant*, shall establish a reasonable date for completing the *Work*."
SC55.3	12.1.3	Delete GC 12.1.3 in its entirety and replace it with the following: "12.1.3 When the *Contractor* considers the *Work Ready-for-Takeover*, it shall submit a written application to the *Owner* and the *Consultant* for review."
SC55.4	12.1.4	In GC 12.1.4, delete the words "list and" from the second line.
SC55.5	12.1.5	Delete GC 12.1.5 in its entirety and replace it with the following: "12.1.5 Following the confirmation of the date of *Ready-for-Takeover* by the *Consultant* and as confirmed by the *Owner*, the *Contractor* may submit a final application for payment in accordance with GC 5.5 – FINAL PAYMENT."
SC55.6	12.1.6	Delete GC 12.1.6 in its entirety.

SC56 GC 12.2 EARLY OCCUPANCY

SC56.1	GC 12.2	Delete GC 12.2 – EARLY OCCUPANCY BY THE OWNER in its entirety, including all subparagraphs thereunder and replace it with the following: "12.2.1 The Owner reserves the right to take possession of and use for any intended purpose any portion or all of the undelivered portion of the Project even though the Work may not have reached Substantial Performance of the Work, provided that such taking possession and use will not unduly interfere, in any material way, with the progress of the Work. The taking of possession or use of any such portion of the Project shall not be deemed to be the Owner's acknowledgement or acceptance of the Work or Project nor shall it relieve the Contractor of any of its obligations under the Contract. 12.2.2 Whether the Project contemplates Work by way of renovations in buildings which will be in use or be occupied during the course of the Work or where the Project involves Work that is adjacent to a structure which is in use or is occupied, the Contractor, without in any way limiting its responsibilities under this Contract, shall take all reasonable steps to avoid interference with fire exits, building access and egress, continuity of electric power and all other utilities, to suppress dust and noise and to avoid conditions likely

		to propagate mould or fungus of any kind and all other steps reasonably necessary to promote and maintain the safety and comfort of the users and occupants of such structures or adjacent structures.”

SC57 GC 12.3 WARRANTY

SC57.1	12.3.2	Delete from the first line of paragraph 12.3.2 the word “The” and replace it with the words “Subject to GC 1.1.3, the…”
SC57.2	12.3.7 to 12.3.12	Add new paragraphs 12.3.7 to 12.3.12 as follows: “12.3.7 Where required by the *Contract Documents*, the *Contractor* shall provide a maintenance bond as security for the performance of the *Contractor’s* obligations as set out in GC 12.3 WARRANTY. 12.3.8 The *Contractor* shall provide fully and properly completed and signed copies of all warranties and guarantees required by the *Contract Documents*, containing: .1 the proper name of the *Owner*; .2 the proper name and address of the *Project*; .3 the date the warranty commences, which shall be at the “*Ready-for-Takeover*” unless otherwise agreed upon by the *Consultant* in writing. .4 a clear definition of what is being warranted and/or guaranteed as required by the *Contract Documents*; and .5 the signature and seal (if required by the governing law of the *Contract*) of the company issuing the warranty, countersigned by the *Contractor*. 12.3.9 Should any *Work* 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 *Contractor* shall ensure that its *Subcontractors* are bound to the requirements of GC 12.3 – WARRANTY for the *Subcontractor’s* portion of the *Work.* 12.3.11 The *Contractor* shall ensure that all warranties, guarantees or other obligations for *Work*, services or *Products* performed or supplied by any *Subcontractor, Supplier* or other person in connection with the *Work* are obtained and available for the direct benefit of the *Owner.* In the alternative, the *Contractor* shall assign to the *Owner* all warranties, guarantees or other obligations for *Work*, services or *Products* performed or supplied by any *Subcontractor, Supplier* or other person in connection with the *Work* 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 *Owner* under the *Contract Documents*.

		12.3.12 The *Contractor* shall commence or correct any deficiency within 2 *Working Days* after receiving a *Notice in Writing* from the *Owner* or the *Consultant*, and shall complete the *Work* 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 *Owner* 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 *Contractor* fail to provide this emergency service within 8 hours of a request being made during the normal business hours of the *Contractor*, the *Owner* is authorized, notwithstanding GC 3.1, to carry out all necessary repairs or replacements at the *Contractor's* expense."

PART 13 INDEMNIFICATION AND WAIVER

SC58 GC 13.1 INDEMNIFICATION

SC58.1	GC 13.1	Delete GC 13.1 – INDEMNIFICATION in its entirety and replace it with the following: "13.1.1 The *Contractor* shall indemnify and hold harmless the *Owner*, its parent, subsidiaries and affiliates, their respective partners, trustees, officers, directors, agents and employees and the *Consultant* 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 *Owner* 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 *Contractor*, its employees, agents, *Subcontractors*, *Suppliers* 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 *Work*, the *Owner's* property or equipment, the *Contractor's* property or equipment or equipment or property adjacent to the *Place of the Work* or death or injury to the *Contractor's* personnel). 13.1.2 The *Owner* shall indemnify and hold the *Contractor*, its agents and employees harmless from and against claims, demands, losses, costs, damages, actions, suits or proceedings arising out of the *Contractor's* performance of the *Contract* which are attributable to a lack of or defect in title or an alleged lack of or defect in title to the *Place of the Work*. 13.1.3 The provisions of GC 13.1 - INDEMNIFICATION shall survive the termination of the *Contract,* 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 *Work* 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."

SC59 GC 13.2 WAIVER OF CLAIMS

SC59.1	13.2.1	In paragraph 13.2.1 in the third line after the word "limitation" add the words "claims for delay pursuant to GC 6.5 DELAYS" -and- add the words "(collectively "**Claims**")" after "*Ready-for-Takeover*" in the fourth line.
SC59.2	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".
SC59.3	13.2.1.2	In subparagraph 13.2.1.2 change the word "claims" to "Claims".
SC59.4	13.2.1.3	Delete subparagraph 13.2.1.3 in its entirety.
SC59.5	13.2.1.4	In paragraph 13.2.1.4 change the word "claims" to "Claims".
SC59.6	13.2.2.1	In paragraph 13.2.2.1 delete the words "in paragraphs 13.2.1.2 and 13.2.1.3" and replace 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".
SC59.7	13.2.3	Delete paragraph 13.2.3 in its entirety.
SC59.8	13.2.4	Delete paragraph 13.2.4 in its entirety.
SC59.9	13.2.5	Delete paragraph 13.2.5 in its entirety.
SC59.10	13.2.6	In paragraph 13.2.6 change the word "claim" to "Claim" in all instances in the paragraph.
SC59.11	13.2.8	In paragraph 13.2.8 change "The party" to "The *Contractor* -and- change the word "claim" to "Claim" in all instances in the paragraph.
SC59.12	13.2.9	In paragraph 13.2.9 delete the words "under paragraphs 13.2.1 or 13.2.3" and replace them with "under paragraph 13.2.1" -and- change both instances of the words "the party" to "the *Contractor*". Change the word "claim" to "Claim" in all instances in the paragraph.

SC60 GC13.3 CONFIDENTIALITY

SC60.1	GC 13.3	"13.3.1 Each of the parties will take reasonable precautions to protect the *Confidential Information* of the other, and will not disclose the *Confidential Information* of the other to any third party except for employees, *Consultant, Suppliers* and *Subcontractors* with a need to know but only to the extent necessary for such obligations to be fulfilled. Before granting access to any *Confidential Information* of the other to any third party other than an employee, a party will undertake to have such third party sign an agreement causing them to be bound by terms substantially the same as those in this present paragraph. 13.3.2 At either party's request, the other will immediately return to that party any *Confidential Information* of that party then in its possession or under its control, except for information necessary to perform duties under the *Contract.* In addition, after the earlier of the completion of the *Contractor*'s obligations under the *Contract* or the termination of the *Contract*, the *Contractor* will return or, with the consent of the *Owner*, destroy all of the *Owner's Confidential Information* provided to it or its personnel, affiliates, employees, agents, *Consultant, Subcontractors,* or *Suppliers*, as promptly as practicable (but in any event within ten (10) days), except for business records required by law to be retained by the *Contractor.* If the *Owner* consents to destruction of *Confidential Information*, then upon request of the *Owner* the *Contractor* shall deliver an affidavit signed by an officer of the *Design-Builder* attesting to the destruction of the *Confidential Information*. 13.3.3 If any unauthorized disclosure of, loss of, or inability to account for, *Confidential Information* of a party occurs while it is in the possession of the other, the other will notify the party immediately. 13.3.4 If any *Confidential Information* contains information received under confidence from any third party, the party receiving that information will on request enter into any non-disclosure agreement that third party may reasonably require that creates similar obligations of confidentiality as those in the *Contract*. 13.3.5 Both during or following the term of the *Contract*, the *Contractor* shall maintain the confidentiality and security of all *Confidential Information* and *Personal Information*, and that it shall not directly or indirectly disclose, destroy, exploit, or use any *Confidential Information* or personal information, except where required by law and having first obtained the written consent of the *Owner*. The *Contractor* acknowledges that it will comply with all requirements of the *Personal Information Protection and Electronic Documents Act*, S.C. 2000, c. 5. 13.3.6 The *Contractor* acknowledges that the *Owner* is bound by the provisions of the *Municipal Freedom of Information and Protection of Privacy Act* (Ontario) ("**MFIPPA**"). The *Contractor* further acknowledges that the *Owner* may be required to disclose any or all of the *Confidential Information* and personal information in the event that it is compelled to do so by law, through a request under *MFIPPA*, or by the rules of any applicable regulatory authority, and in such event, the *Owner* will promptly

		notify the *Contractor* so that the *Contractor* may take such action as it deems appropriate."

SC61 *NEW* **PART 14 OTHER PROVISIONS**

SC61.1	14.1	Add new PART 14 – OTHER PROVISIONS as follows: "**PART 14 OTHER PROVISIONS** **GC 14.1 OWNERSHIP OF MATERIALS** 14.1.1 Unless otherwise specified, all materials existing at the *Place of the Work* at the time of execution of the *Contract* shall remain the property of the *Owner*. All *Work* and *Products* delivered to the *Place of the Work* by the *Contractor* shall be the property of the *Owner.* The *Contractor* shall remove all surplus or rejected materials as its property when notified in writing to do so by the *Consultant*."
SC61.2	14.2	Add new GC 14.2 – CONSTRUCTION LIENS as follows: **"GC 14.2 LIENS** 14.2.1 Notwithstanding any other provision in the *Contract*, the *Consultant* shall not be obligated to issue a certificate, and the *Owner* shall not be obligated to make payment, subject to the *Owner*'s requirement to issue a *Notice of Non-Payment* (Form 1.1) to the *Contractor*, if at the time such certificate or payment was otherwise due: .1 a claim for lien has been registered against the *Project* lands by a *Subcontractor* or a *Supplier* that has not been vacated or discharged by the *Contractor* in accordance with the requirements of this *Contract*, or .2 if the *Owner* or a mortgagee of the *Project* lands has received a written notice of a lien that has not been resolved by the *Contractor* through the posting of security or otherwise. 14.2.2 In the event a construction lien arising from the performance of the *Work* is registered or preserved against the *Project* lands by a *Subcontractor* or a *Supplier*, or a written notice of a lien is given or a construction lien action is commenced against the *Owner* by a *Subcontractor* or a *Supplier*, then the *Contractor* 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 *Place of the Work*). If the lien is merely vacated, the *Contractor* shall, if requested, undertake the *Owner*'s defence of any subsequent action commenced in respect of the lien, at the *Contractor*'s 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 *Owner* against all costs and expenses arising from same, including legal costs on a full indemnity basis. 14.2.3 In the event that the *Contractor* fails or refuses to comply with its obligations pursuant to paragraph 14.2.2, the *Owner* 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 *Owner's* 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 *Project* lands, and in so doing will be entitled to a full indemnity from the *Contractor* for all legal fees, security, disbursements and other costs incurred and will be entitled to deduct same from amounts otherwise owing to the *Contractor*. 14.2.4 In the event that any *Subcontractor* or *Supplier* registers any claim for lien with respect to all or part of the *Place of Work*, the *Owner* 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 *Act*, by paying into court as security the amount withheld. 14.2.5 Nothing in this GC 14.2 serves to preclude the *Contractor* from preserving and perfecting its lien in the event of non-payment by the *Owner*."

APPENDIX 1
to the Supplementary Conditions

Project-specific requirements for a "*Proper Invoice*"

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

.1 the written bill or request for payment must be in writing;

.2 the *Contractor*'s name and current address;

.3 the *Contractor*'s HST registration number;

.4 the date the application for payment was prepared by the *Contractor*;

.5 the period of time in which the services or materials were supplied to the *Owner*;

.6 the purchase order number provided by the *Owner*;

.7 reference to the provisions of the *Contract* under which payment is being sought (e.g. GC 5.3 – PAYMENTS for progress payments, GC 5.4 – SUBSTANTIAL PERFORMANCE OF THE WORK AND PAYMENT OF HOLDBACK GC 5.5 – FINAL PAYMENT for final payment, etc.);

.8 a description, including quantities where appropriate, of the services or materials, or a portion thereof, that were supplied and form the basis of the *Contractor's* request for payment;

.9 the amount the *Contractor* is requesting to be paid by the *Owner*, set out in a statement based on the schedule of values approved under GC 5.2.4, separating out any statutory or other holdbacks, set-offs and HST;

.10 a sworn Statutory Declaration in the form CCDC 9A-2018, only for second and subsequent progress payments;

.11 a current Workplace Safety Insurance Board clearance certificate;

.12 a pre-approved schedule of values, supplied by the *Contractor*, for Divisions 1 through 14 of the *Specifications* (or equivalent Construction Specifications Institute Masterformat) of the *Work*, aggregating the total amount of the *Contract Price*, including all supporting invoicing;

.13 a separate pre-approved schedule of values, supplied by each *Subcontractor*, for each of Division 15, 16, and 17 of the *Specifications* (or equivalent Construction Specifications Institute Masterformat) of the *Work*, aggregating the total amount of the *Contract Price*, including all supporting invoicing;

.14 invoices and other supporting documentation for all claims against the cash allowance;

.15 a current, acceptable, and up to date *Construction Schedule Update*;

.16 if requested by the *Owner*, a current and valid certificate(s) of insurance as required under GC 11.1 – INSURANCE;

.17 the name, title, telephone number and mailing address of the person at the place of business of the *Contractor* to whom payment is to be directed;

.18 a current, up to date, and approved *Shop Drawing* log;

.19 in the case of the *Contractor's* application for final payment, in addition to the foregoing requirements (as applicable):

(a) any *Close-Out Documentation*, together with complete and final as-built drawings;

(b) the *Contractor's* written request for release of the deficiency holdback, including a statement that no written notices of lien have been received by it;

(c) the *Contractor's* written certification that there are no outstanding claims, pending claims or future claims from the *Contractor* or their *Subcontractors* or *Suppliers*; and

(d) sufficient evidence of the *Contractor's* compliance with GC 3.11.

END OF AMENDMENTS TO CCDC 2 - 2020

1 GENERAL

.1 Information on existing conditions made available to bidders under this section, is included in the Bid Documents for information purposes only, and does not form part of the Contract Documents.

.2 The Owner and Consultant assume no responsibility for the scope and accuracy of the information contained in the documents listed herein.

.3 The Contractor shall be responsible for conducting an on-site evaluation of conditions which can be observed and for correlation of these conditions with the information included under this section.

.4 Information contained in documents listed here may be used by the Contractor to assist in an assessment of existing conditions. Evaluation of the information shall remain the responsibility of the Contractor.

2 GEOTECHNICAL REPORT

.1 Geotechnical investigation of the site for guidance in design and construction was carried out for the Owner and has been appended.
.2 Hydrogeological Report (Terraprobe).
.3 Phase 2 ESA (Terrabrobe).
.4 Soil Quality Assessment (Terrabrobe).

END OF SECTION

1 SUMMARY OF WORK

.1 The project consists of:

.1 Addition and renovation for J.J. O'Neil Catholic Elementary School. Site located at 240 Marilyn Avenue, Napanee, Ontario.

.2 Work by Owner comprises the following:

.1 Installation of Owner equipment and furnishings.

2 WORK RESTRICTIONS

.1 Contractor's Use Of Site

.1 Use of site is restricted to the areas designated on the drawings for execution of the Work. Do not unreasonably encumber site with materials or equipment. Move stored products or equipment which interfere with operations of Owner, or other contractors. Obtain and pay for use of off-site additional storage, or work areas as required by the Work.

.2 Hours of Work

.1 Hours of work for this Contract are generally confined to regular daily business hours of 8:00am to 5:00pm, Monday to Friday. Where required by sequencing of the Work, portions of the Work may be required to be performed outside of regular daily business hours, or on weekends, but shall be performed at such times at no additional cost to the Owner.

.2 Once the building is occupied, Contractor access to the building to perform Work to Correct deficiencies or to perform warranty is restricted and work must be done after hours. School day start time is 9:00AM and end of day time is 4:00PM.

3 OFF SITE WORK

.1 All work beyond property lines, adjacent to the site, is included in Contract unless noted otherwise.

END OF SECTION

1 GENERAL

.1 Include all allowances listed below in the Bid Price.

.2 Expend Cash Allowances as directed by the Consultant.

.3 Each Cash Allowance will be adjusted to actual cost as defined hereunder and Contract Price will be amended accordingly by written order.

.4 Progress payments for work and material authorized under Cash Allowances will be made in accordance with GC 5.3 of the Contract.

.5 Where costs under a cash allowance exceed amount of allowance, Contractor will be compensated for excess incurred and substantiated plus allowance for overhead and profit as set out in Contract Documents.

.6 Include progress payments on accounts of Work authorized under cash allowances in Consultant's monthly certificate for payment.

.7 Prepare schedule jointly with Consultant and Contractor to show when items called for under cash allowances must be authorized by Consultant for ordering purposes so that progress of Work will not be delayed.

.8 Cash allowances <u>do not include H.S.T.</u>

2 MATERIAL ALLOWANCES (SUPPLY ONLY)

.1 Material cash allowance shall include and provide payment for:
- .1 Net cost of material.
- .2 Applicable duties and taxes.
- .3 Delivery to the Place of the Work.

.2 Include in the Bid Price, in addition to the material cash allowance, costs for the following:
- .1 Handling at the Place of the Work, including unloading, uncrating, storage and hoisting.
- .2 Protection from damage by elements or otherwise.
- .3 Labour for installation and finishing.
- .4 Other expenses required to complete installation.
- .5 Overhead and profit.

3 ASSEMBLY ALLOWANCES (SUPPLY AND INSTALL)

.1 Assembly cash allowance shall include and provide payment for:
- .1 Net cost of material.
- .2 Applicable duties and taxes.
- .3 Delivery to the Place of the Work.
- .4 Assembly contractors'/suppliers' <u>only</u>, expenses relating to the following:
  - .1 Handling at site, including unloading, uncrating, storage and hoisting.
  - .2 Protection from damage by elements or otherwise.
  - .3 Labour installation and finishing.
  - .4 Other expenses required to complete installation.
  - .5 Overhead and profit.

.2 Include in the Bid Price any overhead and profit or related General Contractor costs.

4 TESTING & LABORATORY SERVICES

.1 Testing & Laboratory Services allowances shall include and provide payment for:

.1 Transportation costs to and from the Place of the Work,

.2 Personnel & equipment required to perform tests or inspections,

.3 Costs of shipping & handling samples to laboratory for testing,

.4 Applicable duties and taxes.

5 ALLOWANCE AMOUNTS

.1 The Total Cash Allowance to be included in the Stipulated Price is $545,000 in Canadian funds.

.2 The Cash Allowance shall cover the following (in general):

.1 Finish Hardware – supply and installation of all finish hardware for wood and hollow metal doors. Supply of finish hardware for aluminum doors - installation by others. Supply of finish hardware for teacher's closet doors - installation by others.

.2 Pin mounted cast aluminum signage on exterior of building.

.3 Hydro Utility - supply and install of the primary terminations. Connection at supply point at street and pad mounted transformer. Utility service connection fees.

.1 Note: The Electrical Contractor shall be responsible for coordinating a servicing agreement and all associated work with the electrical company.

.4 Testing and Inspection.

.5 Security Alarm Systems -- Supply and install as per Division 26 Sections.

.6 A/V systems -- supply and install in gymnasium.

.7 Gas meter upgrades by Utility provider.

.8 Unexpended amounts of Cash Allowances may be reallocated to other work at the sole discretion of the Consultant and Owner.

END OF SECTION

1 MODIFICATIONS TO CONTRACT

.1 Supplemental Instruction: as issued by the Consultant, consistent with the intent of the Contract Documents, and will not involve an adjustment in Contract Price or Contract Time.

.2 Proposed Change: as issued by the Consultant, will notify the Contractor of an impending or proposed change to the Work, and will require submission of a quotation from the Contractor and all affected Subcontractors for each item noted. Submit quotation within the time period stipulated on the form, and indicate separate line items for labour and materials in each case. Work outlined in a Proposed Change must not proceed without the issuance of a Change Order signed by the Owner.

.3 Change Directive: will be issued by the Consultant where an immediate response is required to an on-site condition. This form will authorize the Contractor to proceed with the change, with the stipulation that accurate accounts of costs be recorded, and may contain an upset cost, as agreed upon by the Owner and the Contractor.

.4 Change Order: will be issued by the Consultant upon review and approval of quotations for a Proposed Change, or a Change Directive, and authorizes the Contractor to proceed with the change(s) proposed. A Change Order will amend the Contract Price, and/or the Contract Time.

2 FEES FOR CHANGES IN THE WORK

.1 The fees (mark-ups) permitted to be applied to the Contract Price for changes to the Work shall be in accordance with the Supplementary Conditions of the Contract (CCDC 2 - 2020) as provided.

.2 Fees (mark-ups) for Changes in the Work shall apply to all extras to the Contract Price in accordance with the Supplementary Conditions of the Contract (CCDC 2 - 2020) as provided.

.3 Fees (mark-ups) for Changes in the Work shall only apply to credits to the Contract Price in accordance with the Supplementary Conditions of the Contract (CCDC 2 - 2020) as provided.

END OF SECTION

1 APPLICATIONS FOR PAYMENT

.1 Applications for payment on account may be made monthly as the Work progresses, and shall be preceded by the submission of a Schedule of Values for review by the Consultant, in accordance with the Contract.

.2 The second and all subsequent applications for payment shall include a statement based on the Schedule of Values, a statutory declaration (CCDC-2 2020), and a standard Workers Compensation Certificate of Clearance along with all other required documentation listed in the Supplementary General Conditions.

2 SCHEDULE OF VALUES

.1 Submit Schedule of Values in spreadsheet form acceptable to the Consultant.

.2 Identify on each Schedule of Values, the following information:

.1 Date of Issue
.2 Project name
.3 Owner's name
.4 Contractor's name
.5 Payment period
.6 Payment certificate number

.3 Items of work listed shall include, but not be limited to, separate line items for the following:

.1 General Accounts
.2 Mobilization
.3 Supervision
.4 Bonds and Insurance
.5 Permits and Licenses
.6 Operations and Maintenance Manuals/As-Built Drawings
.7 All trades or portions of the Work, generally in chronological order
.8 Provision of other Products and/or services
.9 Cash Allowance expenditures
.10 Changes in the Work

.4 The total Contract amount for each trade or portion of the Work shall be listed beside each item.

.5 For the purposes of monthly payments, the following values shall be assigned for Operation and Maintenance Manuals and Contractor created Redline and Final electronic As-Built Drawings.

.1 Architectural Maintenance Manuals: $2500.00
.2 Architectural Redline As-Built Drawings: $2500.00
.3 Structural Redline As-Built Drawings: $2500.00
.4 Mechanical Maintenance Manuals: $2500.00
.5 Mechanical Redline and Electronic As-Built Drawings: $2500.00
.6 Electrical Maintenance Manuals: $2500.00
.7 Electrical Redline and Electronic As-Built Drawings: $2500.00
.8 Civil Redline As-Built Drawings: $2500.00

.6 The Values of the Work shall be listed as to the aggregate percentage and dollar value completed, under the following major headings:
- .1 Initial Contract Amounts for each line item,
- .2 Progress to Date,
- .3 Percent Complete,
- .4 Current Holdback Applied,
- .5 Current Invoice less Holdback
- .6 Current Invoice,
- .7 Previous Billings,
- .8 Contract Balance

.7 Work shall be subtotaled under original Contract amounts, Cash Allowance expenditures, and Changes to the Work.

.8 Final totals shall identify:
- .1 Total amount
- .2 Holdback deducted
- .3 Holdback released
- .4 Amount invoiced to date
- .5 Net amount
- .6 HST
- .7 Amount due this Certificate

END OF SECTION

1 PROJECT MANAGEMENT & COORDINATION

.1 Project Coordination

.1 The Contractor is responsible for the overall coordination of the Work. Coordinate the work of all subcontractors, and provide such assistance as is necessary, including but not limited to;

.1 Providing site dimensions and layout,

.2 Providing temporary facilities and controls,

.3 Scheduling subcontractors work to prevent conflicts,

.4 Scheduling and administering regular subtrade scheduling and coordination meetings throughout progress of the Work.

.5 Scheduling and administering regular subtrade safety meetings throughout progress of the Work.

.6 Coordinate construction sequences an schedules including all components of the Work, including all Divisions with interdependent responsibilities.

.2 The Contractor shall facilitate production of interference drawings where necessary for coordination of the Work. Provide such interference drawings to the Consultant for review.

.2 Project Supervision

.1 The Contractor shall provide and maintain full-time supervision on site until Substantial Performance is achieved and the deficiencies have been completed or otherwise agreed with the Owner. The supervisor shall be responsible for the overall day-to-day coordination on site between subtrades.

.2 The supervisor shall coordinate the work of all subcontractors, and provide such assistance as is necessary, including but not limited to;

.1 Layout,

.2 Rough carpentry work for blocking, strapping, nailers, etc.

.3 Project Meetings

.1 Attend all regular bi-weekly project progress meetings throughout progress of work.

.2 Consultant shall chair regular bi-weekly project progress meetings and shall record and distribute same to Owner, Contractor and Subconsultants. Contractor shall forward to appropriate subcontractors.

.4 Project Site Administration

.1 Maintain at job site, one copy each of the following:

.1 Contract drawings.

.2 Project manual.

.3 Addenda and Bid Revisions.

.4 Reviewed shop drawings.

.5 Change orders and other Contract modifications.

.6 Field test and inspection reports.

.7 Approved schedules.

.8 Manufacturer's installation and application instructions.

2 SCHEDULES

.1 Construction Progress Schedule.

.1 Prepare schedule in horizontal chart form, with weekly horizontal time scale identifying first/last work day of each week. Schedule must utilize "critical path" method.

.2 Indicate separate line for each trade or operation of the Work. Arrange trades in chronological order for commencement of that part of the Work.

.3 Identify projected major milestones in the course of the Work such as completion of foundation work, structure, closing in, major inspections by building officials, Substantial Performance, etc.

.2 Submittal Schedule

.1 Provide schedule for submittal of all Shop Drawings, Product Data and Samples.

.2 Provide complete list of all manufacturered products to be used in the course of the Work, including those amended by addenda.

.3 Submission of Schedules

.1 Submit one copy of each schedule to the Consultant for review, prior to first progress billing. Amend schedule as required.

.2 Submit 4 copies of each subsequent issue of schedules to the Consultant.

.3 Update schedule on a regular basis or as requested by the Consultant.

3 ELECTRONIC FILE AGREEMENT

.1 Electronic files for this project will not be released until the Electronic Files Transfer Agreement, appended to this Section, has been completed and returned to the Consultant.

4 ADDITIONAL DOCUMENTS

.1 Consultant may issue additional documents in the form of drawings, specifications, schedules, or written instructions to assist proper execution of the Work. These documents shall take one of the following forms as defined in the Contract;

.1 Supplemental Instruction: no adjustment in Contract Price or Contract Time.

.2 Change Order: amendment to the Contract recommended by the Consultant, and agreed upon by the Owner and the Contractor.

5 SUBMITTAL PROCEDURES

.1 Submit to Consultant, all items specified for review, with reasonable promptness and in orderly sequence so as to not cause delay in the Work. Failure to submit in ample time is not considered sufficient reason for an extension of Contract Time and no claim for extension by reason of such default will be allowed.

.2 The Contractor shall schedule a minimum of 10 working days in order for the Consultants to review each submission. This shall also apply to subsequent resubmissions.

.3 Do not proceed with work affected by the submittal until review is complete.

.4 Review all submittals prior to submission to the Consultant. This review represents that necessary requirements have been determined and verified, or will be, and that each submittal has been checked and coordinated with the requirements of the Work and the Contract Documents. Submittals not stamped, signed, and dated will be returned without review.

.5 Verify field measurements and affected adjacent work are coordinated.

.6 Contractor's responsibility for errors and omissions in submission, or deviations from requirements of Contract Documents, is not relieved by Consultant's review of submittals.

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

.8 Shop Drawings

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

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

.3 Adjustments made on shop drawings by the Consultant are not intended to change the Contract Price. If adjustments affect the value of Work, state such in writing to the Consultant prior to proceeding with the Work.

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

.5 Shop drawings shall be submitted electronically wherever possible. Files shall be in PDF format only.

.6 Shop drawings submitted by FAX, or as copies of FAX transmissions are not acceptable as shop drawings, and will not be reviewed.

.7 Reproductions of Consultants' drawings are not acceptable for the purpose of creating Shop Drawings. Any drawings submitted for review which contain drawings or any parts of drawings produced by the Consultant, will be rejected. The Consultant will not take responsibility for any resulting delays in construction as a result of the above.

.8 Shop drawings not submitted in the scale type of the contract documents (ie. metric for metric drawings) will not be reviewed.

.9 Product Data Sheets

.1 Manufacturer's standard schematics, catalogue sheets, diagrams, schedules, performance charts, illustrations and other descriptive data are acceptable in lieu of shop drawings, where specified.

.2 Product Data Sheets are acceptable provided they conform to the following:

.1 Information not applicable to project has been deleted.
.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.

.3 Submit product data sheets or brochures for requirements requested in specification Sections and as the Consultant may reasonably request where shop drawings will not be prepared due to standardized manufacture of product.

.4 Submit Product Data Sheets.

.5 Product data sheets submitted by FAX, or as copies of FAX transmissions will not be accepted.

.10 Return of Submissions

.1 If upon review by the Consultant, no errors or omissions are discovered or if only minor corrections are made, the shop drawing transparency or one copy of the product data will be returned and fabrication and installation of Work may proceed.

.2 If shop drawings or data sheets are rejected, noted copy will be returned and resubmission of corrected shop drawings or data sheets through the same procedure indicated above, shall be performed before fabrication and installation of Work may proceed.

.11 Samples

.1 Submit samples for review, in duplicate, in sizes requested in respective specification sections. Label samples as to origin and intended use in the Work.

.2 Where colour, pattern or texture is criteria, submit full range of samples.

.3 Deliver samples prepaid to Consultant's office.

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

.5 Adjustments made on samples by the Consultant are not intended to change the Contract Price. If adjustments affect the value of Work, state such in writing to the Consultant prior to proceeding with the work.

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

.7 Reviewed samples or mock-ups will become standards of workmanship and material against which installed work will be checked on project.

.12 Submission Requirements

.1 Accompany submissions with transmittal letter containing:

.1 Date,
.2 Project title and number,
.3 Contractor's name and address,
.4 Drawing/page numbers of each shop drawing or data sheet,
.5 Identification (ie. "Structural Steel Shop Dwgs."), and
.6 Number of copies submitted.

.2 Submissions shall include (where applicable) :

.1 Date and revision date,
.2 Project title and number,
.3 Name of Contractor, Subcontractor(s), Supplier/Manufacturer,
.4 Identification of product or material,
.5 Relation to adjacent structure or materials,
.6 Field dimensions, clearly identified as such,
.7 Reference standards (CSA, CGSB, ASTM, etc.), and
.8 Contractor's stamp, initialled or signed, certifying review of submission, and verification of field measurements.

.13 Distribution of Submittals after Review

.1 Distribute copies of shop drawings and product data which carry Consultant's stamp as follows (where applcable):

.1 Job site file (Record documents),
.2 General Contractor's office,
.3 Subcontractors, and
.4 Suppliers or Fabricators.

END OF SECTION

1 GENERAL

1.1 SECTION INCLUDES
- .1 Requirements for quality of work.
- .2 Requirements for for material inspection and testing.
- .3 Requirements for determination of defective materials and work.

1.2 REFERENCE STANDARDS
- .1 CSA A23.1; Concrete Materials and Methods of Concrete Construction.
- .2 CSA A23.2; Methods of Test for Concrete.
- .3 CSA S16.1; Limit States Design of Steel Structures.
- .4 CSA W47.1; Certification of Companies for Fusion Welding of Steel Structures.
- .5 CSA W59; Welded Steel Construction (Metal Arc Welding).
- .6 CISC; Code of Standard Practice for Structural Steel.
- .7 OPSS; Ontario Provincial Standard Specifications.

1.3 REGULATORY REQUIREMENTS
- .1 Products and services provided to complete the Work shall meet or exceed requirements of specified standards, municipal by-laws, building codes and referenced documents.

1.4 INDEPENDENT INSPECTION AND TESTING
- .1 Independent Inspection and Testing Consultants will be engaged by the Owner for the purpose of inspecting and/or testing individual portions of the Work. The initial cost of such services will be paid through the cash allowances.

1.5 RESPONSIBILITIES
- .1 Inspection and Testing Consultants
  - .1 Inspection and Testing Consultants shall;
    - .1 Provide inspection and testing specified,
    - .2 Inform the Contractor and Consultant immediately upon observance of materials, systems, or procedures not in compliance with the specifications, and
    - .3 Submit complete reports to the Contractor and the Consultant in a timely manner.

- .2 Contractor
  - .1 Contractor shall:
    - .1 Provide access to the Work for Inspection/Testing Consultants, and
    - .2 Inform the Inspection/Testing Consultants in advance of day and time required for inspection and tests.
  - .2 It is the responsibility of the General Contractor to ensure the quality control requirements of the Contract are implemented.

- .3 Consultant
  - .1 The Consultant will make final decisions on changes to the scope of work of inspection and testing that may affect the Contract Price.

.2 When informed of of any material procedure or test result that does not meet or exceed the specifications, the Consultant will respond in an expedient manner to resolve the issue.

1.6 ACCESS TO WORK

.1 Allow inspection & testing companies access to the Work, as well as off site manufacturing and fabrication plants.

1.7 REPORTS

.1 Submit three copies of inspection and test reports to the Consultant.

.2 Provide copies to Subcontractor of work being inspected or tested, manufacturer or fabricator of material being inspected or tested.

.3 Submit one copy of inspection and test reports to the Building Official having jurisdiction, where required by that official.

.4 The cost of tests beyond those called for in the Contract Documents or beyond those required by the law of the Place of Work shall be appraised by the Consultant and may be authorized as recoverable.

1.8 EARTHWORK

.1 All earthwork shall be subject to inspection and testing as specified herein. Inspection and Testing shall include.

.1 Inspection of excavation for foundations.
.2 Inspection of subgrade and granular fill materials.
.3 Inspection of backfill operations.
.4 Inspection and testing of backfill compaction.
.5 Inspection of trenching and bedding associated with underground services.
.6 Inspection and testing of fill and compaction associated with underground services.

1.9 CAST-IN-PLACE CONCRETE

.1 All cast-in-place concrete shall be subject to inspection and testing as specified herein. Inspection and Testing shall include:

.1 Verification of materials delivered to site.
.2 Slump tests.
.3 Sampling of cylinders, and compressive strength tests.

1.10 MASONRY MORTAR

.1 All masonry mortar shall be subject to inspection and testing as specified herein. Inspection and Testing shall include:

.1 Visual inspection of all materials.
.2 Sampling and testing of mortar cubes.

1.11 STRUCTURAL STEEL

.1 All structural steel shall be subject to inspection and testing as specified herein. Inspection and Testing shall include:

.1 Confirmation that materials supplied meet specifications.

.2 Shop inspection during fabrication of steel.
.3 Checking welders' CWB Certification.
.4 Checking fabricated members against design member shapes.
.5 Checking fabricated members against allowable sweep and camber.
.6 Checking fabricated members against specified camber.
.7 Visual inspection of all welded connections including spot checking of joint preparation and fit-up.
.8 Non-destructive testing of welding.
.9 Sample checking that tolerances are not exceeded during erection including fit-up of field welded joints.
.10 Inspection of field cutting.
.11 Inspection and testing of all field bolted connections.
.12 Visual inspection of all welds securing steel deck to structural steel.
.13 Visual inspection of all bearing plate locations.

1.12 AIR/VAPOUR BARRIERS

.1 All building envelope air/vapour barrier components shall be subject to inspection and testing as specified herein. Inspection and Testing shall include:
.1 Visual inspection of total membrane for defects.
.2 Visual inspection of all transition membranes.

1.13 ROOFING

.1 All roofing shall be subject to inspection as specified herein. Inspection and Testing shall include:
.1 Inspection of all roofing materials to verify compliance with specifications.
.2 Inspection of roofing application.

1.14 ASPHALT PAVING

.1 All asphalt paving shall be subject to inspection and testing as specified herein. Inspection and Testing shall include:
.1 Inspection and compaction testing of all granular base courses.
.2 Marshal Density testing of asphalt material.
.3 Compaction testing of all courses of asphalt paving.

2 PRODUCTS

(RESERVED)

3 EXECUTION

3.1 INSPECTION AND TESTING - GENERAL

.1 Furnish test results and mix designs as may be requested.

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

3.2 INSPECTION AND TESTING - PROCEDURES

.1 Notify the appropriate agency and Consultant in advance of the requirement for tests, in order that attendance arrangements can be made.

.2 Submit samples and/or materials required for testing, as specifically requested in specifications. Submit with reasonable promptness and in an orderly sequence so as not to cause delay in the Work.

.3 Provide labour and facilities to obtain and handle samples and materials on site. Provide sufficient space to store, cure and inspect test samples.

3.3 QUALITY OF THE WORK

.1 Quality of the Work shall be first class, executed by workers experienced and skilled in the respective duties for which they are employed. Immediately notify the Consultant if required work is such as to make it impractical to produce required results.

.2 Do not employ any unfit person or anyone unskilled in their required duties. The Consultant reserves the right to require the dismissal from the site, of workers deemed incompetent, careless, insubordinate or otherwise objectionable.

3.4 DEFECTIVE MATERIALS AND WORK

.1 Refer to GC 2.4 of CCDC 2-2020.

.2 Where evidence exists that defective work has occurred, or that work has been carried out incorporating defective products, the Consultant may have independent tests, inspections, or surveys performed in order to determine if work is defective.

.3 Tests, inspections, or surveys carried out under these circumstances will be made at the Contractor's expense in the event of defective work, or at the Owner's expense where work is in conformance. Where tests incorporate a number of samples, payment will be assessed, by the Consultant, based on the ratio of conforming to non-conforming results. This does not include re-testing of soil compaction during placement, where evidence exists of non-conformance with the Contract documents, but rather only if re-testing is called for after completion of compaction.

END OF SECTION

1 GENERAL

1 SECTION INCLUDES
- .1 Codes and Standards.
- .2 Authority Having Jurisdiction.
- .3 Health and Safety Guidelines for Work in Occupied Buildings.
- .4 Permits and Fees.
- .5 Relics, Antiquities and Human Remains.

2 CODES AND STANDARDS
- .1 Codes
  - .1 All construction shall conform to the Ontario Building Code, the National Building Code (NBC) and the National Fire Code (NFC) latest editions including all supplements and amendments.
  - .2 Conform to all other codes, by-laws and regulations as specified within individual sections of the specifications.
- .2 Industry Standards
  - .1 Industry Standards are specified within individual sections as applicable to those portions of the Work. The latest editions of all industry standards shall be the standards for which quality of work shall be assessed.
  - .2 Comply with all relevent codes, standards and industry-accepted practices, as specified herein, or as applicable to the Work.

3 AUTHORITIES HAVING JURISDICTION
- .1 The Chief Building Official of the Municipality of the Place of the Work, is the primary Authority Having Jurisdiction for compliance with all codes, by-laws and regulations as they apply to all construction.
- .2 Other Authorities Having Jurisdiction may be required to review and approve certain portions of the Work. The Chief Building Official of the Municipality of the Place of the Work, will determine the requirements for such involvement.

4 HEALTH AND SAFETY GUIDELINES FOR WORK IN OCCUPIED BUILDINGS
- .1 The Contractor shall conform with requirements of KPRDSB Health and Safety Guidelines for Work in Occupied Buldings, as appended to this Section.

5 PERMITS AND FEES
- .1 No construction work may commence without a valid, posted Building Permit.
- .2 The Owner is responsible for obtaining all necessary information and applying for the Building Permit, including payment of associated fees.
- .3 The Contractor is responsible for applying for, and obtaining all necessary permits, licenses, or certificates required by the Work.

.4 Authorities Having Jurisdiction may levy fees for issuing permits, licenses, or certificates under their jurisdiction. The Contractor shall pay all such fees as required, and shall include the cost of such fees in their Contract Price.

.5 Furnish certificates and permits from other Authorities Having Jurisdiction when so requested by the Consultant.

.6 Prior to commencement of construction, post the Building Permit at the Place of the Work.

6 RELICS, ANTIQUITIES AND HUMAN REMAINS

.1 Comply with the General Conditions of the Contract with respect to relics, antiquities, and human remains.

.2 Isolate and protect human remains, relics, antiquities, items of historical, archeological or scientific interest such as cornerstones, commemorative plaques, inscribed tablets and other similar objects found during the course of the Work.

.3 If such items are discovered in the course of construction, stop work in the immediate vicinity, and give immediate notice to the Consultant as to the nature of the discovery, and await written instructions before proceeding with work in the area.

.4 Resume work only after the conclusion of any inspection and evaluation by experts engaged by the Owner, and only after being given permission to do so.

.5 Relics, antiquities and items of historical or specific interest remain the Owner's property.

END OF SECTION

Abbreviations listed, when used in the Contract Documents, shall have the following meanings:

ABBREVIATION	**MEANING**
AA	ALUMINUM ASSOCIATION
AAMA	ARCHITECTURAL ALUMINUM MANUFACTURERS` ASSOCIATION
AASHO	AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS
ACI	AMERICAN CONCRETE INSTITUTE
AGA	AMERICAN GAS ASSOCIATION
AIA	AMERICAN INSTITUTE OF ARCHITECTS
AIMA	ACOUSTICAL & INSULATING MATERIALS ASSOCIATION
AISC	AMERICAN INSTITUTE OF STEEL CONSTRUCTION
AISI	AMERICAN IRON AND STEEL INSTITUTE
AMCA	AIR MOVING AND CONDITIONING ASSOCIATION INC.
ANSI	AMERICAN NATIONAL STANDARDS INSTITUTE
ASHRAE	AMERICAN SOCIETY OF HEATING, REFRIGERATING & AIR CONDITIONING ENGINEERS
ASTM	AMERICAN SOCIETY FOR TESTING AND MATERIALS
AWI	ARCHITECTURAL WOODWORK INSTITUTE (USA)
AWMAC	ARCHITECTURAL WOODWORK MANUFACTURERS ASSOCIATION OF CANADA
AWS	AMERICAN WELDING SOCIETY
CCA	CANADIAN CONSTRUCTION ASSOCIATION
CCRC	CANADIAN CODE FOR RESIDENTIAL CONSTRUCTION
CEC	CANADIAN ELECTRICAL CODE
CFUA	CANADIAN FIRE UNDERWRITERS ASSOCIATION
CGA	CANADIAN GAS ASSOCIATION
CGSB	CANADIAN GENERAL STANDARDS BOARD
CIQS	CANADIAN INSTITUTE OF QUANTITY SURVEYORS
CISC	CANADIAN INSTITUTE OF STEEL CONSTRUCTION
CITC	CANADIAN INSTITUTE OF TIMBER CONSTRUCTION
CLA	CANADIAN LUMBERMEN`S ASSOCIATION
CMHC	CANADA MORTGAGE & HOUSING CORPORATION
COFI	COUNCIL OF FOREST INDUSTRIES OF BRITISH COLUMBIA
CPCI	CANADIAN PRESTRESSED CONCRETE INSTITUTE
CRCA	CANADIAN ROOFING CONTRACTORS ASSOCIATION
CSA	CANADIAN STANDARDS ASSOCIATION
CSC	CONSTRUCTION SPECIFICATIONS CANADA
CSI	CONSTRUCTION SPECIFICATIONS INSTITUTE (USA)
CSPI	CORRUGATED STEEL PIPE INSTITUTE
CSSBI	CANADIAN SHEET STEEL BUILDING INSTITUTE
CUA	CANADIAN UNDERWRITERS` ASSOCIATION
CWB	CANADIAN WELDING BUREAU
CWC	CANADIAN WOOD COUNCIL
DND	DEPARTMENT OF NATIONAL DEFENCE, CANADA
FM	FACTORY MUTUAL ENGINEERING CORPORATION
FS	FEDERAL SPECIFICATION (USA)
IES	ILLUMINATING ENGINEERING SOCIETY
IGMAC	INSULATED GLASS MANUFACTURERS ASSOCIATION OF CANADA
LTIC	LAMINATED TIMBER INSTITUTE OF CANADA
MIA	MARBLE INSTITUTE OF AMERICA
MPMDD	MODIFIED PROCTOR MAXIMUM DRY DENSITY
NAAMM	NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (USA)
NBFU	NATIONAL BOARD OF FIRE UNDERWRITERS
NBC	NATIONAL BUILDING CODE OF CANADA

NBS	NATIONAL BUREAU OF STANDARDS (USDC)
NEMA	NATIONAL ELECTRICAL MANUFACTURERS' ASSOCIATION
NFPA	NATIONAL FIRE PROTECTION ASSOCIATION
NHLA	NATIONAL HARDWOOD LUMBER ASSOCIATION (USA)
NLGA	NATIONAL LUMBER GRADES AUTHORITY
NRC	NATIONAL RESEARCH COUNCIL
OBC	ONTARIO BUILDING CODE
OHSA	OCCUPATIONAL HEALTH AND SAFETY ACT
OPSS	ONTARIO PROVINCIAL STANDARD SPECIFICATIONS
PCA	PORTLAND CEMENT ASSOCIATION
PCI	PRESTRESSED CONCRETE INSTITUTE
SDI	STEEL DECK INSTITUTE
SPMDD	STANDARD PROCTOR MAXIMUM DRY DENSITY
SSPC	STEEL STRUCTURES PAINTING COUNCIL
TTMAC	TERRAZZO, TILE & MARBLE ASSOCIATION OF CANADA
ULC	UNDERWRITERS LABORATORIES CANADA
UL	UNDERWRITERS LABORATORIES (USA)
USAS	UNITED STATES OF AMERICA STANDARDS INSTITUTE
WSIB	WORKPLACE SAFETY AND INSURANCE BOARD

END OF SECTION

1 REFERENCES

.1 Occupational Health and Safety Act and Regulations for Construction Projects (2000) (Ontario Regulation 213/91, amended by Reg. 631/94, & Reg. 145/00).

.2 National Fire Code of Canada (2005)

.3 Ontario Fire Code (2005)

.4 Ontario Building Code (2012)

2 INSTALLATION AND REMOVAL

.1 Provide temporary utilities, facilities and controls in order to execute the work expeditiously. Remove from site all such work after use.

3 VEHICULAR ACCESS & PARKING

.1 Provide and maintain adequate access to project site.

.2 Build and maintain temporary access roads where indicated or required, and provide snow removal during period of work.

.3 If authorized to use existing roads for access to project site, maintain such roads for duration of Contract and make good damage resulting from Contractor's use of roads. Maintenance shall include regular snow removal if not provided under separate contract, and regular power washing to remove mud and dirt.

.4 Where site access for construction vehicles necessitates use of public roads, remove mud and dirt from such roads where contaminated by construction vehicles.

.5 Traffic Control: Provide and maintain flagpersons, traffic signals, barricades and flares, lights, or lanterns as required to perform the work and protect the public.

.6 Construction Parking

.1 Parking for construction equipment vehicles will be limited to the site or immediate areas of work.

.2 Parking for Contractors' and Subcontactors' personal vehicles will be limited to Construction Site provided it does not constitute a safety hazard nor disrupt the performance of Work.

4 TEMPORARY UTILITIES

.1 Temporary Electricity and Lighting

.1 Arrange, pay for and maintain temporary electrical power supply in accordance with governing regulations and ordinances.

.2 Install temporary facilities for power such as pole line and underground cables to approval of local power supply authority.

.3 Electrical power and lighting systems installed under this contract can be used for construction requirements provided that guarantees are not affected thereby. Make good damage. Replace lamps which have been used more than a period of 3 months.

.4 Provide temporary lighting in all areas of construction, to the minimum requirements of the Occupational Health and Safety Act, and minimum requirements specified herein.

.2 Temporary Water Supply

.1 Arrange, pay for and maintain temporary water supply in accordance with governing regulations and ordinances.

.2 Permanent water supply system installed under this contract can be used for construction requirements provided that guarantees are not affected thereby. Make good damage.

.3 Temporary Heating and Ventilating

.1 Provide and maintain all temporary heat and ventilation necessary during construction, including cost of installation, fuel, operation, attendance and maintenance. Use of direct-fired heaters discharging waste products into work areas will not be permitted unless prior approval is given by Consultant.

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

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

.3 Maintain minimum temperature of 10°C or higher where construction is in progress and maintain until acceptance of structure by Consultant.

.4 Ventilating

.1 Prevent hazardous accumulation of dust, fumes, mists, vapours or gases in areas occupied during construction.
.2 Provide local exhaust ventilation to prevent harmful accumulation of hazardous substances into atmosphere of occupied areas.
.3 Dispose of exhaust materials in manner that will not result in harmful exposure to persons.
.4 Ventilate storage spaces containing hazardous or volatile materials.
.5 Ventilate temporary sanitary facilities.
.6 Continue operation of ventilation and exhaust system for a time after cessation of work process, to assure removal of harmful elements.

.5 Maintain strict supervision or operation of temporary heating and ventilating equipment.

.1 Conform with applicable codes and standards.

.2 Enforce safe practices.
.3 Prevent abuse of services.
.4 Prevent damage to finishes.
.5 Vent direct-fired combustion units to outside.

.6 The permanent HVAC systems of the building, or portions thereof, may not be used during construction.

5 CONSTRUCTION FACILITIES

.1 Field Office

.1 Provide minimum 2400 x 4800mm office and furnish with desk, drawing layout table, filing cabinet, and coat hooks.

.2 Provide minimum 750 Lx lighting level.

.3 Heat to maintain 22°C inside temperature.

.4 Provide 2 operable windows for cross ventilation, or air condition.

.2 Temporary Communication

.1 Provide and pay for temporary communication systems to be installed in Field Office.

.2 Provide hard wire and wireless internet access.

.3 Cellular telephones are acceptable. Pay telephone is not acceptable.

.3 Equipment, Tools and Materials Storage

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

.2 Temporary enclosures required by subtrades as workshops shall be provided by those trades.

.4 Site Storage and Overloading

.1 Confine the Work and the operations of employees to limits indicated by the Contract Documents. Do not unreasonably encumber the premises with products.

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

.5 Sanitary Facilities

.1 Provide sanitary facilities for work force in accordance with governing regulations and ordinances. Post notices and take such precautions as required by local health authorities. Keep area and premises in sanitary condition. Where portable toilet facilities are provided, empty and sanitize such facilities on a weekly basis, or more frequently if required.

.2 Permanent new facilities shall not used by the Contractor.

6 CONSTRUCTION SAFETY MEASURES

.1 Observe all construction safety measures as required by the General Conditions of the Contract, the Occupational Health and Safety Act and Regulations for Construction Projects, and by all authorities having juridiction, provided that in case of conflict or discrepancy, the more stringent requirements shall apply.

.2 Provide applicable spare safety equipment such as helmets, safety glasses, and harnesses, and enforce their use by Consultants, the Owner, their representatives and any authorized visitors to the site.

.3 Provide and maintain fences, gates and locks, covered walkways, guard rails, barriers, night lights, and appropriate warning signage as required for the protection of the public, and of public and private property; as required by the General Conditions of the Contract, the Occupational Health and Safety Act and Regulations for Construction Projects, and by all authorities having jurisdiction. Erect and maintain sturdy railings around shafts, and the like, to protect workmen and the public from injury.

.4 Workplace Hazardous Materials Information System

.1 Comply with all requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of hazardous materials; and regarding labelling and provision of material safety data sheets.

.2 Include copies of all WHMIS data sheets in Operations and Maintenance Manuals.

7 CONSTRUCTION AIDS

.1 Falsework

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

.2 Scaffolding

.1 Design, construct and maintain scaffolding in accordance with CSA S269.2.

.2 Erect scaffolding independent of walls. Remove promptly when no longer required.

.3 Hoisting

.1 Provide, operate and maintain hoists or cranes required for moving of workers, materials and equipment. Make financial arrangements with Subcontractors for use thereof.

.2 Hoists or cranes shall be operated by qualified operator.

8 TEMPORARY BARRIERS & ENCLOSURES

.1 Construction Isolation Fencing

.1 Erect isolation fencing around perimeter of construction areas to protect the public, workers, and the public from injury.

.2 Construction Isolation Fencing shall consist of:

.1 Temporary modular welded wire mesh fencing, minimum 1828 x 2440mm high, by CanFence Rentals Ltd., or equivalent.

.2 Provide lockable gates within hoarding / fencing for access to site by workers and vehicles.

.3 Provide barriers around trees and planting beds designated to remain. Protect from damage.

.4 Enclosure of Structure

.1 Provide temporary weathertight enclosures and protection for exterior openings until permanently enclosed.

.2 Erect enclosures to allow access for installation of materials and working inside enclosure.

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

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

.5 Dust Control

.1 Provide dust tight screens or partitions to localize dust generating activities, and for the protection of workers, or finished areas of Work.

.2 Dust screens shall consist of, as a minimum, 0.15mm thick fire retardant polyethylene sheets secured to appropriate framing and sealed at all joints and at perimeter to prevent migration of dust

.1 Poly sheet: Polytarp, Super Six by Polytarp Products or approved alternative.

.3 Maintain and relocate protection until such work is complete.

.4 Provide dust catching walk-off matting, at all construction entrances.

9 TEMPORARY CONTROLS

.1 Drainage & Erosion Control

.1 Refer to Section 01 57 19 – Temporary Environmental Controls and Site Grading & Servicing drawings.

.2 Tree and Plant Protection

.1 Refer to Section 01 57 19 – Temporary Environmental Controls and Landscape drawings.

.3 Security Measures

.1 Where progress of construction reaches point where building exterior is fully enclosed, provide construction cylinders for doors, and secure building against intrusion. Where installation of fixtures and equipment, or storage of materials and equipment, inside the building has begun prior to installation of exterior windows and doors, provide temporary plywood enclosures for window and door openings to prevent intrusion until permanent closures are in place.

.2 Extent of security services shall be at the sole discretion of the Contractor (except as noted in item .3 below) and all costs incurred shall be paid for by the Contractor. Note that the fit, finish and new appearance of the finished building will not be compromised to accommodate temporary security provisions. Materials, products, finishes, etc. damaged due to vandalism are to be restored and/or replaced to an as-new condition.

.3 Commencing at a date which is four (4) months prior to the scheduled date for Substantial Performance, Contractor shall arrange and pay for the provision of "after hours" manned security at the project site. Security shall provide surveillance and oversite of the building and site areas, during all times when the Contractor's construction personnel are not in attendance. Continue services until time of substantial completion.

.4 Site Signs and Notices

.1 Maintain approved signs and notices in good condition for duration of project, and dispose of off site on completion of project or earlier if directed by Consultant.

.2 No other signs or advertisements of any description except notices regarding safety and instruction, shall be put up around the building, or site, without the approval of the Consultant.

END OF SECTION

1 REFERENCES
- .1 National Building Code of Canada (2005)
- .2 National Fire Code of Canada (2005)
- .3 Ontario Fire Code (2007)
- .4 Guidelines for Maintaining Fire Safety during Construction in Existing Buildings, (10/31/88) Ontario Ministry of the Solicitor General, Office of the Fire Marshal.
- .5 Ontario Building Code (Regulation 350/06)

2 FIRE SAFETY

.1 Fire Fighting Equipment

.1 Provide and maintain in working order, ULC labelled, 9kg 4A 60BC type fire extinguishers, and locate in prominent positions to approval of authorities having jurisdiction.

.2 Fire Department Access

.1 Provide and maintain fire access routes as designed, as soon as construction sequence will allow. Access routes must have compacted granular subbase, and base in place before superstructure of building may proceed.

.2 Construction activities must not obstruct access routes designated for fire department equipment. If necessary that existing access be obstructed or deleted, alternative access, acceptable to the fire department, must be provided prior to commencement of construction, in accordance with Ontario Building Code location and design criteria for required access routes.

.3 Control of Combustible Materials

.1 The stockpiling of construction materials adjacent to the existing building must be carefully controlled in accordance with the Ontario Fire Code. Materials stored, and their proximity to, equipment used in construction may create a fire hazard. Control of combustibles on a construction site is regulated under the Occupational Health and Safety Act.

.4 Hot Work

.2 Conform to the requirements of the Occupational Health and Safety Act – Regulations for Construction Projects.

.3 Provide all necessary guards and barriers to protect workers, property, and the public when performing hot work such as torching, cutting or coring. Protect all adjacent combustible materials.

.4 Provide a "Fire Watch" for a minimum of 3 hours after each instance of discontinuing hot work.

END OF SECTION

1 DEFINITIONS

.1 Environmental Pollution and Damage: presence of chemical, physical, biological elements or agents which adversely affect human health and welfare; unfavourably alter ecological balances of importance to human life; affect other species of importance to humankind; or degrade environment aesthetically, culturally and/or historically.

.2 Environmental Protection: prevention/control of pollution and habitat or environment disruption during construction. Control of environmental pollution and damage requires consideration of land, water, and air; biological and cultural resources; and includes management of visual aesthetics; noise; solid, chemical, gaseous, and liquid waste; radiant energy and radioactive material as well as other pollutants.

2 SUBMITTALS

.1 Submittals: in accordance with Submittal Procedures.

.2 Prior to commencing construction activities or delivery of materials to Site, submit Environmental Protection Plan for review and approval by Consultant Environmental Protection Plan is to present comprehensive overview of known or potential environmental issues which must be addressed during construction.

.3 Address topics at level of detail commensurate with environmental issue and required construction tasks.

.4 Environmental protection plan: include:

.1 Name(s) of person(s) responsible for ensuring adherence to Environmental Protection Plan;

.2 Name(s) and qualifications of person(s) responsible for manifesting hazardous waste to be removed from Site;

.3 Name(s) and qualifications of person(s) responsible for training site personnel;

.4 Descriptions of environmental protection personnel training program;

.5 Erosion and sediment control plan which identifies type and location of erosion and sediment controls to be provided including monitoring and reporting requirements to assure that control measures are in compliance with erosion and sediment control plan, Federal, Provincial and Municipal laws and regulations;

.6 Drawings showing locations of proposed temporary excavations or embankments for haul roads, stream crossings, material storage areas, structures, sanitary facilities and stockpiles of excess or spoil materials including methods to control runoff and to contain materials on Site;

.7 Traffic control plans including measures to reduce erosion of temporary roadbeds by construction traffic, especially during wet weather. Plans include measures to minimize amount of mud transported onto paved public roads by vehicles or runoff;

.8 Work area plan showing proposed activity in each portion of area and identifying areas of limited use or non-use. Plan to include measures for marking limits of use areas including methods for protection of features to be preserved within authorized work areas;

.9 Spill Control Plan: including procedures, instructions, and reports to be used in event of unforeseen spill of regulated substance;

.10 Non-Hazardous solid waste disposal plan identifying methods and locations for solid waste disposal including clearing debris;

.11 Air pollution control plan detailing provisions to assure that dust, debris, materials, and trash, do not become air borne and travel off-site;

.12 Contaminant prevention plan that: identifies potentially hazardous substances to be used on Site; identifies intended actions to prevent introduction of such materials into air, water or ground; and details provisions for compliance with Federal, Provincial, and Municipal laws and regulations for storage and handling of these materials;

.13 Waste water management plan that identifies methods and procedures for management and/or discharge of waste waters which are directly derived from construction activities, such as concrete curing water, clean-up water, dewatering of ground water, disinfection water, hydrostatic test water and water used in flushing of lines;

.14 Historical, archaeological, cultural resources biological resources and wetlands plan that defines procedures for identifying and protecting historical, archaeological, cultural resources, biological resources and wetlands;

.15 Pesticide treatment plan: to be included and updated, as required.

3 FIRES

.1 Fires and burning of rubbish on Site is strictly prohibitted.

4 DISPOSAL OF WASTES

.1 Burying of rubbish and waste materials on Site is strictly prohibitted.

.2 Do not dispose of waste or volatile materials, such as mineral spirits, oil or paint thinner into waterways, storm or sanitary sewers.

5 DRAINAGE & EROSION CONTROL

.1 Provide erosion and sediment control plan that identifies type and location of erosion and sediment controls to be provided. Plan: include monitoring and reporting requirements to assure that control measures are in compliance with erosion and sediment control plan, Federal, Provincial, and Municipal laws and regulations.

.2 Storm Water Pollution Prevention Plan (SWPPP) may be substituted for erosion and sedimentations control plan.

.3 Provide temporary drainage and pumping as necessary to keep excavations and Site, free from water.

.4 Do not pump water containing suspended materials into waterways, sewer or drainage systems.

.5 Control disposal or runoff of water containing suspended materials or other harmful substances in accordance with local authority requirements.

.6 Provide and maintain temporary drainage and pumping as necessary to keep excavations and site free from excess water.

.7 Provide silt fencing at site perimeters and where required by local authorities to prevent contamination of adjoining properties from silt and water drainage.

6 TREE AND PLANT PROTECTION

.1 Protect existing trees and plants on all adjacent properties, where in close proximity to construction activities, or where construction access passes within 3m of trees or plants, whether indicated on drawings or not.

.2 Conform to all local By-Laws regarding tree preservation and protection.

.3 Protect existing trees and plants on site as indicated.

.4 Restrict tree removal to those designated by Consultant. Wrap in burlap trees and shrubs adjacent to construction work, storage areas and trucking lanes. Encase trees and shrubs with protective wood framework from grade level to height of 2134mm.

.5 Protect roots to minimum 1m beyond dripline during excavation and site grading to prevent disturbance or damage. Avoid unnecessary traffic, dumping and storage of materials over root zones of protected trees. Minimize stripping of topsoil and vegetation.

.6 The Minimum Tree Protection Zone will be the drip line. Within this tree protection zone there will also be no construction activity including but not limited to no root cutting, no alteration or disturbance to existing grades of any kind, no changes to the grade by adding fill, excavating or scraping, no storage of construction materials or equipment, no stockpiling of soil, debris or construction waste, & no movement or storage of heavy vehicles or equipment. Tree protection barriers must be included and priced as part of the project. For short term project (up to 2 months), standard T-bars and plastic safety fence can be used. For a longer term project, use 10 gauge chain link fence and standard T-bars. In all cases, standard T-bars should not be spaced more than 6 to 7 feet apart. These protection barriers must be erected before the project starts, must be maintained throughout the project, and taken down when final inspection and signoffs are completed.

7 WORK ADJACENT TO WATERWAYS/DRAINAGE DITCHES

.1 Do not operate construction equipment in waterways.

.2 Do not use waterway beds for borrow material.

.3 Do not dump excavated fill, waste material or debris in waterways.

.4 Design and construct temporary crossings to minimize erosion to waterways.

.5 Do not skid construction materials across waterways.

.6 Avoid indicated spawning beds constructing temporary crossings of waterways.

8 POLLUTION CONTROL

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

.2 Prevent sandblasting and other extraneous materials from contaminating air and waterways beyond application area, by providing temporary enclosures.

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

9 HISTORICAL / ARCHAEOLOGICAL ARTIFACTS

.1 In the event that buried archaeological remains are encountered on the property during construction activities, the Heritage Operations Unit of the Ministry of Tourism and Culture be notified immediately.

.2 In the event that human remains are encountered during construction, the proponent should immediately contact both the Ministry of Tourism and Culture, and the Registrar or Deputy Registrar of Cemeteries at the Cemeteries Regulation Unit, Ministry of Government Services, (416) 326-8404.

10 NOTIFICATION

.1 Consultant will notify Contractor in writing of observed non-compliance with Federal, Provincial or Municipal environmental laws or regulations, permits, and other elements of Contractor's Environmental Protection plan. Contractor shall, after receipt of such notice, inform Consultant of proposed corrective action and take such action for approval by Consultant.

.2 Consultant will issue stop order of Work until satisfactory corrective action has been taken.

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

END OF SECTION

1 PRODUCT OPTIONS

.1 Provide products specified under individual specification sections. Where Specification lists two or more products, or two or more manufacturers of the same product, the Contractor may select one of the listed products or manufacturers. Confirm selection of products and manufacturers when requested by the Consultant.

.2 When only one product or manufacturer is listed in the specifications, it is intended that only that product or manufacturer is acceptable.

2 PRODUCT SUBSTITUTION PROCEDURES

.1 Substitution Procedures During Construction

.1 Products may only be substituted during the Construction period for one or more of the following reasons:

.1 Insolvency of the product manufacturer.

.2 Inability of the manufacturer to provide the product(s) in the timeframe required to maintain the construction schedule.

.3 Product specified has been discontinued.

.4 Substitution proposed offers better performance than that specified, at no additional cost.

.5 Substitution offers equivalent performance to that specified, at a reduced cost to the Owner (reduction in Contract Price).

.2 Items 2.1.1.2, and 2.1.1.3 will require a letter from the manufacturer, confirming their inability to provide the products specified, or inability to meet the schedule.

.3 Items 2.1.1.4, and 2.1.1.5 will be at the discretion of the Owner.

3 AVAILABILITY

.1 Immediately upon signing Contract, review Product delivery requirements, and identify lead times for supply of all Products. If lead times in supply of Products may affect the Construction Schedule, notify the Consultant in order that appropriate action may be authorized in ample time to prevent delay in performance of the Work.

.2 The Contractor shall order Products and materials in a timely fashion so as to ensure that delivery of such Products and materials shall coincide with the Construction Schedule. Failure of the Contractor or their Subcontractors to order Products and materials in a timely fashion, shall not be cause for substitution in accordance with the criteria set out under Article 2 – Product Substitution Procedures.

.3 In the event of failure to notify the Consultant of Product delivery problems at the commencement of the Work, and should it appear that the Work may be delayed for such reason, the Consultant reserves the right to substitute more readily available Products of similar character of their chosing, at no increase in Contract Price.

4 REFERENCE STANDARDS

.1 Within the specifications, reference standards are identified. Conform to these standards, in whole or part, as specifically requested.

.2 If there is question as to whether any product or system is in conformance with applicable standards, the Consultant reserves the right to have such products or systems tested to prove or disprove conformance.

.3 The cost for such testing will be born by the Owner in the event of conformance with Contract Documents or by the Contractor in the event of non-conformance.

.4 Conform to latest date of issue of referenced standards in effect on date of submission of bids, except where a specific date of issue is specifically noted.

5 PRODUCT TRANSPORTATION & DELIVERY

.1 Transportation and delivery costs of Products required in the performance of the Work, are included in the Contract Price.

.2 Transportation and delivery costs of Products supplied by the Owner will be paid for by the Owner. Unload, handle, and store such Products on site.

.3 Products must be appropriately crated, skidded, boxed, shrink-wrapped, or otherwise packaged to protect such products from damage during shipment. Products which arrive at the site in a damaged condition must be rejected and returned to the supplier/manufacturer for immediate replacement.

.4 Advise the Owner 30 days in advance of anticipated delivery dates for materials and equipment supplied by the Owner.

6 PRODUCT STORAGE, HANDLING AND PROTECTION

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

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

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

.4 Store cementitious products clear of earth or concrete floors, and away from walls.

.5 Keep sand, when used for grout or mortar materials, clean and dry. Store sand on wooden platforms and cover with waterproof tarpaulins during inclement weather.

.6 Store sheet materials and lumber on flat, solid supports and keep clear of ground. Slope to shed moisture.

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

.8 Remove and replace damaged Products at own expense and to the satisfaction of the Consultant.

7 MANUFACTURER'S INSTRUCTIONS

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

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

.3 Improper installation or erection of Products, due to failure in complying with these requirements, authorizes the Consultant to require removal, replacement where necessary, and re-installation at no increase in Contract Price.

8 FASTENINGS

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

.2 Prevent electrolytic action between dissimilar metals and materials.

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

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

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

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

.7 Obtain Consultant's approval before using explosive actuated fastening devices.

9 QUALITY OF MATERIALS

.1 Products, materials, equipment and articles (referred to as Products throughout the specifications) incorporated in the Work shall be new, not damaged or defective, and of the best quality (compatible with specifications) for the purpose intended. If requested, furnish evidence as to type, source and quality of Products provided.

.2 Products relying on uniformity of colour and pattern for appearance, such as resilient flooring, carpeting, fabrics, and vinyl wallcovering, shall be from one dye lot for the project. All products delivered to the site must be labeled as to dye lot, or production run number, as well as production date.

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

.4 Should any dispute arise as to the quality or fitness of Products, the Consultant may request additional testing based upon the requirements of the Contract Documents, to confirm acceptability of products or materials. Refer to Article 10 - Defective Materials And Work, and Section 01 40 00.

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

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

10 DEFECTIVE MATERIALS AND WORK

.1 Where evidence exists that defective work has occurred, or that work has been carried out incorporating defective products, the Consultant may have independent tests, inspections, or surveys performed in order to determine if work is defective.

.2 Tests, inspections, or surveys carried out under these circumstances will be made at the Contractor's expense in the event of defective work, or at the Owner's expense where work is in conformance. Where tests incorporate a number of samples, payment will be assessed, by the Consultant, based on the ratio of conforming to non-conforming results. This does not include re-testing of soil compaction during placement, where evidence exists of non-conformance with the Contract documents, but rather only if re-testing is called for after completion of compaction.

12 WARRANTIES & GUARANTEES

.1 Warrant all products and labour forming part of the Work for the period specified in the Contract, unless otherwise specified herein.

.2 Warrant products and assemblies for the specified periods of time where in excess of the Contract Warranty, as specified within their respective sections.

.3 Guarantee aspects of the Work for the specified periods of time where in excess of the Contract Warranty, as specified within their respective sections.

.4 Warranties and Guarantees shall commence at Date of Substantial Performance of the Contract as certified by the Consultant.

.5 Warranties and Guarantees shall be original copies, printed on company letterhead, or on a standard company warranty certificate, bearing the name of the company.

.6 Warranties and Guarantees shall indicate:

.1 Name of the Principal (the Manufacturer/Subcontractor),
.2 Name of the Obligee (the Owner),
.3 Name and address of Project,
.4 Commencement date (Date of Substantial Performance),
.5 Duration of warranty or guarantee,

.6 Clear statement of what is included, and what if any exclusions there are, and

.7 Signature of Principal's representative having signing authority.

END OF SECTION

1 EXAMINATION

.1 Acceptance of Conditions

.1 The General Contractor shall examine all existing or pre-determined conditions, prior to commencing work in that area, and report to the Consultant all conditions unacceptable for work to proceed. Commencement of work shall imply acceptance of conditions as is.

.2 Subcontractors shall examine all existing or pre-determined conditions affecting their portion of the Work, prior to commencing such work, and report to the Contractor all conditions unacceptable for work to proceed. Commencement of work shall imply acceptance of conditions as is.

2 PREPARATION

.1 Field Engineering

.1 Locate, confirm and protect control points prior to starting the Work. Preserve permanent reference points during construction.

.2 Establish reference lines and elevations. Locate and lay out by instrumentation.

.2 Records

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

3 CUTTING AND PATCHING

.1 Submit a written request in advance, for approval of cutting or alteration which affects:

.1 Structural integrity of any element of Project.
.2 Integrity of weather-exposed or moisture-resistant elements.
.3 Efficiency, maintenance, or safety of any operational element.
.4 Visual qualities of sight-exposed elements.
.5 Work of Owner or separate contractor.

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

.3 After uncovering, inspect conditions affecting performance of work. Beginning of cutting or patching means acceptance of existing conditions.

.4 Perform cutting, fitting and patching, including excavation and fill, to complete the Work. Perform work to avoid damage to other work.

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

.6 Cut rigid materials using power saw or core drill. Pneumatic or impact tools not allowed.

.7 Fit work airtight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces. At penetration of fire-rated wall, ceiling, or floor construction, completely seal voids with fire stopping material, full thickness of construction element.

.8 Refinish surfaces to match adjacent finishes; for continuous surfaces refinish to nearest intersection; for an assembly, refinish entire unit.

.9 Provide all openings greater than 200mm in non-structural elements of work for penetrations of mechanical and electrical work. Mechanical and Electrical Subcontractors shall provide all sleeves and locations for sleeves. The cost of all cutting and patching required by Mechanical and Electrical Subcontractors shall be paid for by those trades.

.10 Ensure that all cutting and patching work, including that by Mechanical and Electrical Subcontractors, is properly performed by the respective trades skilled in that line of work. Restore work with new products in accordance with Contract Documents.

4 LOCATION OF EQUIPMENT AND FIXTURES

.1 Location of mechanical and electrical equipment, fixtures and devices indicated or specified, are to be considered as approximate. Final location of such items will be determined on site, based on integration with structural and architectural elements, and as required by coordination with other trades. In the event of a conflict, final determination of location of these items rests with the Consultant.

.2 Prepare and submit for review by the Consultant, interference field drawings, to indicate relative position of various services and equipment, at the following locations as a minimum:

.1 Under all rooftop mechanical units.
.2 At locations of all major ductwork, piping, and conduit crossovers.
.3 Where ductwork passes under major structural elements.

.3 Locate equipment, fixtures and distribution systems to provide minimum interference and maximum usable space and in accordance with manufacturer's recommendations for safety, access and maintenance.

.4 Request a review of items by Consultant once rough-in is underway, prior to final installation, and obtain approval for actual locations.

5 CONCEALMENT

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

.2 In existing building, all pipes shall be enclosed in shafts. All conduit shall be placed in accordance with approved conduit shop drawings.

6 LIGHTING FIXTURES AT SUSPENDED CEILINGS

.1 Ensure that secure support is provided for lighting fixtures by suspended ceilings, or by separate hangers, or by both.

.2 Coordinate the ceiling system and lighting fixture installations to provide adequate support.

.3 Submit affidavits with acceptable design information confirming that the installation of the suspended ceiling system and/or separate fixture hangers will provide adequate support for the lighting fixtures without exceeding specified deflection tolerances for the ceiling system.

.4 Conform to current requirements of the Electrical Safety Authority (ESA).

7 EXISTING SERVICES

.1 Where work involves the interruption of, or connection to existing services, carry out such work as directed by governing authorities, with minimum of disturbance to pedestrian and vehicular traffic.

.2 Before commencing work, establish location and extent of service lines in area of work and notify Consultant of findings.

.3 Submit schedule to, and obtain approval from Consultant for any shutdown or closure of active service or facility. Adhere to approved schedule and provide notice to affected parties.

.4 Provide adequate bridging over trenches which cross sidewalks or roads to permit normal traffic.

.5 Where unknown services are encountered, immediately advise Consultant and confirm findings in writing.

.6 Remove abandoned service lines to distance of 1821mm from foundations. Cap or otherwise seal lines at cut-off points as directed by Consultant.

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

8 PROTECTION OF WORK IN PROGRESS

.1 Adequately protect Work completed or in progress. Work damaged or defaced due to failure in providing such protection is to be removed and replaced, or repaired, as directed by the Consultant, at no increase in Contract Price.

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

.3 Protect finished surfaces with overlays of protective materials such as Kraft paper, cardboard, or plywood, as required for individual applications to provide adequate protection.

END OF SECTION

1 GENERAL

.1 Conduct cleaning and disposal operations to comply with local ordinances and environmental protection legislation.

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

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

2 CLEANING DURING CONSTRUCTION

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

.2 Remove waste material and debris from the work areas and deposit in waste container at the end of each working day.

.3 Vacuum clean interior areas prior to start of finishing work. Maintain areas free of dust and other contaminants during finishing operations.

.4 Individual Subcontractors are responsible for the daily clean-up and removal of debris related to, or generated by, their own work. The overall responsibility for project cleanliness rests with the Contractor.

3 WASTE MANAGEMENT

.1 Audit, separate and dispose of construction waste generated by new construction or by demolition of existing structures in whole or in part, in accordance with Ontario Regulations 102/94 and 103/94 made under the Environmental Protection Act.

.2 Fires, and burning of rubbish or waste on site is prohibited.

.3 Burying of rubbish or waste materials, except as specified herein, is prohibited.

.4 Disposal of waste or volatile materials such as mineral spirits, oil, gasoline or paint thinner into ground, waterways, or sewer systems is prohibited.

.5 Empty waste containers on a regular basis to prevent contamination of site and adjacent properties by wind-blown dust or debris.

4 FINAL CLEANING OPERATIONS

.1 Immediately following Date of Substantial Performance, and prior to Owner occupancy of the building or portion of the building affected by the Work, conduct full and complete final cleaning operations.

.2 Final cleaning operations shall be performed by an experienced professional cleaning company, possessing equipment and personnel sufficient to perform full building cleaning operations.

.3 Remove all surplus products, tools, construction machinery and equipment not required for the performance of remaining work, and thereafter remove any remaining materials, equipment, waste and debris.

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

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

.6 Cleaning operations shall include the removal of all stains, spots, scuff marks, dirt, dust, remaining labels, adhesives or other surface imperfections.

.7 Remove all paint spots or overspray from all affected surfaces.

.8 Clean and polish all glass and mirrors. Replace broken, scratched or disfigured glazing. Remove remaining manufacturer's and safety "X" labels.

.9 Clean and polish all finished metal surfaces such as enamelled or stainless steel, chrome, aluminum, brass, and bronze.

.10 Clean and polish all vitreous surfaces such as plumbing fixtures, ceramic tile, porcelain enamel, or other such materials.

.11 Clean all ceramic tile surfaces in accordance with the manufacturer's instructions, and apply final coat of sealer where specified.

.12 Clean inside of all millwork and cabinetry.

.13 Vacuum, clean and dust behind grilles, louvres and screens.

.14 Sealing and waxing of resilient floor surfaces shall be done by Contractor in accordance with manufacturer's written instructions. Coordinate final cleaning and scheduling of sealing and waxing.

.15 Broom clean and spray wash all exterior paved surfaces.

.16 Remove dirt and other disfiguration from exterior surfaces.

.17 Clean all roofs, gutters, downspouts, areaways, drywells, and drainage systems.

.18 Clean all equipment and fixtures to a sanitary condition, clean or replace filters of mechanical equipment.

END OF SECTION

1 INSPECTION AND DECLARATION PROCEDURES

.1 Arrange for, conduct and document final inspections, close-out and commissioning at the completion of the Work in accordance with the procedures described in the General Conditions of the Contract, and OAA/OGCA Document 100.

2 SUBSTANTIAL PERFORMANCE

.1 Contractor's Inspection

.1 Refer to OAA/OGCA Document 100 – STAGE 2.

.2 The Contractor and all Subcontractors shall conduct an inspection of the work, identify deficiencies and defects, and make corrections as required to conform with the Contract Documents. Notify Consultant in writing of satisfactory completion of Contractor's Inspection and that corrections have been made. Request a Consultant's Inspection.

.2 Contractor's Application for Substantial Performance of the Work

.1 Refer to OAA/OGCA Document 100 – STAGE 3.

.2 When the Contractor has carried out the steps in Stage 2 of OAA/OGCA Document 100, and has determined that the requirements of the Contract have been substantially performed as defined by local Lien legislation, the Contractor shall make application for Substantial Performance of the Work.

.3 In addition to the requirements of OAA/OGCA Document 100, the following items shall accompany the Contractor's application for Substantial Performance. These items must be complete in all respects, and all verification certificates and reports having been submitted and approved by the Consultants:

.1 Completed (and accepted) Maintenance Manuals for all disciplines (No. of copies as specified),
.2 As-Built Drawings for all disciplines (No. of copies as specified),
.3 Mechanical, Sprinkler, and Electrical as-built CAD drawings,
.4 Occupancy Permit (where required by Municipality),
.5 Air Balance Report (legible technicians worksheets are acceptable),
.6 Gas fired appliances inspection,
.7 Plumbing Inspection,
.8 Domestic Water Quality Test Report,
.9 Sprinkler dry test verification letter stamped and signed by sprinkler design Engineer,
.10 Mechanical start-up reports (Boilers, HVAC Units, Chillers, Water Softeners, etc.),
.11 Fire Alarm verification (include legible technicians worksheets),
.12 Emergency Lighting verification,
.13 Electrical distribution system inspection,
.14 ESA Hydro Certificate, and
.15 Systems operations have been demonstrated to Owner's personnel.

.3 Consultant's Inspection

.1 The Consultants shall perform an inspection of the Work to assess the validity of the Contractors application, and shall identify in separate lists, unfinished work and deficiencies. Contractor shall correct work accordingly.

.4 Certificate of Substantial Performance

.1 Refer to OAA/OGCA Document 100 – STAGE 4.

.2 Should the Consultant concur with the Contractor's application for Substantial Performance, the Consultant shall notify the Contractor of approval of the application for Substantial Performance and issue a Certificate of Substantial Performance.

.3 The Contractor shall publish a copy of the Certificate of Substantial Performance in a construction trade newspaper, and shall provide the Consultant with proof of the date of publication.

3 LIEN PERIOD AND RELEASE OF BASIC HOLDBACK

.1 Refer to OAA/OGCA Document 100 – STAGE 5.

.2 Commencement of Lien Periods

.1 The day following the date of publication of Certificate of Substantial Performance shall be the date of commencement of the 45 day Lien Period prior to release of basic holdback, unless required otherwise by lien statute of the Place of the Work.

.2 When the Contractor has carried out the required steps in Stages 3 and 4 of OAA/OGCA Document 100, the Contractor shall make application for Release of Basic Holdback.

.3 The Consultant shall prepare the Certificate for Payment for release of basic holdback, and promptly upon receipt of the necessary documentation, issue the Certificate for Payment to the Owner.

4 FINAL INSPECTION AND PAYMENT

.1 Refer to OAA/OGCA Document 100 – STAGE 6.

.2 Submit a signed statement stating following have been performed:

.1 Work has been reviewed for compliance with Contract Documents,
.2 All defeciencies have been corrected,
.3 All unfinished work has been completed, and
.4 Work is complete and ready for Final Inspection.

.3 When items noted above are completed, a final inspection of the Work will be performed by the Owner, the Consultants, and the Contractor.

.4 If the Work is deemed to be incomplete, complete outstanding items and request a reinspection.

.5 If the Work is deemed to be complete, the Consultant will issue a Final Certificate for Payment.

5 DEFICIENCY REVIEW

.1 Following the issuance of the Certificate of Substantial Performance and prior to the Contractor's application for Final Payment and release of any monies retained as "Finishing Holdback", the Contractor shall continue to complete unfinished work and correct deficiencies. At the request of the Contractor, the Consultants shall conduct up to two general deficiency reviews during this period.

.2 The first review will be undertaken only if the Contractor has inspected the Work, and states in writing that the unfinished work noted in their application for Substantial Performance has been completed, and at least 50% of all deficiencies have been corrected.

.3 The second review will be undertaken only if the Contractor has inspected the Work, and states in writing that 90% of the deficiencies have been corrected.

.4 Should further review by Consultants be required due to failure of the Work to comply with Contract Documents or the criteria set out herein, the Owner will deduct amount of Consultant's compensation for reinspection services from monies owed to the Contractor.

END OF SECTION

1 REFERENCES
.1 OAA/OGCA Document 100; OAA/OGCA Take-Over Procedures.

2 OPERATION AND MAINTENANCE MANUALS
.1 General
.1 Prepare Operation and Maintenance Manual during the course of construction and have completed prior to Date of Substantial Performance.

.2 Submission
.1 Maintain one copy of the Operation and Maintenance Manual volume(s) for periodic review and comment, as requested by the Consultant during the course of construction.

.2 Submit two (2) final hard copies (one copy for school with all school related documents and one copy for Community Centre with al Community Centre related documents) and two (2) USB device with PDF version of all documents of the final completed volume(s) with the application for Substantial Performance in accordance with OAA/OGCA Document 100.

.3 Format
.1 Bind data in commercial quality, 219 x 279mm, "D" ring binders, having clear cover and spline pockets.

.2 Identify each binder on the cover and spline with the following:
OPERATION & MAINTENANCE MANUALS
J.J. O'Neil Catholic Elementary School
VOLUME ___ OF ___

.3 Provide table of contents and index tab sheets for each volume. Itemize and tabulate contents.

.4 Provide drawings with reinforced punched binder tab, or insert into clear sleeves in folded format. Group drawings as to content, and index for quick reference.

.4 Contents - Each Volume
.1 Table of Contents: provide title of Project, Date of submission and names:
.1 Addresses, and telephone numbers of Consultant and Contractor with name of responsible parties;
.2 Schedule of products and systems, indexed to content of volume.

.2 For each product or system: List names, addresses and telephone numbers of sub-contractors and suppliers, including local source of supplies and replacement parts.

.3 Product Data: mark each sheet to identify specific products and component parts, and data applicable to installation; delete inapplicable information.

.4 Operation and Maintenance Manuals shall contain, as a minimum, the following information:

.1 List of Contents; cross-referenced to each Volume.
.2 Contact information for maintenance and repairs
.3 Warranty and guarantee certificates
.4 Equipment start-up and troubleshooting instructions
.5 Equipment schematics & diagrams
.6 Catalogue of all maintenance materials and quantities
.7 Complete list of Contractor, Subcontractors and suppliers, indicating name, address, telephone & fax numbers, email addresses, name of contact person and description of work done.
.8 Complete list of products used in the work, indicating product name and manufacturer for each listing.
.9 Copy of Finish Hardware List, complete with all amendments and revisions, if applicable.
.10 Schedule of paints and coatings. Include sufficient explanation to fully identify each surface with the applicable paint or coating used. Enclose copy of Colour Schedule.
.11 All "reviewed" shop drawings.
.12 Maintenance instructions for all finished surfaces.
.13 Brochures and cuts of all equipment and fixtures.
.14 Operating and maintenance instructions for all equipment.
.15 All Warranties and Guarantees required by the Specifications for this Work.

.5 Refer to Division 21, 22 and 23 for more specific mechanical data required beyond the description of this paragraph.

.6 Refer to Division 26 for more specific electrical data required beyond the description of this paragraph.

.7 Drawings: supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams.

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

3 AS-BUILT DRAWINGS

.1 Record information on a clean set of black line opaque drawings. Consultant will provide two (2) complete sets of printed project drawings, (one complete CADD set on USB flash drive) and two (2) complete sets of specifications for the purpose of recording as-built conditons.

.2 Maintain as-built drawings on site and update as construction progresses. Allow periodic review by Consultant as requested.

.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 Measured depths of elements of foundation in relation to finish first floor datum.
- .2 Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
- .3 Measured locations of internal utilities and appurtenances, referenced to visible and accessible features of construction.
- .4 Field changes of dimension and detail.
- .5 Changes made by change orders.
- .6 Details not on original Contract Drawings.
- .7 References to related shop drawings and modifications.

4 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 Panel board circuit directories: provide electrical service characteristics, controls, and communications.

.3 Include installed colour coded wiring diagrams.

.4 Operating Procedures: include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.

.5 Maintenance Requirements: include routine procedures and guide for trouble-shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.

.6 Provide servicing and lubrication schedule, and list of lubricants required.

.7 Include manufacturer's printed operation and maintenance instructions.

.8 Include sequence of operation by controls manufacturer.

.9 Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.

.10 Provide installed control diagrams by controls manufacturer.

.11 Provide Contractor's coordination drawings, with installed colour coded piping diagrams.

.12 Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.

.13 Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.

.14 Include all test and balancing reports

.15 Additional requirements: As specified in individual specification sections.

5 MATERIALS AND FINISHES

.1 Building Products, Applied Materials, and Finishes: include product data, with catalogue 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 recommended schedule for cleaning and maintenance.

.4 Additional Requirements: as specified in individual specifications sections.

6 MAINTENANCE MATERIALS, SPARE PARTS & TOOLS

.1 Provide spare parts in quantities specified in individual specification sections. Provide identical items to those installed in the Work.

.2 Provide maintenance materials in quantities specified in individual specification sections. Provide identical items of same manufacturer, dye lot or production run as items in the Work.

.3 Provide special tools in quantities specified in individual specification sections, and tag items identifying their function and equipment or products to which they are associated.

.4 Receive and catalogue all items. Check inventory and include approved listings in Operations and Maintenance Manual.

.5 Obtain receipts for delivered products and submit prior to Substantial Performance.

.6 Quality

.1 Spare parts, maintenance materials and special tools provided shall be new, not damaged or defective, and of the same quality and manufacture as products provided in the Work.

.2 If requested, furnish evidence as to type, source and quality of Products provided.

.3 Defective products will be rejected, regardless of previous inspections. Replace products at own expense.

.7 Delivery, Storage, And Handling

.1 Deliver all materials required as maintenance materials, spare parts or special tools, to the site, include shipping costs, and store as directed.

.2 Store spare parts, maintenance materials and special tools in a manner to prevent damage, or deterioration.

.3 Store in original and undamaged containers with manufacturer's seals or labels intact.

.4 Store materials subject to damage from severe climatic changes in a climate-controlled, weatherproof enclosure.

.5 Store paints and freezable materials in a moderately heated and ventilated room.

7 WARRANTIES AND BONDS

.1 Separate each warranty or bond with index tab sheets keyed to Table of Contents listing.

.2 List subcontractor, supplier, and manufacturer, with name, address, and telephone number of responsible principal.

.3 Obtain warranties and bonds, executed in duplicate by subcontractors, suppliers, and manufacturers, within ten days after completion of the applicable item of work.

.4 Start date for all warranties are to be the Date of Sustantial Performance, regardless if put into use.

.5 Verify that documents are in proper form, contain full information, and are notarized. Co-execute submittals when required.

.6 Retain warranties and bonds until time specified for submittal.

END OF SECTION

1 General

1.1 **SECTION INCLUDES**

.1 Labour, Products, equipment and services necessary for demolition and removals Work in accordance with the Contract Documents.

.2 Work included: Requirements for demolishing, salvaging and removing wholly or in part the various items designated on the drawings or required to be removed or partially removed for the receipt of the Work of this Contract, including not necessarily limited to:

.1 Alteration and renovations to existing building.
.2 Cutting and removing of walls, floors, ceilings, doors and frames, in the existing buildings as indicated on Drawings.
.3 Patching, making good openings and chases in walls, floors, ceilings, including the supply and installation of lintels, channels and finishes.
.4 Removal of rubbish, debris, demolished fixtures, fitments and items not scheduled to remain the Owner's property, resulting from the demolition and preparatory work.
.5 Remove abandoned services such as conduits, pipes, wiring, ducts, fixtures, equipment, etc. where required for the work or indicated on the drawings.
.6 Removal of asphalt pavements, concrete curbs and walks, and other site amenities as indicated on drawings.
.7 Removal of all mechanical items including plumbing fixtures, services etc. where required for the work or indicated on drawings and or where not required to be relocated.
.8 Removal of existing electrical items including fixtures, etc. where required for the work or indicated on the drawings and not required to be relocated.
.9 Dust control during the operations of the work of this Section.
.10 Removal shall mean removal from site and safe disposal in a legal manner.

1.2 **REFERENCES**

.1 CSA S350-M, Code of Practice for Safety in Demolition of Structures.

.2 OPSS, Ontario Provincial Standard Specification.

1.3 **SUBMITTALS**

.1 Where required by Authorities having jurisdiction, submit a Fire Plan to local fire department for review and approval.

.2 Submit shop drawings, diagrams and details in accordance with the Conditions of the Contract.

.3 30 calendar days prior to start of demolition and removals work, submit for review, drawings, diagrams or details showing sequence of disassembly work and shoring of supporting structures in accordance with authorities having jurisdiction.

.4 Submit for approval, a plan showing impacts, interruptions and delays to Owners operations.

.5 Have submissions signed and sealed by Professional Engineer licensed in Province of Ontario.

.6 Submit to Consultant, details of where rubble, debris and other materials are to be disposed or reused. Include each disposal/reuse site location, operator's name and business address, type of license under which site operates, and criteria used by site to assess suitability of rubble, debris and other materials for disposal.

.7 Give notice to Utility Authorities controlling services and appurtenances which will be affected by demolition work.

1.4 **QUALITY ASSURANCE**

.1 Prepare waste audits, waste reduction workplans, source separation programs and recycling programs as required by jurisdictional authorities and update programs and implement such programs as required.

.2 Perform the work of this section in accordance with the 'Environmental Protection Act' including Ontario Regulation 102 and the 'Environmental Assessment Act' including Ontario Regulation 103.

.3 Conform to Fire Code, Regulation under the Fire Marshals Act.

.4 The demolition contractor must engage a registered professional engineer who holds a certificate of authorization and an appropriate level of liability insurance to prepare demolition procedures.

.5 As part of the contract requirements, the engineer for the demolition contractor should be required to sign the general review commitment required by city building departments.

1.5 **SITE CONDITIONS**

.1 Interruptions to Owners operations will not be permitted.

.2 Perform operations, machine and equipment movements, deliveries and removals at time or times that will permit uninterrupted operations in and around structures, including parking, deliveries, and Site access and egress.

2 Products

2.1 **MATERIALS**

.1 All materials requiring removal shall become the Contractor's property and shall be removed and disposed of from the site, as the work progresses, unless indicated otherwise.

.2 Salvaged material:
- .1 Salvage and stockpile Products, materials, and equipment as specified herein, indicated on Site or indicated on drawings.
- .2 Coordinate items to be salvaged with Consultant.
- .3 Salvaged materials shall not be chipped, cracked, split, stained or damaged.
- .4 Store items off of moist surfaces.

3 Execution

3.1 **GENERAL**

.1 Clean up rubble and debris, resulting from work promptly and dispose at end of day or place in waste disposal bins. Empty bins on regular basis.

.2 Stockpiling of rubble, debris, and surplus Products on Site will not be permitted.

.3 Remove, handle and transport Products indicated to be salvaged and stored for future use. Transport Products to storage area(s) designated by Consultant. Perform work to prevent any damage to Products during removal and in storage. Products damaged during removal, will be inspected by Consultant. Consultant will determine extent of damage and accept or refuse Products.

.4 List and description of items to be removed and stored or reused:
- .1 Rain water leader.
- .2 Additional items as indicated on the drawings or by the Consultant.

.5 Take precautions to guard against movement, settlement or collapse of adjacent services, sidewalks, driveways, or trees. Be liable for such movement, settlement or collapse caused by failure to take necessary precautions. Repair promptly such damage when ordered.

3.2 **EXAMINATION**

.1 Verify condition and dimensions of previously installed Work upon which this Section depends. Report defects to Consultant. Commencement of work of this Section means acceptance of existing conditions.

.2 Examine adjacent structures and other installations prior to commencement of demolition and removals work in accordance with Section 31 00 00.

3.3 **PRESERVATION OF REFERENCES**

.1 Record location and designation of survey markers and monuments located within demolition area, prior to removal. Store and restore markers and monuments upon completion of Work or relocate as directed by Consultant.

3.4 PROTECTION

.1 Provide, erect and maintain required hoarding, sidewalk sheds, catch platforms, lights and other protection around Site before commencing work. Maintain such areas free of snow, ice, mud, water and debris. Lighting levels shall be equal to that prior to erection.

.2 Provide flagmen where necessary or appropriate to provide effective and safe access to Site to vehicular traffic and protection to pedestrian traffic.

.3 Prevent movement or damage of adjacent structures, services, walks, paving, trees, landscaping, and adjacent grades. Supply and install bracing, and shoring as required. Make good damage caused by demolition to acceptance of Consultant.

.4 Protect adjacent structures and property against damage which might occur from falling debris or other causes. Repair or replace damage caused from work of this Section to acceptance of Consultant.

.5 Do not interfere with use of adjacent structures and Work areas. Maintain free, safe passage to and from adjacent structures and Work areas.

.6 Take precautions to support affected structures. If safety of structure being demolished, adjacent structures or services are endangered, cease demolition operations and take necessary action to support endangered item. Immediately inform Consultant. Do not resume demolition until reasons for endangering have been determined and corrected and action taken to prevent further endangering.

.7 If movement or settlement occurs, install additional bracing and shoring as necessary and make good damage to acceptance of Consultant.

.8 Hang tarpaulins where debris and other materials are lowered. Build in around openings with wood and plywood at locations used for removal of debris and materials.

.9 Prevent debris from blocking surface drainage system, elevators, mechanical, and electrical systems which are required to remain in operation.

.10 Pay particular attention to prevention of fire and elimination of fire hazards which would endanger Work or adjacent structures and premises.

.11 Close off access to areas where demolition is proceeding by barricades and post warning signs.

.12 Supply, install and maintain legal and necessary barricades, guards, railings, lights, warning signs, security personnel and other safety measures, and fully protect persons and property.

.13 Blasting is not permitted.

3.5 PREPARATION

.1 Disconnect and/or re-route electrical data, communication and telephone service lines entering structures to be demolished. Remove abandoned lines as indicated on Contract Drawings. Post warning signs on electrical lines and equipment which is required to remain energized.

.2 Arrange to disconnect and cap designated mechanical services:
- .1 Natural gas supply lines: As indicated on drawings, to be removed by gas company.
- .2 Sewer and water lines: Remove and dispose of as indicated on Contract Drawings.
- .3 Other underground services: Remove and dispose of as indicated on Contract Drawings.

.3 Disassemble and remove mechanical equipment, ductwork and piping complete with supports and associated components.

.4 Do not disrupt active or energized utilities designated to remain undisturbed.

.5 Perform rodent and vermin control to comply with health regulations.

3.6 CONCRETE CUTTING AND CORING

.1 Prior to cutting or coring any concrete slab, suspended or on grade, or any concrete beam, investigate by telemetrically scanning the element for presence of embedded services (piping, cabling, conduit, etc.), and for locations of reinforcing steel in suspended concrete slabs and beams.

.2 Acceptable telemetric scanning systems include:
- .1 X-Ray scanning of suspended slabs and for concrete beams.
- .2 (Ground-penetrating) radar for slab on grade, for suspended slabs and for concrete beams.

.3 Magnetic radio scanners not acceptable for telemetric scanning.

.4 The term x-rays include gamma ray methods, and procedures that use electrically generated x-rays.

.5 Where x-rays employed:
- .1 Provide Owner minimum 5 working days advance notice of scanning time in order to provide sufficient advance notice to personal that may be affected by the x-ray work.
- .2 Conform to Owner's radiation protection requirements prior to start of any x-ray work.

.6 Provide Owner and Consultant with inspection agency's written report, summarizing investigations and conclusions.

.7 Obtain Consultant's direction where investigations reveal that cutting or coring required in Contract would cut or damage embedded services, or cut or damage reinforcing steel in suspended concrete slabs or beams.

.8 Execute cutting and coring to prevent damage to all embedded services. Make good all damage arising from cutting embedded services.

.9 Execute cutting and coring to prevent damage (cutting in whole or in part) reinforcing steel in suspended concrete slabs with Consultant's prior authorization.

.10 Make good all damage arising from cutting reinforcing steel in suspended concrete slabs and beams.

3.7 **DEMOLITION**

.1 Perform demolition with extreme care. Confine effects of demolition to those parts which are to be demolished.

.2 Perform work and prevent inconvenience to persons outside those parts which are to be demolished.

.3 Carry out demolition in accordance with the requirements of CSA S350-M.

.4 Demolish parts of structure to permit construction of addition and remedial work as indicated.

.5 Demolition shall proceed safely in systematic manner from roof to grade and as necessary to accommodate remedial work indicated. Work on each floor level shall be complete before commencing work on supporting structure and safety of its supports are impaired. Parts of building which would otherwise collapse prematurely shall be securely shored. Walls and piers shall not be undermined.

.6 For buildings with basements, demolish buildings including foundations, footing and basement slab.

.7 For buildings without basement, remove concrete slabs or wood floor construction at grade level.

.8 Demolish foundation walls below finished grade.

.9 Fill all equipment pits and depressions with gravel or sand.

.10 Backfill to grade all basements and excavations with recycled granular fill material.

.11 Oversized bricks, concrete chunks and rock can be separated for crushing by mechanical means instead of disposal. Crushed materials can be intermixed with granular material for use as backfill.

.12 Do not overload floor or wall with accumulations of material or debris or by other loads.

.13 Perform work to minimize dusting. Keep work area wetted down with fog sprays to prevent dust and dirt rising. Supply and install temporary water lines and connections that may be required. Upon completion, remove installed temporary water lines. Use covered chutes, water down.

.14 Do not sell or burn materials on Site.

.15 Remove existing equipment, services, and obstacles where required for refinishing or making good of existing surfaces, and replace as Work progresses.

.16 At end of day's work, leave Work in safe condition with no part in danger of toppling or falling.

.17 Drainage and sewer system protection:
- .1 Ensure that no dust, debris or slurry enters drainage and sewer system on Site.
- .2 Remove and dispose of debris and slurry promptly from Site.
- .3 Comply with Town of Napanee Sewer Use By-Law.

.18 Asphalt pavement:
- .1 Break out and remove existing asphalt pavement, curbs and sidewalks within confines of Work as shown on Contract Drawings.
- .2 Square up adjacent surfaces to remain in place by saw cutting or other methods acceptable to Consultant to avoid damage to remaining pavement.
- .3 Protect adjacent joints and load transfer devices.
- .4 Protect underlying granular materials.

.19 Concrete:
- .1 Demolish concrete by methods which avoid impact loads on items which are not to be demolished.
- .2 Where only part or parts of a concrete floor, wall, roof, foundation or other items are to be demolished, use saw cuts to isolate areas which are to be demolished except where existing reinforcing steel is to be left in place. Prior to such isolating, install suitable support to prevent premature movement of area(s) being isolated and undesirable transfer of loads as cutting progresses. If necessary remove area(s) to be demolished by successively isolating small sections.
- .3 Where reinforcing steel is to be left in place, use saw cuts from surface of concrete around perimeter(s) of area(s) to be demolished, chip concrete without damaging reinforcing steel. Retouch damaged epoxy coating of existing reinforcing steel.

.20 Masonry:
- .1 Demolish block or brick walls in small sections of not more than 2 m^2. Do not permit masonry to fall in mass from one level to another.
- .2 Where only part(s) of a wall is to be demolished, install adequate support for adjacent part(s).
- .3 After removal of masonry walls, grind smooth floors ready for new floor finish.

.21 Steel: Where only part or parts of structure is to be demolished, dismantle and maintain structure stable. Do not place excessive loads on components. Install adequate temporary guys and supports to ensure stability and to prevent excessive loading. Support each component being disconnected from structure, and lower, do not drop, component after it is disconnected.

.22 Cut openings through existing walls, partitions, roofs and floors. Establish exact location of steel reinforcing in existing concrete slabs or walls before cutting. Be responsible for damage to existing steel reinforcing and be liable for structural failure. Make good surfaces disturbed with materials to match existing.

23. Where doors are scheduled to be removed, include removal of door frames and door hardware.

24. Remove interior partitions, fittings, fixtures and accessories as indicated on drawings. Partitions and walls shall be removed full height to structure above.

25. Demolish all other items indicated or required.

3.8 RECYCLING

.1 Whenever possible, all materials shall be recycled. Pay all costs for this work.

.2 Deliver to nearest appropriate recycling depot all materials accepted for recycling by Authorities having jurisdiction over the Place of Work, including but not limited to cardboard, paper, plastic, aluminum, steel, and glass.

.3 Deliver to nearest appropriate depot all scrap and excess gypsum wallboard for recycling of this material.

.4 Ceiling tiles to be stacked on skids and wrapped for recycling and delivered to nearest appropriate recycling depot.

.5 Carpet tile to be recycled by Viking Recycling or by Interface (only when a new order is placed).

.6 Base building light fixture lamps to be placed on skids and wrapped for recycling and delivered to nearest appropriate recycling depot.

3.9 DISPOSAL OF MATERIALS

.1 Remove from Site, rubble, debris, and other materials that can not be recycled resulting from demolition and removals work in accordance with Section 31 00 00 and Authorities having Jurisdiction, except where specified or indicated on Contract Drawings to be reused.

.2 Conform to requirements of municipality's Works Department regarding disposal of waste materials.

.3 Materials prohibited from municipality waste management facilities shall be removed from Site and dispose of at recycling companies specializing in recyclable materials.

3.10 RESTORATION

.1 Where demolition removed a structure or installation, rough grade and restore area in accordance with Section 31 00 00.

END OF SECTION

1 General

1.1 **SECTION INCLUDES**

.1 Labour, Products, equipment and services necessary for masonry Work in accordance with the Contract Documents.

1.2 **REFERENCES**

.1 ASTM A82/A82-M, Specification for Steel Wire, Plain, for Concrete Reinforcement.

.2 ASTM C207, Specification for Hydrated Lime for Masonry Purposes.

.3 CAN/CSA A23.1/A23.2, Concrete Materials and Methods of Concrete Construction, Methods of Test and Standard Practices for Concrete.

.4 CAN/CSA A82, Fired Masonry Brick made from Clay or Shale.

.5 CSA A123.3, Asphalt Saturated Organic Roofing Felt.

.6 CSA A165 Series, CSA Standards on Concrete Masonry Units.

.7 CSA A179, Mortar and Grout for Unit Masonry.

.8 CSA A370, Connectors for Masonry.

.9 CSA A371, Masonry Construction for Buildings.

.10 CAN/CSA A3000, Cementitious Materials Compendium.

.11 CSA G30.18, Carbon Steel Bars for Concrete Reinforcement.

.12 CSA S304.1, Design of Masonry Structures.

1.3 **SUBMITTALS**

.1 Shop Drawings:
- .1 Submit shop drawings in accordance with the Conditions of the Contract indicating wall sections, details, reinforcing and anchors, special detailing, patterning and locations of control joints.

.2 Samples:
- .1 Submit samples in accordance with the Conditions of the Contract for the following:
- .2 Submit samples of each type and colour of masonry unit used prior to ordering material.
- .3 Submit samples of coloured mortar to match masonry samples.
- .4 Submit samples of each type and size of masonry anchors, ties and horizontal reinforcing.
- .5 Submit 250mm x 200mm samples of dampproof course and through-wall flashing membranes.

.3 Source Quality Control:

.1 In accordance with the Conditions of the Contract, manufacturers of concrete masonry units must submit independent laboratory test reports performed within twelve (12) months immediately prior to date of delivery of materials, certifying compliance of masonry units and mortar components with specification requirements.

1.4 QUALITY ASSURANCE

.1 Perform work of this section in strict accordance with these specifications, standards referenced herein and with all warranty requirements.

.2 Work of the section shall be performed by mechanics having a minimum of two (2) years documented experience in laying concrete and clay masonry units. Submit proof of experience if requested by Consultant.

.3 Pre-installation Meeting:

.1 Convene a pre-installation meeting for the work specified in this section, to be attended by the General Contractor (Site Superintendent & Project Manager), Masonry Contractor (Foreman & Project Manager) and Consultant, to review on site conditions and review installation procedures and materials.

.4 Mock-up:

.1 Construct one mock-up panel of unit masonry construction, 2400mm wide x 1600mm high in a location accepted by Consultant.

.2 Demonstrate use of reinforcement, ties, through-wall flashing, weep holes, jointing, coursing, mortar, bonding, control joints and workmanship.

.3 Mock-up may form part of Work if accepted by Consultant. Mock-ups which do not form part of Work are to be removed from Site during final cleanup or when directed by Consultant.

.4 Rejected mock-ups: Correct rejected mock-ups and request re-review by Consultant.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle Products in accordance with the Conditions of the Contract and as specified herein.

.2 Deliver all masonry units cubed and banded on hardwood pallets, with polyethylene 'shrink-wrap' or other non-staining covering.

.3 Deliver mortar materials in original unbroken and undamaged packages with the manufacturer's name and brand distinctly marked thereon and upon delivery, cover and protect from moisture.

.4 Remove unacceptable materials from Site and replace to acceptance of Consultant. Store materials off ground protected from wetting by rain, snow or ground water, or inter-mixture with earth or other materials. Store metal ties and reinforcement to prevent corrosion.

.5 Comply with CSA A371. Do not use salt or calcium-chloride to remove ice from masonry surfaces.

.6 Do not concentrate storage of materials on any part of structure beyond design load, take particular care not to overload unsupported portions of structure which may have not attained their full design strength.

1.6 **SITE CONDITIONS**

.1 Do not lay masonry when ambient temperature is at or below 5°C unless temporary protection and heating is provided. Supply and install temporary protection and heating for installed, uncured unit masonry when ambient conditions are at, below or are likely to go below 5°C, until seven (7) days after installation.

.2 Conform to cold and hot weather masonry requirements of CSA A371 and Recommended Practices of the Ontario Masonry Contractors' Association for cold and hot weather masonry work.

2 Products

2.1 **MATERIALS**

.1 Use same suppliers of masonry units, accessory materials and source of aggregate for entire project.

.2 Portland cement: Type 10 to CSA A5.

.3 Blended cement: to CSA A362.

.4 Aggregates: to CSA A23.1.

.5 Hydrated Lime: to ASTM C207, Type S.

.6 Supplementary Cementing Materials: to CSA A23.5.

2.2 **MASONRY UNITS**

.1 The physical properties of the concrete masonry units at the time of delivery by the manufacturer to the site, shall conform to the requirements of Table 1 of CSA A165.1, as classified herein. Test reports submitted to the Consultant by the manufacturer prior to delivery shall verify conformance, in order for material to be acceptable.

.2 Acceptable Manufacturers:
- .1 Atlas Block
- .2 Boehmers
- .3 Brampton Brick
- .4 Canada Building Materials (CBM)
- .5 Day & Campbell
- .6 Simcoe Block
- .7 Permacon

.8 Richvale York
.9 TCG Materials.

.3 Lightweight Concrete Masonry Units: to CSA A165.1. Use for all fire rated applications and block exposed to view.
.1 Classifications: H/15/D/M, S/15/D/M or Sc/15/D/M as required.
.2 Size: OCBA metric modular, sizes as indicated on drawings.

.4 Standard Weight Concrete Masonry Units: to CSA A165.1. Use for all non-fire rated applications and where concealed.
.1 Classifications: H/15/A/M, S/15/A/M or Sc/15/A/M as required.
.2 Size: OCBA metric modular, sizes as indicated on drawings.

.5 Brick: CAN/CSA A82, type to match existing, for use in renovation areas where quantities of existing brick is insufficient for reuse.
.1 Brick type 1: Brampton Brick, Contemporary Series, Nueva, Size: metric modular. Colour: to be "Charcoal Matt".
.2 Brick type 2: Brampton Brick, Contemporary Series, Nueva, Size: metric modular. Colour: to be "Royal Grey".

.6 Provide special shapes such as return corners, lintels, universal knock-outs, A-blocks, peirs, bull-nosed blocks, etc., to perform masonry work with minimal cutting or breaking of masonry units.

.7 Provide solid masonry units where required for mechanically fastening blocking, furring, mechanically applied finishes or where noted.

.8 Supply masonry units with exposed surfaces free of cracks, chips, blemishes and broken corners.

2.3 ACCESSORIES

.1 Reinforcement: CSA A370, CSA A371 and ASTM A82, all components to be hot dipped galvanized unless otherwise specified, horizontal reinforcement shall be sized to suit width of masonry in accordance with CSA A371. Undersized or oversized reinforcing is not acceptable:
.1 This specification is based on products manufactured by Blok-Lok Ltd. Products by Dur-O-Wal Ltd. and Fero Corporation are approved alternatives.
.2 Type 1 (single wythe): Truss type; 'Blok-Trus BL30'. Wire size shall be Extra Heavy, 4.76 mm diameter side rods x 9 ga cross rods.
.3 Connectors: CSA A370 and CSA S304.1.
.4 Reinforcing steel: CSA G30.18, Grade 400, refer to Contract Drawings for number, size and location.
.5 Reinforcing corner units: Provide pre-manufactured 'L' and 'T' corner units, **crimped metal strap ties are not acceptable**.

.2 Loose steel lintels and lateral support angles: Supplied as part of work of Structural Sections.

.3 Through-wall flashings and air/vapour barrier:
- .1 Membrane: 1.0mm thick, single-ply, self-adhering, self-sealing, rubberized asphalt, bonded to a cross-laminated high density polyethylene film.
  - .1 'Blueskin SA' by Henry Company Canada Inc.
  - .2 'Sopraseal Stick 1100 T' by Soprema.
  - .3 'Exo-air 110' by Tremco.
  - .4 'Air-Shield' by W.R. Meadows.
- .2 Primer: purpose made solvent based primer as recommended by membrane manufacturer.
- .3 Mastic: purpose made mastic to seal leading edges of membranes and perimeter of items that project through the membrane as recommended by membrane manufacturer.

.4 Prefinished metal flashing: continuous strips of 19mm folded drip edge, pre-painted sheet steel, ASTM A653/A653M; Classification LFQ, Grade A, Z275 zinc coating designation, 0.60mm (24ga) minimum base steel thickness, commercial quality, prefinished with Perspectra Series coating system by U.S. Steel Canada, or WeatherX by Vicwest Steel. Colour to be Vicwest Charcoal, confirm with Consultant prior to ordering material.

.5 Compressible filler: 75mm x 6mm thick preformed, polyurethane foam; 25V by Emseal Joint Systems Ltd.

.6 Control joint filler: 10mm thick, preformed, acrylic impregnated sealing foam; BackerSeal (GreyFlex) by Emseal Joint Systems Ltd. or approved alternative.

.7 Control joint bond breaker: CSA A123.3; 15lb, asphalt impregnated, non-perforated felt paper as manufactured by IKO Manufacturing Inc. or approved alternative.

2.4 MORTAR AND GROUT

.1 Loadbearing and all interior masonry: CSA A179, Type S, proportion method.

.2 Exterior non-loadbearing masonry: CSA A179, Premixed 1-1-6 Type N, portland cement/lime, proportion method.

.3 Cement: CAN/CSA A3000, normal Portland, Type GU. Provide white cement where required for white or light coloured mortars.

.4 Masonry aggregate: CSA A179. Provide white aggregate where required for white or light coloured mortars.

.5 Water: Clean potable, free from deleterious elements and free from salts that can cause efflorescence.

.6 Mortar Colour
- .1 Interior Concrete Block: Natural.
- .2 Exterior brick masonry: Coloured mortar pigment; 'Bay Ferrox' by Bayer Inc. or approved alternative by Elementis Pigments. Colour to match approved sample.

.7 Concrete fill and grout: 20MPa concrete in accordance with CAN/CSA A23.1/A23.2.

.8 All mortar products for masonry work shall be pre-mixed products and batch plant mixed on site for quality control.

3 Execution

3.1 **PROTECTION**

.1 Supply and install temporary waterproof, non-staining coverings, secured against displacement, to extend over wall and down sides to protect masonry Work from snow and wind driven rain and from drying too quickly, until masonry Work is completed and protected by flashings and other permanent construction.

.2 Supply and install non-staining, protective coverings on horizontal and vertical surfaces to protect Work of this Section from damage, staining, marking and mortar droppings.

3.2 **QUALITY OF WORK**

.1 Perform masonry work in accordance with CSA A371 and as indicated.

.2 Before commencing masonry work, verify required limitations for wall heights, wall thicknesses, openings, bond, anchorage, lateral support and compressive strengths of masonry units and mortars.

.3 Supply and install masonry Work plumb, level and true to line, with vertical joints in alignment and horizontal courses level, uniform and straight.

.4 Perform masonry mortar and grout work in accordance with CSA A179 except where specified otherwise.

.5 Provide temporary bracing of all masonry walls until permanent bracing is installed.

.6 Lay out coursing and bond to achieve correct coursing heights and continuity of bond above and below openings with minimum of cutting.

.7 Machine cut all masonry units where adjusted in size, to obtain straight, clean, even, unchipped edges. Cut units as required to fit adjoining work neatly or for flush mounted electrical outlets, grilles, pipes, conduit, leaving 3mm maximum clearance. Use full-sized units without cutting wherever possible.

.8 Tolerances in notes to Article 5.3 of CSA A371 apply.

.9 Do not use chipped, cracked, deformed or otherwise damaged units in any masonry work. Exercise caution to ensure exposed faces are free from stains, chips and cracks. Should deficiencies occur after installation, replace damaged units. Patching of damaged units is not acceptable.

.10 Coordinate work of this section with work of mechanical and electrical trades for conduit, piping and other items built into masonry work. Masonry Subcontractor must cooperate with mechanical and electrical trades, for placement of such items within masonry walls.

3.3 MORTAR MIXING

.1 Mix mortar with maximum amount of water consistent with workability for maximum tensile bond strength within capacity of mortar.

.2 Do not use mortar which has begun to set. Use mortar within two (2) hours after initial mixing. Re-temper mortar during two (2) hour period only as required to restore workability.

.3 Do not use admixtures without Consultant's written acceptance.

.4 Add mortar colour and admixtures to requirements of manufacturer's instructions.

.5 Provide uniformity of mix and colouration.

3.4 LAYING MASONRY UNITS

.1 Bond: Set concrete masonry units in Running bond. Tooth bond all intersections of walls and partitions unless otherwise indicated.

.2 Coursing height:
- .1 Concrete masonry units: 200mm for one block and one joint.
- .2 Exterior brick veneer: Coursing pattern to match existing.

.3 Construct all masonry walls full height to underside of structure or deck above, unless otherwise shown. Leave 25mm void between top of wall and structure above. Fill void with sprayed foam insulation in accordance with Section 07 21 19. Where walls are fire separations, firestop to Section 07 85 00.

.4 Set bearing plates for joists, beams, etc., at locations and elevations indicated and grout into place.

.5 Install a full bed of mortar for first and second courses of masonry, for masonry units 100mm thick and less and between solid units. For remaining courses, all face beds and end webs shall be fully mortared.

.6 Tool mortar joints slightly concave with non-staining tools where exposed to view unless indicated otherwise. Strike joints flush in non-exposed areas and all joints within wall cavities. Use sufficient force to press mortar tight against masonry units on both sides of joints. Remove excess, remaining mortar material and burrs.

.7 Remove all excess mortar from surface of masonry exposed to view.

.8 Scrape, wire-brush and clean all surfaces of masonry of all dirt, mortar drippings, oil and other deleterious materials that are to receive self-adhesive membrane barriers.

.9 Install special shaped and sized concrete block units as indicated and as required for a complete and coordinated assembly and to minimize cut units.

.10 Provide lightweight block for all fire-rated applications and all block exposed to view.

.11 Provide standard weight block for all non-fire rated applications and where concealed.

.12 Provide solid masonry units where required for mechanically fastening of blocking, furring or mechanically applied finishes.

.13 Do not form chases in loadbearing walls less than 240mm thick. Do not form chases closer than 2m apart in any wall, unless otherwise shown.

.14 Do not construct horizontal chases for piping or conduit unless other reasonable means of allowing for services are impossible. Where horizontal chases are required, construct chases using lintel blocks filled solid with concrete fill as specified.

.15 Build in conduits as required without breaking bond.

.16 Build wall openings, slots and recesses required for ducts, grilles, pipes and other items.

.17 Install steel bench brackets supplied under the Work of section 05 50 00.

.18 Coordinate installation of conduit, outlet boxes and other mechanical and electrical built-ins with Work of Mechanical and Electrical trades.

.19 Where necessary to temporarily stop horizontal runs of masonry and in building corners, step-back masonry diagonally to lowest course previously laid. Do not 'tooth-in' new masonry. Fill in adjacent courses before heights of stepped masonry reach 1200mm.

.20 Brace door jambs to maintain plumbness. Set anchors between metal frames and masonry and fill voids between hollow metal frames and masonry walls with mortar.

3.5 VERTICAL REINFORCING

.1 Refer to Structural drawings.

.2 Place vertical reinforcement in cells of concrete unit masonry as detailed on the drawings. Provide A-blocks where required to facilitate ease of placement.

.3 Place vertical reinforcement accurately and secure against displacement by using ties or clips. Tack welding of reinforcement to secure in place will not be permitted.

.4 Secure vertical reinforcement in wall using sufficient spacers on each face to maintain the requisite distance between reinforcement and wall face and so that vertical bars are plumb. Provide spreader bars spaced at 2m centres in both directions.

.5 Place concrete fill in masonry unit cells, in maximum 2 course lifts. Vibrate to remove all air pockets.

3.6 **HORIZONTAL REINFORCING**

.1 At all single and double wythe concrete masonry walls, install reinforcing at vertical intervals of 400mm maximum and lapped 152mm at each splice. Provide prefabricated 'L' and 'T' sections at corners and intersections of masonry walls.

.2 Provide reinforcement in the first, second and top bed joints at 200mm vertical spacing, every second joint thereafter.

.3 Provide additional reinforcement immediately above lintel and below sill courses, extending 600mm beyond jamb.

3.7 **LINTELS**

.1 Install reinforced concrete masonry lintels over all openings in masonry wider than 400mm where steel or reinforced concrete lintels are not indicated.

.2 Reinforced concrete masonry lintels may be formed on the ground and lifted into place.

.3 Install loose steel lintels, as indicated in Contract Drawings. Centre over opening width.

.4 End bearing shall be uniformly distributed and not less than 200mm.

.5 Provide two courses of solid block beneath all lintel bearing.

.6 Install reinforcing steel and concrete fill in block lintels. Maintain sufficient support for reinforced concrete masonry lintels until initial compressive strength of concrete fill is achieved (minimum 7 days).

3.8 **LATERAL SUPPORT AND ANCHORAGE**

.1 Provide lateral support and anchorage in accordance with CAN3 S304 and as indicated on the drawings.

.2 Provide partition stabilization anchors at top of all masonry partitions at underside of structure for full length of wall at 1220mm o.c. maximum in accordance with CAN3 S304.

3.9 CONTROL JOINTS

.1 Provide vertical control joints to CSA A371 and as shown on the drawings.

.2 Width of control joint shall be 10mm.

.3 Horizontal reinforcing shall be continuous across control joint at every fourth course.

.4 Control joints shall be continuous across thickness of exterior wall. Where vertical joints in interior and exterior wythes do not align, an offset of maximum 200mm is allowable.

.5 Where not otherwise shown or detailed, the following minimum requirements for vertical control joints in unit masonry shall apply:
- .1 Above all openings in masonry, extending from end point of lintel to top of masonry.
- .2 At all structural column or pilaster locations.
- .3 All locations where structural substrate changes.
- .4 At all uninterrupted panels of masonry, maximum panel width shall be 7m.
- .5 Within 1m each side of changes in direction of wall.

3.10 THROUGH-WALL FLASHING AND AIR/VAPOUR BARRIER

.1 Clean, scrape and wire-brush all surfaces to receive through-wall flashing and air/vapour barrier membranes, remove all dirt, oil and loose mortar materials.

.2 Install prefinished metal flashing drip above all openings prior to installation of through-wall flashing membrane.

.3 Prime all surfaces to receive through-wall flashing and air/vapour barrier at manufacturers recommended rate and allow to dry and flash over prior to application of membranes.

.4 Position membrane to allow for minimum 50mm laps at all edges.

.5 Roll back membrane and remove release paper. Press membrane firmly into primer and roll membrane and all seams to ensure full contact with substrate.

.6 Seal leading edge of all membranes and projections through membranes with mastic approved for use with membranes.

3.11 FIELD QUALITY CONTROL

.1 Prior to commencement of construction, the Masonry Subcontractor shall prepare and mix on-site, under supervision of the Consultant and the Testing & Inspection Authority, mortar samples to determine compliance with the specifications.

.2 Tests of such samples shall be determine a ratio-by-mass value of "control value" for mortar mixes.

.3 Masonry mortar shall be tested in accordance with CSA A179; Mortar and Grout for Unit Masonry, supplemented as follows:

.1 Additional cubes shall be poured under on-site conditions for comparison with "ideal" samples.

.4 Subsequent sample ratio tests taken during the course of construction shall not vary from the control value by more than 15%.

END OF SECTION

1 General

1.1 **SECTION INCLUDES**

.1 Design, labour, Products, equipment and services necessary for load-bearing metal studs work in accordance with the Contract Documents.

1.2 **REFERENCES**

.1 ASTM A123, Specification for Zinc (Hot Dip Galvanized) Coatings on Iron & Steel Products.

.2 ASTM A653/A653 M, Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

.3 ASTM C1002, Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs.

.4 CAN/CGSB 1.40-M, Primer, Structural Steel, Oil Alkyd Type.

.5 CISC/CPMA 1.73a, A Quick-Drying One-Coat Paint for Use on Structural Steel.

.6 CSA W47.1, Certification of Companies for Fusion Welding of Steel.

.7 CSA W55.3, Certification of companies for resistance welding of steel and aluminum.

.8 CSA W59, Welded Steel Construction (Metal Arc Welding).

.9 CSA S136, North American Specification for the Design of Cold Formed Steel Structural Members.

.10 Canadian Sheet Steel Building Institute CSSBI 52M, Lightweight Steel Framing Binder.

1.3 **DESIGN REQUIREMENTS**

.1 Design load-bearing metal studs to withstand live, dead, lateral, wind, seismic, handling, transportation, and erection loads.

.2 Design load-bearing metal studs based on Limit States Design principles using factored loads and resistances. Loads and load factors to be in accordance with the National Building Code (NBC). Resistance factors to be determined in accordance with the NBC and CAN/CSA-S136-M.

.3 Design bridging to prevent member rotation and member translation perpendicular to the minor axis. Provide for secondary stress effects due to torsion between lines of bridging.

.4 Design load-bearing metal studs in accordance with following Climatic Design Data for Napanee contained in the Ontario Building Code:
  .1 Design temperature: January 1%, July 2 ½%.
  .2 Wind (Hourly wind pressures): 1 in 50 year occurrence.

.5 Design load-bearing metal studs for the full specified design wind load with the following deflection limits:
- .1 Brick veneer: L/720.
- .2 Metal siding and panels: L/360.

.6 Design load-bearing metal studs without relying on sheathing or gypsum board to resist torsion and weak axis buckling.

1.4 SUBMITTALS

.1 Product data:
- .1 Submit duplicate copies of manufacturer's Product data in accordance with the Conditions of the Contract indicating:
  - .1 Performance criteria, compliance with appropriate reference standard, characteristics, and system limitations.
  - .2 Product transportation, storage, handling and installation requirements.

.2 Shop drawings:
- .1 Submit shop drawings in accordance with the Conditions of the Contract indicating:
  - .1 Wall construction, load-bearing metal stud wall system, design loads, member sizes, materials, component details, depth and gauge designation exclusive of coatings, location and spacings of framing members, connection and bracing details, bearing, anchorage, loadings, temporary bracing, welds, types and locations of mechanical fasteners, splices, permanent bracing, strapping and sheathing.
  - .2 Indicate locations, dimensions, openings and requirements of related work.
  - .3 Indicate welds by welding symbols as defined in CSA W59.
  - .4 Complete engineering design data to confirm that load-bearing metal studs meet design requirements specified.

.3 Certificates: Prior to commencement of work, submit 2 certified copies of load-bearing metal stud mill reports covering material properties.

1.5 QUALITY ASSURANCE

.1 Retain a Professional Engineer, licensed in Province of Ontario, with experience in work of comparable complexity and scope, to perform following services as part of work of this Section:
- .1 Design of load-bearing metal studs.
- .2 Review, stamp, date and sign shop drawings and design calculations.
- .3 Conduct shop and on-site inspections, prepare and submit written inspection reports verifying that this part of Work is in accordance with Contract Documents and reviewed shop drawings.

.2 Companies to be certified under Division 1 or 2.1 of CSA W47.1 for fusion welding of steel structures and/or CSA W55.3 for resistance welding of structural components.

2 Products

2.1 **ACCEPTABLE MANUFACTURERS**

.1 Bailey Metal Products.

.2 Sanders Steel Inc.

.3 Steelform Building Products.

2.2 **MATERIALS**

.1 General: All materials under work of this Section, including but not limited to, primers are to have low VOC content limits.

.2 Steel: to CSA S136, Grade A to D steel with Z275 zinc coating designation in accordance with ASTM A653/A653M.

.3 Welding materials: to CSA W59 and certified by Canadian Welding Bureau.

.4 Screws: pan head, self-drilling, self-tapping sheet metal screws, corrosion protected to minimum requirements of CSSBI, length to suit intended end use.

.5 Anchors: concrete expansion anchors or other suitable drilled type fasteners.

.6 Bolts, nuts, washers: hot dipped galvanized to ASTM A123, 600 g/m² zinc coating.

.7 Primer paint: CAN/CGSB-1.40-M or CPMA 1.73a.

.8 Acoustic insulation: In accordance with Section 09 21 16.

.9 Sill Plate Gasket: Polyethylene foam, moisture resistant, 4.8 mm thick; 'FoamSealR' by Owens Corning or approved alternative.

.10 Isolation coating: Black bituminous coating, acid and alkali resistant material.

.11 Exterior Sheathing: 15.9 mm, unless otherwise indicated, 'GlasRoc Brand Sheathing' with EGRG by CertainTeed Gypsum Canada, 'Secure Glass-Mat Sheating' by CGC Inc. or 'Dens-Glass Gold' by G-P Products.

.12 Sheathing screws: to ASTM C1002, Type S, corrosion resistant, 12.7 mm penetration into steel, complete with 38 mm diameter washers.

2.3 **METAL FRAMING**

.1 Metal studs: to CAN/CSA S136, fabricated from zinc coated steel, depth as indicated. Minimum steel thickness to be 0.91 mm.

.2 Stud tracks: fabricated from same material and finish as metal studs, depth to suit.
  .1 Bottom track: single piece.
  .2 Top track: two piece telescoping or single piece as required by design.

.3 Bridging: fabricated from same material and finish as studs, 38 x 12 x 1.22 mm minimum thickness.

.4 Angle clips: fabricated from same material and finish as studs, 38 x 38 mm x depth of metal stud, 1.22 mm minimum thickness.

.5 Tension straps and accessories: In accordance with reviewed shop drawings and as recommended by manufacturer.

3 Execution

3.1 **EXAMINATION**

.1 Verify condition and dimensions of previously installed Work upon which this Section depends. Report defects to Consultant. Commencement of work of this Section means acceptance of existing conditions.

3.2 **PREPARATION**

.1 Verify substrate surfaces are solid, free from surface water, frozen matter, and other foreign matter detrimental to performance. Ensure environmental and site conditions are suitable for installation of system.

3.3 **INSTALLATION**

.1 Install load-bearing metal studs in accordance with reviewed shop drawings and manufacturer's written instructions.

.2 Install sill plate gasket under bottom track at foundation wall locations and in locations indicated in accordance with manufacturer's written instructions. Butt all end and perpendicular joints tightly.

.3 Perform work in accordance with CSSBI 52M. Perform welding in accordance with CSA W59.

.4 Erect studs plumb, aligned and securely attached with 2 screws minimum at each point of attachment, or welded in accordance with manufacturer's recommendations. Anchor tracks securely to structure at 800 mm o.c. maximum, unless lesser spacing prescribed on shop drawings.

.5 For telescoping tracks install 50 mm minimum telescoping track at top of walls where required to accommodate vertical deflection. Nest top track into deflection channel a minimum of 30 mm and a maximum of 40 mm. Do not fasten tracks together. Stagger joints.

.6 Seat studs into bottom tracks and top track. Install studs at not more than 50 mm from abutting walls, openings, and each side of corners and terminations with dissimilar materials.

.7 Brace metal studs with horizontal internal bridging at spacing shown on reviewed shop drawings. Fasten bridging to steel clips fastened to metal studs with screws or by welding.

.8 Frame openings in stud walls to adequately carry loads by use of additional framing members and bracing as detailed on shop drawings.

.9 Cutouts: Limit distance from centerline of last unreinforced cutout to end of member to less than 300 mm.

.10 Touch up welds with coat of zinc rich primer.

.11 Erection Tolerances;
- .1 Plumb: not to exceed 1/500th of member length.
- .2 Camber: not to exceed 1/1000th of member length.
- .3 Spacing: not more than 3 mm from design spacing.
- .4 Gap between end of stud and track web: not more than 4 mm.

.12 Install acoustic insulation in accordance with Section 09 21 16.

.13 Apply isolation coating over entire contact surfaces of all dissimilar materials to prevent electrolytic action for protection from galvanic corrosion.

3.4 SHEATHING INSTALLATION

.1 Install sheathing materials in accordance with manufacturer's written instructions.

.2 Install sheathing with long dimension perpendicular to metal studs, offset joints and butt tight, centre edges of sheathing over metal studs, mechanically fasten with specified fasteners and washers in accordance with manufacturer's instructions.

.3 At soffits seal joints between boards with mortar/adhesive and tape in accordance with sheathing manufacturer's written instructions. Clean sheathing of dust and foreign materials.

END OF SECTION

1 General

1.1 **SECTION INCLUDES**

.1 Design, labour, Products, equipment and services necessary for the miscellaneous and metal fabrication work in accordance with the Contract Documents.

1.2 **REFERENCES**

.1 ASTM A53, Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.

.2 ASTM A123, Specification for Zinc (Hot Dip Galvanized) Coatings on Iron & Steel Products.

.3 ASTM A153, Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

.4 ASTM A307, Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.

.5 ASTM A653/A653M, Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvanealed) by the Hot-Dip Process.

.6 CISC/CPMA 1.73a, A Quick-Drying One-Coat Paint for Use on Structural Steel.

.7 CAN/CSA-G40.20/G40.21-M, General Requirements for Rolled or Welded Structural Quality Steel/ Structural Quality Steels.

.8 CAN/CSA S16.1-M, Limit States Design of Steel Structures.

.9 CSA S136.1-M, Commentary on CAN/CSA S136-M, Cold Formed Steel Structural Members.

.10 CSA W47.1, Certification of Companies for Fusion Welding of Steel Structures.

.11 CSA W48, Filler Metal and Allied Materials for Metal Arc Welding.

.12 CSA W59-M, Welded Steel Construction (Metal Arc Welding).

.13 CAN/CSA W117.2-M, Safety in Welding, Cutting and Allied Processes.

.14 CAN/CGSB 1.40-M, Primer, Structural Steel, Oil Alkyd Type.

.15 CGSB 85-GP-16M, Painting Galvanized Steel.

.16 Steel Structures Painting Council (SSPC), Steel Structures Painting Manual, Vol. 2.

1.3 **DESIGN REQUIREMENTS**

.1 Design details and connections, where not shown on Drawings, in accordance with CAN/CSA-S16.1 and CSA S136.1.

1.4 **SUBMITTALS**

.1 Shop drawings:
- .1 Submit shop drawings for fabrication and erection of miscellaneous and metal items in accordance with the Conditions of the Contract indicating:
  - .1 Materials, core thicknesses, class of finish (AMP 555), connections, joints, method of anchorage, number of anchors, supports, reinforcement, details, and accessories.
  - .2 Ensure shop drawings are of one uniform size and based on field measurements.

1.5 **QUALITY ASSURANCE**

.1 Retain a Professional Engineer, licensed in the Province of Ontario, with experience in work of comparable complexity and scope, to perform the following services as part of the work of this Section:
- .1 Design steel stairs, railings, and metal fabrication items that are required to resist live, dead, lateral, wind, or seismic loads.
- .2 Review, stamp, date and sign shop drawings.

.2 Workmanship: Fabricate work of this Section to meet the required class of workmanship indicated below in accordance with AMP 555, Section 8.
- .1 Class 1: for use on direct exposed to view fabricated items:
  - .1 Exposed surfaces are finished smooth with pitts, mill marks, nicks, burrs, sharp edges, and scratches filled or ground off. Defects should not show when painted, polished, or finished.
  - .2 Welds should be concealed where possible. Exposed welds are ground to small radius with uniform sized cove unless otherwise noted.
  - .3 Distortions should not be visible to the eye.
  - .4 Exposed joints are fitted to a hairline finish.

.3 Execute welding by firms certified in accordance with CSA W47.1 Division 1 or 2.1. Ensure welding operators are licensed per CSA W47.1 for types of welding required by Work.

2 Products

2.1 **MATERIALS**

.1 General:
- .1 All materials under work of this Section, including but not limited to, primers and paints are to have low VOC content limits.
- .2 Unless detailed or specified herein, standard products will be acceptable if construction details and installation meet intent of Drawings and Specifications.
- .3 Include all materials, products, accessories, and supplementary parts necessary to complete assembly and installation of work of this Section.
- .4 Incorporate only metals that are free from defects which impair strength or durability, or which are visible. Install only new metals of best quality, and free from rust or waves and buckles, and that are clean, straight, and with sharp defined profiles.

.2 Structural shapes, plates, and similar items: CAN/CSA-G40.20/G40.21-M, Grade 350W. Hollow structural sections: CAN/CSA-G40.20/G40.21-M, Grade 350W, Class H.

.3 Galvanized sheet steel: ASTM A653/A653M Grade A, Z275 Commercial Quality zinc coating, size and shape as shown.

.4 Steel bar grating: Bearing bar sizes and spacing as indicated on drawings. Grating as manufactured by Borden Metal Products Ltd., Fisher & Ludlow Ltd. or McNichols Co.

.5 Metal grating stair treads: Grating treads with checkered plate nosing. 'Welded Steel Treads' by Fisher & Ludlow Ltd.; Safety Steps' by IKG Borden; or 'Stair Treads' by Amico-ISG.

.6 Bollards (protection posts): ASTM A53/A53-M, galvanized Schedule 40 standard weight steel pipe in quantity and sizes shown.

.7 Welding materials: CSA W48 and CSA W59-M.

.8 Fasteners: Conforming to ASTM A307, Grade A, in areas not exposed to view, use unfinished bolts with hexagon heads and nuts. In areas exposed to view, use bolts, nuts, washers, rivets, lock washers, anchor bolts, machine screws and machine bolts Z275 zinc coated in accordance with ASTM A653/A653M. Supply bolts of lengths required to suit thickness of material being joined, but not projecting more than 6 mm beyond nut, without the use of washers.

.9 Primer paint: CAN/CGSB-1.40-M or CPMA 1.73a.

.10 Galvanized primer paint: Inorganic zinc rich primer. For use on galvanized fabrications where touch up is to remain unpainted in finished work; Carbozinc 11WB by Carboline Company, Catha-Coat 305 by Devoe Coatings or Zinc Clad XI by Sherwin Williams.

.11 Drilled inserts: Mega by ITW Construction Products or HSL by Hilti Inc. heavy-duty anchors, sizes as shown.

2.2 FABRICATION

.1 Verify dimensions of existing Work before commencing fabrications and report any discrepancies to the Consultant.

.2 Fit and assemble work in shop where possible. Execute work in accordance with details and reviewed shop drawings.

.3 Use self-tapping shake-proof screws on items requiring assembly by screws or as indicated. Use screws for interior metal work. Use welded connections for exterior metal work unless otherwise found acceptable by the Consultant.

.4 Ensure exposed welds are continuous for length of each joint. File or grind exposed welds smooth and flush. Seal exterior steel fabrications against corrosion in accordance with CAN/CSA S16.1-M.

.5 Execute shop welding to requirements specified.

.6 Carefully make and fit details. Take special care with exposed finished work to produce a neat and correct appearance to the Consultant's acceptance.

.7 Assemble members without twists or open joints.

.8 Correctly size holes for connecting work of other trades where such can be determined prior to fabrication. Where possible, show holes on shop drawings. Place holes not to cause appreciable reduction in strength of member.

.9 Draw mechanical joints to hairline tightness and seal countersunk screw and access holes for locking screws with metal filler where these occur on exposed surfaces.

2.3 **FABRICATED ITEMS**

.1 Refer to Drawings for details of metal fabrication work and related items not specifically listed in this Section.

.2 Where work is required to be built into work of other Sections supply such members to respective Sections.

.3 Provide metal fabrication items indicated below and items not indicated to be supplied under other Sections. The following items includes miscellaneous and metal fabrication including but not limited to the items listed below.

.4 Grating stairs:
- .1 Fabricate steel channel stringer of size, construction and attachment to structure as shown. Close exposed ends of stringers with 3 mm thick steel closure plates welded to edges of exposed flange edges.
- .2 Treads and landings: Landings to be fabricated from steel bar grating and stair treads to be one piece grating with checkered plate nosing, landing grating to be same grating type as tread grating.
- .3 Support treads, risers and landings as detailed on reviewed shop drawings.

.5 Handrails, guardrails, and posts:
- .1 Design railings to withstand minimum horizontal and vertical loads as required to meet requirements of authorities having jurisdiction. In no instance shall load design of railings be less than 3.0 kN/m horizontally and 1.5 kN/m vertically.
- .2 Close open ends of steel handrails with 1.9 mm thick closure neatly welded. Fabricate railings, handrails, and guardrails as shown on drawings.
- .3 Handrail bracket: Fabricate as shown. After fabrication, galvanized bracket in accordance with ASTM A123.

.6 Lintels: Fabricated from CAN/CSA-G40.20/G40.21-M, Grade 350W, size and location as shown, width to be not less than 25 mm less than width of wall and extend 200 mm beyond opening at each end. Unless otherwise shown, fabricate lintels in block walls of steel sections.

7. Masonry lateral support angles:
- .1 Supply only, to Section 04 20 00 for installation, all horizontal lateral support anchors at top of non-load-bearing masonry walls.

.2 Refer to Structural Drawings for size and spacing of required support anchors. Provide drilled holes as required for anchorage.

.3 Galvanized for all exterior wall and unheated and high humidity locations.

8. Shelf Angles: Of size indicated on Drawings and as specified in structural steel specifications, with adjustable inserts for vertical adjustment and slotted holes for horizontal; galvanized.

.9 Steel ladders:

.1 Provide roof access ladders as indicated on Drawings.

.2 Fabricate complete with steel stiffeners, rungs, angle rails, bent plate straps or angle brackets as shown.

.10 Bollards:

.1 Provide bollards as indicated on drawings. Posts to be 250 mm diameter with a wall thickness of 8 mm. Place posts into a 1500 mm foundation, fill with 20 Mpa concrete and round top. Project pipes 1500 mm above finished grade. Finish prime coat.

.2 Finish: Provide paint finish in accordance with Section 09 91 00, colour to be selected by Consultant.

.11 Bench brackets:

.1 Supply only, for installation under work of Section 06 20 00, bench brackets constructed of steel plates of sizes noted. Provide supports at maximum 609 mm centres and not less than 152 mm from ends of bench run.

.2 Construct supports as detailed. Provide all drill holes required for concealed anchorage of wood bench and for anchoring to building structure.

.12 Miscellaneous steel brackets, supports and angles:

.1 Supply and install or supply for installation by trades responsible, all loose steel brackets, supports and angles where indicated, except where such brackets, supports and angles are specified under work of other Sections. Drill for countersunk screws, expansion anchors and anchor bolts.

.2 Unless otherwise specified, prime paint for interior installation; galvanized finish for exterior installation.

.13 Gas meter enclosure: Fabricate steel-framed railing in accordance with reviewed shop drawings, anchored to exterior wall framing and concrete slab.

2.4 ANCHORS AND FASTENING

.1 Use weld studs of size not larger than 10 mm for attaching miscellaneous materials and equipment to building steel. If weight of item requires larger fasteners use clips or brackets and secure by welding or through bolting.

.2 Use self drilling expansion type concrete anchors for attaching to masonry and concrete

.3 Do not secure items to steel deck.

.4 Use steel beam clamps of two bolt design to transmit load to beam web. Do not use C and I clamps.

.5 Mount vertical access ladders in accordance with OBC.

2.5 WELDING

.1 Perform welding by electric arc process.

.2 Execute welding to avoid damage or distortion to Work. Execute welding in accordance with following standards:
- .1 CSA W48 - for Electrodes. If rods are used, only coated rods are allowed.
- .2 CSA W59-M and CSA W59S1-M for design of connections and workmanship.
- .3 CAN/CSA W117.2-M - for safety.

.3 Thoroughly clean welded joints and expose steel for a sufficient distance to perform welding operations. Finish welds smooth. Supply continuous and ground welds which will be exposed to view and finish paint.

.4 Test welds for conformance and remove work not meeting specified standards and replace to Consultant's acceptance.

2.6 SHOP PAINTING

.1 Clean steel to SSPC SP6 and remove loose mill scale, weld flux and splatter.

.2 Shop prime steel with one coat of primer paint to dry film thickness of 0.07 mm. Paint on dry surfaces, free from rust, scale, grease. Do not paint when temperature is lower than 7 deg C. Paint items under cover and leave under cover until primer is dry. Follow paint manufacturer's recommendations regarding application methods, equipment, temperature, and humidity conditions.

.3 Shop prime galvanized steel in accordance with CGSB 85-GP-16M.

.4 Clean but do not paint surfaces being welded in field.

.5 Do not paint surfaces embedded in concrete, but clean as if they were to be primed.

.6 Do not prime steel to be fireproofed or to receive intumescent paint coating.

.7 Do not prime machine finished surfaces, but apply an effective anti-rust compound.

.8 Take precautions to avoid damage to adjacent surfaces.

2.7 HOT DIP GALVANIZING

.1 After fabrication, hot dip galvanize specific miscellaneous steel items as indicated. After galvanizing, plug relief vents air tight with appropriate aluminum plugs as suitable and required for intended metal fabricated item. Straighten shapes and assemblies true to line and plane after galvanizing. Repair damaged galvanized surfaces with zinc rich primer in accordance with manufacturer's printed directions.

.2 Hot-dip galvanize members in accordance with requirements of the following ASTM, with minimum coating weights or thicknesses as follows:

.1 Rolled, pressed and forged steel shapes, plates, bars and strips: ASTM A123; average weight of zinc coating per square/metre of actual surface, for 4.8 mm and less thickness members 600 g/m^2 for 6 mm and heavier members 640 g/m^2.

.2 Iron and steel hardware: ASTM A153; minimum weight of zinc coating, in ounces per square foot of surface, in accordance with ASTM A153,Table 1 for the various classes of materials used in the Work.

3 Execution

3.1 **EXAMINATION**

.1 Examine previously installed Work, upon which this Section depends, verify dimensions and condition of existing Work, and coordinate repairs, alterations, and rectification if necessary. Commencement of work of this Section is deemed to signify acceptance of existing, prior conditions.

.2 Obtain Consultant's written approval prior to field cutting or altering of structural members.

3.2 **ERECTION**

.1 Install metal fabrications in accordance with reviewed shop drawings and manufacturer's written instructions.

.2 Fit joints and intersecting members accurately. Make work in true planes with adequate fastenings. Build and erect work plumb, true, square, straight, level and accurate to sizes detailed, free from distortion or defects detrimental to appearance or performance.

.3 Perform drilling of concrete and steel as required to fasten work of this Section.

.4 Erect rails and handrails in true vertical and horizontal planes, rigid, and free from whip.

.5 Continuously weld connections for railings and anchor directly to steel stringers.

3.3 **FIELD PAINTING**

.1 Paint bolt heads, washers, nuts, field welds and previously unpainted items. Touch up shop primer damaged during transit and installation, with primer to match shop primer.

END OF SECTION

1 General

1.1 **SECTION INCLUDES**

.1 Labour, Products, equipment and services necessary for rough carpentry work in accordance with the Contract Documents.

1.2 **REFERENCES**

.1 ASTM A153, Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

.2 ASTM A325, Specification for Bolts Quenched/Tempered Steel Nominal Thread Diameter M16 - M36 For Structural Steel Joints.

.3 ASTM A653, Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

.4 ASTM F1667, Driven Fasteners: Nails, Spikes and Staples.

.5 CAN/CSA O80 Series M, Wood Preservation.

.6 CSA O121-M, Douglas Fir Plywood.

.7 CAN/CSA O141, Softwood Lumber.

.8 CAN/ULC-S102, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

.9 NLGA, Standard Grading Rules for Canadian Lumber, National Lumber Grades Authority

1.3 **QUALITY ASSURANCE**

.1 Lumber identification: Grade stamp of an agency certified by the Canadian Lumber Standards Accreditation Board.

.2 Plywood identification: Grade mark in accordance with applicable CSA standards.

.3 Lumber quality: Carefully select individual pieces so that knots and obvious defects will not interfere with placing bolts, proper nailing or making proper connections.

.4 Moisture Content of wood at time of construction shall be 19% maximum.

.5 Each piece of pressure treated lumber and fire retardant treated lumber shall be shop marked with the pressure treatment brand and ULC monogram respectively, in accordance with CAN/CSA O80-M.

6. Dimensions of lumber shall conform to dressed sizes specified in CAN/CSA-0141 unless actual dimensions are otherwise indicated or specified.

7. Dimensional references to lumber on Drawings and in Specifications are to nominal sizes unless actual dimensions are indicated. Such actual dimensions shall be dry size.

.8 Lumber defects: Discard wood with defects which will render a piece unable to serve its intended function. Lumber will be rejected by Consultant for excessive warp, twist, bow, crook, mildew, fungus, or mould, as well as for improper cutting and fitting, whether or not it has been installed.

1.4 **ENVIRONMENTAL REQUIREMENTS**

1. When it is required that wood maintain dimensional stability and tolerances to ensure accurate installation of later work, store and install it only in dry areas, and where no further installation of moist materials is contemplated.

1.5 **PRODUCT DELIVERY, STORAGE AND HANDLING**

.1 Store materials in a dry area. Cover materials with tarpaulins or polyethylene sheets to prevent moisture absorption and impairment of structural and aesthetic properties. Vent to allow air movement. Tie covering to keep in place.

2 Products

2.1 **MATERIALS**

.1 General: All materials under work of this Section, including but not limited to, adhesives are to have low VOC content limits.

.2 Lumber: Softwood, G4S, moisture content 19% or less at time of installation, in accordance with the following:
- .1 Lumber shall be of same species and grade, equally seasoned and shall be processed and stamped at same mill.
- .2 CSA O141 and NLGA Standard Grading Rules for Canadian Lumber.
- .3 Board quality: Construction or better.
- .4 Dimension quality:
  - .1 Structural joists, planks, and framing: No. 1 Select Structural.
  - .2 Light framing: Construction.

.3 Plywood: CSA O121-M, G1S unsanded, T & G, standard construction, laminated with waterproof adhesive, exterior grade, Thickness as indicated on drawings.

.4 Roof lumber: NLGA, Construction grade light framing, Jack Pine, S4S, pressure treated to CAN/CSA-O80 series using copper based waterborne preservative treatment, impregnated to a net retention of 4 kg/ m^3 of preservative unless otherwise specified by preservative manufacturer.

.5 Surface applied wood preservative: Green coloured copper napthenate or 5% pentachlorophenol solution, water repellant preservative or same copper based preservative as used for shop impregnation, in accordance with CAN/CSA O80.

.6 Fire retardant treatment of lumber and plywood: 'Dricon' fire retardant treatment by Biewer Lumber or approved alternative, conforming to CAN/CSA-O80.20 and CAN/CSA-O80.27 respectively, to provide a flame spread rating of 25 or less in accordance with CAN/ULC-S102.

.7 Rough hardware: Conforming to ASTM F1667; Nails, bolts, screws, anchors, expansion shields, and other fastenings required to frame and fix rough carpentry as follows:
- .1 Nails, spikes and staples: Spiral type.
- .2 Bolts: ASTM A325; 12.7 mm diameter minimum with nuts and washers unless noted otherwise.
- .3 Screws: Countersunk head, full thread type.
- .4 Proprietary fasteners: Toggle bolts, expansion shields, lag bolts, screws, inorganic fibre plugs, recommended for purpose by manufacturer.
- .5 Galvanize rough hardware used in fire treated wood and hardware exposed to the atmosphere.

.8 Fasteners for use in pressure treated wood: Provide hot dipped galvanized fasteners complying to ASTM A153 and connectors in accordance with ASTM A653, Class G185 for non-structural members. Provide type 304 or 316 stainless steel fasteners and connectors for use in Structural, pressure treated wood.

3 Execution

3.1 **EXAMINATION**

.1 Verify condition and dimensions of previously installed Work upon which this Section depends. Report defects to Consultant. Commencement of work of this Section means acceptance of existing conditions.

3.2 **GENERAL**

.1 Lay out work carefully and to accommodate work of others. Cut and fit accurately: erect in position indicated by Drawings.

.2 Install rough carpentry to allow for expansion and contraction of the materials.

.3 Cut work into lengths as long as practicable and with square ends. Align, level, square, plumb, and secure work permanently in place. Brace work temporarily as required. Join work only over solid backing.

.4 Bore holes true to line and to same size as bolts. Drive bolts into place for snug fit, and use plates or washers for bolthead and nut bearings. Turn up bolts and lag screws tightly when installed, and again just before concealed by other work or at completion of Work.

.5 Provide anchors, bolts, and inserts required for attachment of the work of this Section, to those performing the work of other Sections and who are responsible for their installation.

.6 Do not attach work by wood plugs or blocking in concrete or masonry. Use lead shields, expansion shields, or similar methods only as approved by Consultant.

3.3 **MISCELLANEOUS WOODWORK**

.1 Fit and install wood furring, strapping, grounds and blocking. Adequately size, correctly place and conceal members for finishes, fitments and for work under other Sections. Do not assume that Drawings show required work exactly or completely. Anchor wood members securely in place.

.2 Install rough bucks, nailing strips and linings to rough openings as required for backing for frames and other work.

.3 Except where steel supports are specifically shown, provide wood blocking and supports in metal stud partitions for fastening of item such as casework and other wall mounted accessories. Have respective trades approve the location of such wood blocking.

.4 Bolt wood blocking or nailing strips to steel framing.

.5 Align and plumb faces of furring and blocking to tolerance of 1:600.

.6 Use fire retardant lumber for blocking/framing in ceiling\ spaces, partitions and bulkheads.

3.4 **ROOF WOODWORK**

.1 Install roof woodwork as indicated on drawings.

.2 Fasten roof woodwork at maximum 400 mm o.c. in staggered pattern unless noted otherwise.

3.5 **BACKBOARDS**

.1 Install plywood backboards, primed and painted white on both sides, with fire retardant paint.

.2 Use minimum 19 mm thick plywood on 19 x 38 mm furring around perimeter and at maximum 300 mm intermediate spacing.

3.6 **FASTENERS**

.1 Frame, anchor, fasten, tie and brace members for required strength and rigidity.

.2 Use hot dipped galvanized fasteners for exterior work and work below grade.

.3 Countersink bolts and bolt heads as required for clearance of other work.

.4 Size fasteners to penetrate base member by half of fastener length minimum. Minimize splitting of wood members by staggering nails in direction of grain.

.5 For plywood use spiral, annular or resin coated nails and staples.

3.7 **SURFACE-APPLIED WOOD PRESERVATIVE**

.1 Treat raw surfaces, drilled holes and cut ends of pressure treated wood with 2 coats of wood preservative immediately after cutting.

.2 Apply preservative by dipping, by brush or by pouring into plugged holes to completely saturate surface.

END OF SECTION

1 General

1.1 **SECTION INCLUDES**

.1 Labour, Products equipment and services necessary for the finish carpentry Work in accordance with the Contract Documents.

1.2 **REFERENCES**

.1 ANSI A208.1, Particleboard.

.2 ANSI/NEMA LD 3, High-Pressure Decorative Laminates.

.3 ASTM F1667, Driven Fasteners: Nails, Spikes and Staples.

.4 Architectural Woodwork Manufacturers Association of Canada (AWMAC).

.5 Architectural Woodwork Standards (AWS) - Quality Standards for Architectural Woodwork.

.6 CSA O115-M, Hardwood and Decorative Plywood.

.7 CAN/CSA O141, Softwood Lumber.

.8 CSA O151-M, Canadian Softwood Plywood.

.9 National Hardwood Lumber Association (NHLA) Rules for the Measurement and Inspection of Hardwood and Cypress.

.10 National Lumber Grades Authority (NLGA) Standard Grading Rules for Canadian Lumber.

1.3 **SUBMITTALS**

.1 Shop drawings: Submit shop drawings of finish carpentry Work in accordance with the Conditions of the Contract indicating materials, thicknesses, sizes, finishes, wood species, grades, profiles, connection attachments, shop jointing, field jointing, reinforcing, anchorage, fastener types and sizes, location of exposed fastenings, mechanical and electrical service routes, service outlets, cutout locations, and sizes. Include erection drawings, plans, elevations, sections, and details as applicable.

.2 Samples: Submit samples of the following in accordance with the requirements of the Conditions of the Contract:
- .1 Two representative pieces of each type of wood to receive a stained or natural finish.
- .2 Two representative pieces of each type of wood finished as specified.
- .3 Two of each colour, pattern, gloss, and texture of plastic laminate, in manufacturer's standard tag size.
- .4 One of each item of finish carpentry hardware.
- .5 Two of each solid surface, in 100 x 75 x 12 mm samples.

1.4 QUALITY ASSURANCE

.1 Execute Work of this Section by member of AWMAC, with 5 years experience in finish carpentry Work of comparable complexity and scope. Submit proof of experience upon Consultant's request.

.2 Fabricate finish carpentry Work in accordance with AWS Quality Standards, Premium Quality materials and installation unless otherwise indicated. Perform Work in accordance with the definition of Good Workmanship as defined in the AWS Quality Standards.

.3 Remove and replace finish carpentry Work which does not conform to the AWS Quality standards or as amended by these Specifications.

.4 Mock-up:
- .1 Shop fabricate one mock-up of a base cabinet, wall cabinet, and counter top for each type of surfacing specified, complete with hardware and shop applied finishes, installed in location acceptable to Consultant.
- .2 Arrange for Consultant's review and acceptance, allow 48 hours after acceptance before proceeding with Work.
- .3 When accepted, mock-up will demonstrate minimum standard for this work. Mock-up may remain as part of Work if accepted by Consultant. Remove and dispose of mock-ups which do not form part of Work.

1.5 DELIVERY, STORAGE, AND HANDLING

.1 Deliver, store, and handle finish carpentry in accordance with the AWS Quality Standards. Control the temperature and humidity in accordance with the AWS recommendations, before, during, and after finish carpentry delivery, and also during storage and installation.

.2 Cover finished plastic laminated work with heavy kraft paper or put in cartons during shipment. Protect installed surfaces by approved means. Do not remove until immediately before final inspection.

1.6 EXTENDED WARRANTY

.1 Submit an extended warranty for plastic laminate work of this Section in accordance with General Conditions, except that warranty period is extended to 2 years from date of Substantial Performance of the Work.
- .1 Warrant against defects in material and workmanship including but not limited to opening of joints, cracking, shrinkage, warpage, and delamination of plastic laminate.
- .2 Coverage: Complete replacement including affected adjacent Work.

2 Products

2.1 **MATERIALS**

.1 General: All materials under Work of this Section, including but not limited to, adhesives and mastics, are to have low VOC content limits.

.2 Concealed framing lumber: Eastern Spruce, Balsam Fir, or Jack Pine, to CAN/CSA O141, NLGA, and AWS Custom Grade, S4S, average moisture content 7% +/- 2% at installation.

.3 Hardwood lumber: Plain sliced grade A white birch to NHLA and AWS Premium Grade, S4S, average moisture content 7% +/- 2% at installation.

.4 Hardwood Plywood (for cabinet frames, stretchers and blocking): Graded in accordance with AWMAC/AWI; average moisture content of 6-8 percent; species and grade as follows:
- .1 Shop sanded veneer core Birch plywood, 19 mm or 25 mm thickness.

.5 Softwood plywood for drawer body construction: Birch veneer core plywood (all laminations Birch veneer), interior grade plywood, G2S, sanded
- .1 Quality Standard: GOST 3916.1 (Russian), Veneer Grade: BB/BB;
- .2 Thicknesses: 12 mm (nine laminations) and 15 mm (eleven laminations)

.6 Hardwood veneer:
- .1 Birch unless otherwise indicated, conforming to ANSI/HPVA HP-1 having finishes and meeting grades as follows:
  - .1 Transparent finish, Grade AA.
- .2 Face veneer cut: Rotary cut.
- .3 Edging: Solid Birch.
- .4 Sizes, thickness, and shapes as indicated.

.7 Shelving: 19 mm thickness for spans up to 700 mm, 25 mm thickness for longer spans, Birch hardwood core veneers, with PVC edge banding.

.8 Cabinet Backs: Birch plywood, 12 mm thickness.

.9 Plastic laminate: Provide plastic laminates conforming to ANSI/NEMA LD 3 as follows:
- .1 Flatwork face sheet: 1.2 mm thick, heavy wear resistance.
- .2 Vertical interior face sheets: 0.8 mm thick.
- .3 Postformed face sheet: 0.8 mm thick.
- .4 Backing sheet: thickness to match face sheet, high pressure laminate, manufactured by same manufacturer as face sheet.
- .5 Plastic laminate: Refer to Room Finish and Colour Schedule for plastic laminate types and colours.

.10 Solid surfacing:
- .1 12 mm thick sheet stock, provide with bullnose edge and all cutouts as required. 'Avonite' solid surfacing or approved alternative. Refer to Colour and Material Schedule for colour type.

.2 Installation and seam adhesives to be as recommended by solid surfacing manufacturer, colour matched to solid surfacing.

.11 Particle board core (for cabinet door and drawer fronts): ANSI A208.1, Grade M2 of thickness indicated. Particleboard to be bound with waterproof adhesive and meeting the following minimum criteria:
.1 Density: minimum 705 kg/m^3.
.2 Internal bond: 0.45 N/mm^2.
.3 Modulus of rupture: 14.5 N/mm^2.
.4 Modulus of elasticity: 2250 N/mm^2.
.5 Face screw holding: 1000 N.
.6 Edge screw holding: 900 N.

.12 Laminating adhesive: CSA O112 Series, water resistant type, low VOC content, selected by laminate manufacturer for intended end use.

.13 Draw bolts and splines: Type as recommended by fabricator.

.14 Nails and staples: Conforming to ASTM F1667; Size and type to suit application, galvanized for exterior work, interior humid areas and for treated lumber; plain finish elsewhere.

.15 Bolts, nuts, washers, blind fasteners, lags and screws: Size and type to suit application. Stapling is not acceptable.

.16 Adhesive and bituminous mastic: Selected by the millwork fabricator with low VOC content.

.17 Miscellaneous metals: In accordance with Section 05 50 00.

.18 Finishing: In accordance with Section 09 91 00.

2.2 HARDWARE

.1 The following hardware is the minimum quality standard for the work of this Section. Alternatives may be considered provided they are approved by Consultant prior to ordering of products. Refer to Finish and Colour Schedule for additional hardware items.

.2 19 mm Door Hinges: Blum Press–In 170 degree self close full overlay or Salice equivalent. Hinges to be provided with factory installed knock in dowels. For quantity of hinges required per door, refer to hinge manufacturer's manual. Wood screw fastening system will not be accepted.

.3 19 mm Door Hinge Plates: One piece plate with min. 3 mm height adjustment. Hinge plates to be installed using pre-mounted system screws, Euro screw in 5mm pre-drilled hole. Wood screw fastening system will not be accepted.

.4 19 mm Door Dampener: Blumotion 971A with Cruciform Base or Salice equivalent required for all 19mm doors to allow for soft closing.

.5 19 mm Bumpers: Polyurethane 3 mm high X 10 mm diameter / minimum 2 per door and drawer front.

.6 Shelf Standards and Clips: KV 255 pilaster and KV 256 clip – satin nickel finish / Note: Pilasters to be fully recessed into gables.

.7 Drawer and Door Pulls: Stainless Steel D- Pull / 8 mm diameter X 96 mm centres - complete with with 8/32 machine screws.

.8 Coat Rods and Flanges: Richelieu # 122108140 and 1225140.

.9 Coat Hooks: 'CBH 86' by Canadian Builders Hardware Mfg. or approved alternative.

.10 Elbow catches: Richelieu Heavy Duty Elbow Catch # 5540180 / nickel finish / required at all two door units.

.11 Drawer Slides: Accuride 45 kg (100 lbs) #3832EC x length to suit. Finish C - Clear Electroplating.

.12 Locks:
- .1 Cam locks/deadbolt locks complete with lock core by Hafele, type to suit application and installation.
- .2 Each room to be keyed alike.
- .3 All cabinet doors and drawers to be lockable. Provide three keys per key code and five master keys.

.13 Castors: 50 mm, general duty rubber swivel caster with brake and 57 kg (125 lb) weight capacity, 'Model F25086' by Richelieu.

2.3 PLASTIC LAMINATE WORK

.1 Perform plastic laminate Work in accordance with AWS Quality Standards and ANSI/NEMA LD 3.

.2 Ensure adjacent parts of continuous laminate work match in colour and pattern.

.3 Laminate plastic laminates to core materials in accordance with manufacturer's instructions.

.4 Fabricate core surfaces and profiles with continuous support and bond over entire surface to receive plastic laminate.

.5 Apply plastic laminate backing sheets to balance shrinkage stresses induced by plastic laminate face sheets.

.6 Minimize joints in plastic laminate Work; do not install joints in plastic laminate Work in less than 2400 mm o.c. Locate joints minimum 610 mm from cut-outs. Offset core and plastic laminate facing joints.

.7 Form shaped profiles and bends as indicated, using postformed grade laminate to laminate manufacturer's instructions.

.8 Use straight self-edging laminate strip to match adjacent colour, finish, gloss, and pattern to cover exposed edge of core material. Chamfer exposed edges uniformly at approximately 20 degrees. Do not mitre laminate edges.

.9 Apply laminated plastic liner sheet to interior of cabinetry and where indicated.

.10 Fabricate units by solid surfacing manufacturer's certified or approved fabricator/ installer. Fabricate built-up profiles as indicated.

2.4 FABRICATION

.1 Be responsible for methods of construction and for ensuring that materials are rigidly and securely attached and will not be loosened by the work of other sections.

.2 Coordinate locations of concealed supports and blocking with other parts of Work. Provide cutouts for outlet boxes and other fixtures.

.3 Fabricate work in a manner which will permit expansion and contraction of the materials without visible open joints. Conceal joints and connections in wherever possible.

.4 Set nails and countersink screws, apply wood filler to indentations, sand smooth and leave ready to receive finish.

.5 Mitre exposed corners, no end grain shall be visible in completed installation.

.6 Finish millwork in accordance with Section 09 91 00. Finished millwork shall be free from bruises, blemishes, mineral marks, knots, shakes and other defects and shall be selected for uniformity of colour, grain and texture.

.7 Shop assemble finish carpentry to accommodate delivery and handling and to ensure passage through building openings.

.8 Shop install cabinet hardware for doors, shelves and drawers. Recess shelf standards unless noted otherwise.

.9 Fabricate sills, screens, frames, benches and moldings to profiles shown.

2.5 CABINET FABRICATION

.1 General:
- .1 Cabinet Components: As specified in AWMAC QSI Section 400-G as amended by the following requirements;
- .2 Hardware: Supply hinges, drawer slides, products and materials as specified.
- .3 Door and Drawer Fronts: Particle board core.
- .4 Cabinet Boxes: Particle board core.
- .5 Rails, Toe Kicks and Cabinet Bases: Hardwood veneer core.
- .6 Backs: Particle board core.
- .7 Blocking: Solid lumber.
- .8 Provide Semi-Exposed surfaces in same quality and finish as Exposed parts.

.9 Adjustable Shelf Techniques/Supports: AWMAC QSI 400B-T-9;
.1 Custom Grade: Adjustable shelf multiple holes (min. 5 mm diameter, single pin).
.10 Joinery of case body members: AWMAC QSI 400B-T-10, stop-dado joints which are glued and mechanically fastened with screws.
.11 All cabinets provided for this project shall meet or exceed the Custom requirements of AWMAC QSI 400-B-C-1 thru 6.

.2 Wood Cabinet Construction: AWMAC QSI Section 400-G-7 (A), flush overlay style, Custom Grade as amended by the following requirements;
.1 Exposed and Semi-Exposed Parts (except countertops): Particle board core with HPPL faces.
.2 Exposed and Semi Exposed Parts: PVC edgebanding. Lapped joint with top and bottom bands lapping side bands.
.3 Wood Veneer Grain Direction: AWMAC QSI Section 400 A-T-1;
.1 Premium Grade: Grain direction to run vertically for all doors, drawer fronts and overhead bulkheads.

.3 Wall Cabinets: Finish to match base cabinets.
.1 Provide top and bottom filler and corner panels.
.2 Provide scribes and fillers with maximum 25 mm exposed dimension.
.3 Underside of Cabinets: Type 'B' flush (one tight line visible).
.4 Cabinet backs: Wall hung cabinet backs must not be relied upon to support the full weight of the cabinet and its anticipated locad for hanging/mounting purposes. Method of back joinery and hanging/mounting mechanisms should transer the load to case body members.

.4 Shelving: AWMAC QSI 400B-T-9 Premium Grade, as amended by the following:
.1 Construction:
.1 Pilasters and clips system.
.2 HPPL on tops and bottoms and 3 mm thick PVC edge banding on exposed edges to match exposed parts.
.3 Core: Hardwood core veneer. 19 mm thickness up to 700 mm spans, 25 mm thickness for spans greater than 700 mm.
.2 Provide adjustable shelves in all cabinets.

.5 Seating cubbies:
.1 Construct seating cubbies of sizes and details as noted.
.2 Anchor wood to supports in a concealed manner.
.3 Mitre joints at corners. Keep joints to a minimum.
.4 Round all corners, edges and ends.

3 Execution

3.1 **INSTALLATION**

.1 Install Work in accordance with AWS Quality Standards and tolerances for Architectural Woodwork. Set and secure finish carpentry in place, rigid, plumb, square, and level.

.2 Scribe and cut as required, fit to abutting walls, and surfaces, fit properly into recesses and to accommodate columns, fixtures, outlets, or other projecting, intersecting or penetrating objects leaving a 0.8 mm gap maximum.

.3 Coordinate cutouts for plumbing fixtures, inserts, appliances, outlet boxes, and other fixtures, in finish carpentry. Round internal corners of cut-outs and seal exposed cores.

.4 Form joints to conceal shrinkage.

.5 Install draw bolts and splines in laminated plastic counter top joints at maximum spacing 450 mm o.c., and 75 mm from edge. Make joints flush, hairline butt joints.

.6 Install finishing hardware accurately and securely in accordance with manufacturer's directions, adjust and clean.

.7 Install prefinished millwork at locations shown on drawings. Position accurately, level, plumb straight.

.8 Apply bituminous coating over wood framing members in contact with masonry or cementitious construction.

.9 Solid surfacing:
- .1 Install solid surfacing in accordance with manufacturer's instructions.
- .2 Align work plumb and level.
- .3 Seal perimeter of fabrication to adjacent construction in accordance with Section 07 92 00.

.10 Hardwood caps:
- .1 Provide 13 mm thick plywood blocking mechanically fastened and glued to masonry with hardwood trim in reveal.
- .2 Install 38 x 190 mm hardwood cap with rounded exposed edges and ends, glued and mechanically fastened to wood blocking with countersunk fasteners complete with plugs.

.11 Storage cubicles:
- .1 Install 400 mm deep cubicles with vertical divisions as indicated on drawings.
- .2 Mechanically fasten to substrate with blocking and countersunk/plugged fasteners.

.12 Seating cubbies: Install cubbies, straight, level and plumb, in true vertical and horizontal manner.

.13 Benches:
- .1 Construct wood benches of sizes and details as noted.
- .2 Anchor wood to supports in a concealed manner.
- .3 Mitre joints at corners. Keep joints to a minimum.
- .4 Round all corners, edges and ends.
- .5 Install bench brackets and supports supplied under work of Section 05 50 00.

.14 Fastening:
- .1 Coordinate wall securement, anchorage, and blocking for finish carpentry items.

.2 Position items of finished carpentry work accurately, level, plumb, true and fasten or anchor securely.

.3 Design and select fasteners to suit size and nature of components being joined. Use proprietary devices as recommended by manufacturer.

.4 Provide heavy duty fixture attachments for wall mounted cabinets.

.5 Set finishing nails to receive filler. Where screws are used to secure members, countersink screw in round cleanly cut hole and plug with wood plug to match material being secured.

.15 Remove and replace damaged, marked, or stained finish carpentry.

END OF SECTION

1 General

1.1 **SECTION INCLUDES**

.1 Labour, Products, equipment and services necessary for sheet waterproofing work in accordance with the Contract Documents.

1.2 **SUBMITTALS**

.1 Product data: Submit manufacturer's Product data in accordance with the Conditions of the Contract indicating characteristics, performance criteria, and limitations. Indicate preparation, installation requirements and techniques, Product storage, and handling criteria.

.2 Shop drawings: Submit shop drawings in accordance with the Conditions of the Contract indicating location and extent of system and system finish applications; system and joint sealant treatment materials, details of terminations at end of each days' work; large scale details, including relationships with adjacent construction; installation sequence and methods; connections; edge treatment at discontinuous edges; and accessories and other pertinent information required for proper and complete installations.

.3 Samples: Submit following samples in accordance with the Conditions of the Contract:
- .1 Two 300 x 300 mm samples of waterproofing membrane.
- .2 Two samples, 300 mm long, of fastening bar.
- .3 Two samples 300 x 300 mm of protection board.

.4 Certification: Submit installer's certification verifying compliance with specification requirements.

.5 Extended warranty: Submit extended warranty signed and registered by the manufacturer providing the warranty in the name of the Owner for the timeframe and coverage specified in this Section.

1.3 **QUALITY ASSURANCE**

.1 Qualifications: Execute work of this Section by manufacturer-approved, skilled, qualified, and experienced workers, trained in installation of work of this Section.

1.4 **SITE CONDITIONS**

.1 Do not install the work of this Section outside of environmental ranges as recommended by manufacturer without Consultant's and Product manufacturer's written acceptance.

.2 Supply and install temporary protection and facilities to maintain Product manufacturer's, and above specification, environmental requirements before, during, and after installation.

1.5 **EXTENDED WARRANTY**

.1 Submit an extended written warranty for sheet waterproofing work in accordance with the Conditions of the Contract, except that warranty period is extended to five (5) years from date of Substantial Performance of the Work.
- .1 Warrant work against defects including adhesive failure, cohesive failure, waterproofing failure, and water leakage.
- .2 Coverage: Complete replacement including effected adjacent Work.

2 Products

2.1 **MATERIALS**

.1 All materials under work of this Section, including but not limited to, primers are to have low VOC content limits.

.2 All components of the waterproofing system shall be supplied by one manufacturer.

.3 Primer:
- .1 'Aquaprime' by Henry Company Canada Inc.
- .2 'CCW AWP' by Carlisle Coatings and Waterproofing.
- .3 'Elastocol Stick' by Soprema.
- .4 'Mel-Prime Primer by W. R. Meadows

.4 Mastic:
- .1 'Polybitume 570-05 Sealing Compound' by Henry Company Canada Inc.
- .2 'CCW 704 Mastic' by Carlisle Coatings and Waterproofing.
- .3 'Sopramastic 200' by Soprema
- .4 'Pointing Mastic' by W. R. Meadows

.5 Sheet waterproofing: 1.5 mm thick, single-ply, self adhering, self sealing, rubberised asphalt, bonded to a cross-laminated high density polyethylene film.
- .1 'Blueskin WP 200' by Henry Company Canada Inc.
- .2 'CCW Miradri 860/861' by Carlisle Coatings and Waterproofing.
- .3 'Colphene 3000' by Soprema
- .4 'Mel-Rol' by W. R. Meadows

.6 Fastening bar: Continuous 25 mm wide x 3 mm thick aluminum bar, predrilled for mechanical attachment.

.7 Protection Board:
- .1 '990-31' by Henry Company Canada Inc.
- .2 'CCW Protection Board - V' by Carlisle Coatings and Waterproofing.
- .3 'Sopraboard' by Soprema Inc.
- .4 'Sealtight Vibraflex Waterproofing Protection Board' by W. R. Meadows.

.8 Accessories: As recommended by waterproofing system manufacturer.

3 Execution

3.1 **EXAMINATION**

.1 Verify condition and dimensions of previously installed Work upon which this Section depends. Report defects to Consultant. Commencement of work of this Section means acceptance of existing conditions.

.2 Verify that existing substrates to receive waterproofing are clean, dry, sound, smooth, and continuous.

.3 Coordinate sealing of interruptions in, and protrusions through waterproofing membrane. Verify that other work items projecting through waterproofing membrane are in place and are securely installed.

3.2 **MASTIC AND PRIMER**

.1 Fill substrate voids, gaps, depressions, cracks, and joints with mastic until continuous, smooth, substrate for waterproofing is achieved.

.2 Prime substrate surfaces to receive waterproofing in accordance with manufacturer's instructions, at recommended application rate, allow to dry. Vary coverage to suit surface porosity.

.3 Prime surfaces. Re-prime surfaces if not covered with waterproofing membrane within 4 hours.

3.3 **WATERPROOFING**

.1 Install mastic where required to ensure integrity of waterproofing installation at protrusions and other complex details.

.2 Install waterproofing in accordance with manufacturer's instructions.

.3 Lap waterproofing ends and edges 50 mm minimum. Roll waterproofing and laps for continuous adhesion over entire substrate area; use manufacturer's recommended roller.

.4 Extend waterproofing as required to connect to other components of work comprising waterproofing system.

.5 Cut and fit waterproofing as required for passage of protrusions, ensuring continuous adherence to substrate.

.6 At end of days' work, trowel mastic water cut-off along uppermost edge of incomplete waterproofing assembly, to prevent loss of adhesion and damage waterproofing.

.7 Supply and install continuous mechanical fastening bar to clamp waterproofing both sides of unfilled gaps, cracks, and joints.

.8 Supply and install protection board in accordance with detailed system, and manufacturer's instructions.

3.4 **REPAIR**

.1 Repair misaligned or inadequately lapped seams, punctures, or other damage with additional ply of waterproofing sized to extend 150 mm minimum in all directions from repair edge.

END OF SECTION

1 General

1.1 **SECTION INCLUDES**

.1 Labour, Products, equipment and services necessary for the application of cementitious waterproofing work at the interior floor and walls of elevator pit(s) in accordance with the Contract Documents.

1.2 **SUBMITTALS**

.1 Product data:
- .1 Submit duplicate copies of manufacturer's Product data in accordance with the Conditions of the Contract indicating:
  - .1 Performance criteria, installation details, physical properties, detailed application and installation instructions, and limitations.
  - .2 Product transportation, storage, and handling requirements.

.2 Shop drawings: Submit shop drawings in accordance with the Conditions of the Contract indicating materials, details, dimensions, thickness, treatment of joints and cracks, protection, penetration details, and relationship to adjacent construction.

.3 Certificates:
- .1 Submit certifications for items required at least 4 weeks prior to installation of work of this Section.
- .2 Submit manufacturer's certification that waterproofing system materials and accessories supplied are compatible, meet Specification requirements and that installer is approved by membrane manufacturer.
- .3 Submit inspection reports, within 3 working days after each inspection, and certification by manufacturer confirming that installations are in accordance with manufacturer's requirements.

.4 Extended warranty: Submit extended warranty signed and registered by the manufacturer providing the warranty in the name of the Owner for the timeframe and coverage specified in this Section.

1.3 **QUALITY ASSURANCE**

.1 Installers qualifications: Perform work of this Section by a company that has a minimum of five years proven experience in the installation of cementitious waterproofing of a similar size and nature and that is approved by manufacturer. Submit to Consultant, applicator's current certificate of approval by the material manufacturer as proof of compliance.

.2 Cementitious waterproofing system shall be tested in accordance with the following standards and conditions, and the testing results shall meet or exceed the performance requirements as specified herein:
- .1 Independent Laboratory: Testing shall be performed by an independent laboratory meeting the requirements of the Standards Council of Canada. Testing laboratory shall obtain all concrete samples and water proofing product samples.

.2 Crystalline Penetration: Crystallizing capability of waterproofing material shall be evidenced by independent SEM (Scanning Electron Microscope) photographs documenting penetration of crystal-forming waterproofing material to a depth of 50 mm.

.3 Permeability:

.1 Independent testing shall be performed according to U.S. Army Corps of Engineers CRD C48-73 "Permeability of Concrete".

.2 Concrete samples (treated and untreated) to have design strength of 13.8 MPa and thickness of 50 mm. No admixtures permitted.

.3 Coatings to have maximum thickness of 1 mm per coat with up to two coats permitted.

.4 Samples to be pressure tested to 1.2 MPa (121.5 m head of water).

.5 Treated samples, after crystalline growth has occurred, shall exhibit no measurable leakage.

.4 Chemical Resistance:

.1 Independent testing shall be performed according to ASTM C267 "Chemical Resistance of Mortars" and ASTM C39 "Compressive Strength of Cylindrical Concrete Specimens".

.2 Concrete samples (treated and untreated) to have design strength of 27.6 MPa. No admixtures permitted.

.3 Coatings to have maximum thickness of 1 mm per coat with up to two coats permitted.

.4 Untreated and treated specimens to be immersed for a minimum of 84 days in following chemical solutions: hydrochloric acid (3.5pH), brake fluid, transformer oil, ethylene glycol, toluene, caustic soda.

.5 Treated specimens shall exhibit no detrimental effects after exposure, and shall have a minimum of 14% increase in compressive strength versus untreated control specimens.

.6 Potable Water Approval: Independent testing shall be performed according to NSF Standard 61 and approval for use of waterproofing material on structures holding potable water shall be evidenced by NSF certification.

.3 Mock-up:

.1 Construct one 3 m^2 mock-up of waterproofing in location acceptable to Consultant.

.2 Demonstrate as a minimum one inside corner, one outside corners, surface preparation, and typical installation.

.3 Arrange for Consultant's review and acceptance, allow 48 hours after acceptance before proceeding with work.

.4 Mock-up may remain as part of Work if accepted by Consultant. Remove and dispose of mock-ups which do not form part of Work.

.5 Upon acceptance, mock-up shall serve as a minimum standard of quality for the balance of the work of this Section.

.4 Pre-installation meetings:

.1 Arrange with manufacturer's representative and Consultant to inspect substrates, and to review installation procedures 48 hours in advance of installation.

1.4 **DELIVERY, STORAGE, AND HANDLING**

.1 Store packaged materials in original undamaged containers with manufacturers labels and seals intact, in dry enclosed area, off the ground. Prevent damage of materials during handling and storage.

.2 Handle and store materials in accordance with manufacturers written instructions.

1.5 **SITE CONDITIONS**

.1 Do not install work of this Section outside of following environmental ranges without Consultant's and Product manufacturer's written acceptance:
.1 Ambient air and surface temperature are below: 5°C.
.2 Precipitation: None.

.2 Ensure that temperature of substrate and its moisture content conforms to manufacturer's minimum requirements, before proceeding with work.

.3 Supply and install temporary protection and facilities to maintain Product manufacturer's, and above specified environmental requirements for 24 hours before, during, and 24 hours after installation.

1.6 **EXTENDED WARRANTY**

.1 Submit an extended warranty for cementitious waterproofing work in accordance with the General Conditions of the Contract, except that warranty period is extended to five years from date of Substantial Performance of the Work. .
.1 Warrant work against leakage.
.2 Coverage: Complete replacement including affected adjacent Work.

2 Products

2.1 **MATERIALS**

.1 Cementitious Waterproofing system: Furnish a waterproofing system comprising of cement quartz and other non-toxic chemicals, and additives which, on contact with moisture, produce a crystalline growth throughout the capillary voids in the concrete. 'MasterSeal 500' by Master Builders Solutions, 'Permaquik Crystalline Waterproofing' by Tremco, 'Cem-Kote CW Plus' by W.R. Meadows or equivalent product(s) by Xypex Chemical Corporation.

2.2 **MIXES**

.1 Mix waterproofing material, by volume with clean water free from salt and deleterious materials, to the required proportions and consistency in accordance with manufacturer's written recommendations to achieve.

.2 Mix waterproofing material in quantities that can be applied within 20 to 30 minutes from time of mixing.

.3 As mixture thickens, stir frequently, but do not add additional water. Do not mix bonding agents or admixtures with cementitious waterproofing materials.

3 Execution

3.1 **EXAMINATION**

.1 Verify that concrete surfaces are sound and clean, and that form release agents and materials used to cure the concrete are compatible with waterproofing treatment.

.2 Examine surfaces to be waterproofed for form tie holes and structural defects such as honeycombing, rock pockets, faulty construction joints and cracks. Such defects to be repaired in accordance with manufacturer's written instructions.

.3 Verify condition and dimensions of previously installed work upon which this Section depends. Report defects to Consultant. Commencement of work of this Section means acceptance of existing conditions.

3.2 **PREPARATION**

.1 Verify substrate surfaces are solid, free from surface water, frozen matter, dust, oil, grease, scaling or laitance, projections and any other foreign matter detrimental to performance. Obtain manufacturer's approval of substrate in writing, submit copy to Consultant.

.2 Concrete surfaces to receive waterproofing shall have an open capillary system to provide tooth and suction, and shall be free from scale, excess form oil, laitance, curing compounds and foreign matter.

.3 Smooth surfaces or surfaces covered with excess form oil or other contaminants shall be washed, lightly sand-blasted, water-blasted, or acid etched with muriatic acid as necessary to provide a clean absorbent surface. Surfaces to be acid-etched shall be saturated with water prior to application of acid.

.4 Surface defects shall be repaired in accordance with manufacturer's instructions and as follows:

.1 Form Tie Holes, Construction Joints, Cracks: Chip out defective areas in a "U" shaped slot 25 mm wide and a minimum of 25 mm deep. Clean slot of debris and dust. Soak area with water and remove excess surface water. fill the foregoing with material suited for the purpose by the material manufacturer and finish flush to wall.

.2 Rock Pockets, Honeycombing or Other Defective Concrete: Rout out defective areas to sound concrete. Remove loose materials and saturate with water. Remove excess surface water and fill with material suited for the purpose by the material manufacturer and finish flush to wall.

.3 Prior to application of waterproofing treatment, thoroughly saturate concrete surfaces with clean water as required to ensure migration of crystalline chemicals into voids and capillary tracts of the concrete. Remove free surface water before application.

3.3 INSTALLATION

.1 Install cementitious waterproofing in accordance with reviewed shop drawings and manufacturer's written instructions.

.2 Construction Joints: Apply waterproofing in slurry form at a minimum rate of 1.0 kg/m^2 to joint surfaces between concrete pours. Moisten surfaces prior to slurry application. Where joint surfaces are not accessible prior to pouring new concrete, consult manufacturer for application procedure.

.3 Walls:
- .1 Apply waterproofing uniformly to concrete surfaces with semi-stiff bristle brush or broom, or suitable spray equipment.
- .2 Apply waterproofing in 2 coats to a minimum application rate of 1.0 kg/m^2.
- .3 When brushing, work slurry well into surface of the concrete, filling surface pores and hairline cracks. When spraying, hold nozzle close enough to ensure that slurry is forced into pores and hairline cracks.

.4 Slabs:
- .1 Remove ponding water on slab and allow concrete to dry to a damp appearance.
- .2 Over freshly floated concrete, broadcast waterproofing material dry onto concrete at time in initial set at a minimum rate of 1.0 kg/m^2. Float and then machine trowel concrete to a smooth, level and dense surface. Free from trowel marks, ridges, pinholes, and other defects.
- .3 If it is not possible to broadcast waterproofing onto slab, waterproofing can be installed in slurry form. Application would be similar to wall application specified herein.

3.4 CURING

.1 Begin curing as soon as waterproofing has hardened sufficiently so as not to be damaged by a fine spray. Cure waterproofing with a mist fog spray of clean water three times a day for 2 to 3 days, or cover treated surfaces with damp burlap for the prescribed period. In warm climates, more than three sprayings per day may be necessary to prevent excessive drying of coating.

.2 During the curing period, protect treated surfaces from damage by wind, sun, rain and temperatures below 2°C. If plastic sheeting is used for protection, it must be raised off of waterproofing coating to allow sufficient air circulation.

3.5 FIELD QUALITY CONTROL

.1 Flood test:
- .1 Do not conceal waterproofing until inspection and testing are completed to satisfaction of Consultant.
- .2 Temporarily plug drains and dam horizontal surface areas to be tested and flood with water to minimum depth of 50 mm.
- .3 Maintain flooded depth for 24 hours.
- .4 If leaks occur repair and retest.
- .5 Remove water at end of test.

3.6 CLEANING

.1 Clean to Consultant's approval, soiled surfaces, spatters, and damage caused by work of this Section.

.2 Check area drains to ensure cleanliness and proper function, and remove debris, equipment and excess material from site.

END OF SECTION

1 General

1.1 **SECTION INCLUDES**

.1 Labour, Products, equipment and services necessary for the thermal insulation work in accordance with the Contract Documents.

1.2 **REFERENCES**

.1 CGSB 71-GP-24M, Flexible Adhesive for Bonding Cellular Polystyrene Insulation.

.2 CAN/ULC-S701, Thermal Insulation, Polystyrene, Boards and Pipe Covering.

.3 CAN/ULC-S702, Mineral Fibre Thermal Insulation for Buildings.

1.3 **SUBMITTALS**

.1 Product data: Submit manufacturer's Product data in accordance with the Conditions of the Contract indicating characteristics, performance criteria, and limitations. Indicate installation requirements and techniques, storage, and handling criteria and installation procedure acceptable to manufacturer.

.2 Certification: Submit installer's certification verifying compliance with specification requirements.

1.4 **QUALITY ASSURANCE**

.1 Qualifications: Execute work of this Section by company specializing in thermal insulation work with minimum of three years, recent, documented experience, on work of comparable complexity and scope.

2 Products

2.1 **MATERIALS**

.1 All materials under work of this Section, including but not limited to, adhesives are to have low VOC content limits.

2. Batt insulation:
   .1 Batt insulation (non-rated): CAN/ULC-S702, Type 1, friction fit; 'Unfaced Thermal and Sound Control Batts' by Johns Manville, 'EcoTouch Pink Fiberglas Insulation' by Owens Corning Canada or 'ComfortBatt' by Rockwool.
   .2 Batt insulation (fire-rated/acoustic): ASTM C665, Paperless, semi-rigid, spun stone wool fibre mats, of thickness as indicated on Contract Drawings, 'MinWool SAFB' by Johns Manville, 'SAFB Thermafiber' by Owens Corning Inc. or 'Rockwool AFB' by Rockwool.

.3 Rigid insulation: CAN/ULC-S701, Type 4; Minimum RSI of 0.87, Extruded polystyrene, ship-lapped edges. Thickness: As indicated on Drawings.
- .1 'Styrofoam SM' by Dupont de Nemours Inc.
- .2 'Foamular C-300' by Owens Corning Canada Inc.

.4 Adhesive for polystyrene insulation: CGSB 71-GP-24M, Type 2, Class A, and approved by air/vapour barrier manufacturer when adhesive is in direct contact with air/vapour barrier membrane.

3 Execution

3.1 **EXAMINATION**

.1 Verify condition of previously installed Work upon which this Section depends. Report defects to Consultant. Commencement of work of this Section means acceptance of existing conditions.

.2 Ensure substrate surfaces are dry, clean, suitable to receive adhesive and free from other deleterious substances.

3.2 **INSTALLATION**

.1 Install thermal insulation in longest panel sizes possible in accordance with manufacturer's instructions.

.2 Butt insulation with moderate contact and, cut and fit them tightly around other construction elements. Offset single layer vertical joints and both vertical and horizontal joints in multiple layer applications.

.3 Make thermal insulation continuous, maintain thermal protection continuity and secure to prevent displacement. Ensure that insulation is tight to substrate without air gaps.

.4 Cut and fit thermal insulation tightly around electrical boxes, plumbing and heating pipes and ducts, exterior doors and windows, and other protrusions.

.5 Leave 75 mm separation between thermal insulation and heat emitting devices such as recessed light fixtures.

.6 Cut and trim thermal insulation neatly to fit spaces; do not excessively compress insulation to fit. Install only thermal insulation boards which are free from chipped or broken edges.

.7 Fill miscellaneous cavities with insulation to maintain continuity of thermal barrier. Do not compress insulation to fit.

.8 Arrange for Consultant to review thermal insulation before it is enclosed.

3.3 **SECUREMENT**

.1 Batt insulation (non-rated):
- .1 Install batt insulation in partitions, between studs, and as indicated on Contract Drawings and in accordance with the manufacturer's instructions.
- .2 Fill stud cavities to full height of partitions and carefully cut and fit required batt insulation type around services and protrusions.

.2 Rigid insulation (Adhesive attachment):
- .1 Apply adhesive to thermal insulation foam boards in accordance with manufacturer's recommendations.
- .2 Omit adhesive bonding of foam board insulation over expansion and control joints.

END OF SECTION

1 General

1.1 **SECTION INCLUDES**

.1 Labour, Products, equipment and services necessary for sprayed foam insulation work in accordance with the Contract Documents.

1.2 **REFERENCES**

.1 ASTM A653/A653M, Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvanealed) by the Hot-Dip Process.

.2 ASTM D1621, Standard Test Method for Compressive Properties Of Rigid Cellular Plastics.

.3 ASTM D1622, Standard Test Method for Apparent Density of Rigid Cellular Plastics.

.4 ASTM D1623, Standard Test Method for Tensile and Tensile Adhesion Properties of Rigid Cellular Plastics.

.5 ASTM D2842, Standard Test Method for Water Absorption of Rigid Cellular Plastics.

.6 ASTM E96, Standard Test Methods for Water Vapor Transmission of Materials.

.7 CAN/ULC S705.1, Standard for Thermal Insulation - Spray Applied Rigid Polyurethane Foam, Medium Density, Material Specification.

.8 CAN/ULC S705.2, Standard for Thermal Insulation - Spray Applied Rigid Polyurethane Foam, Medium Density, Application.

1.3 **SUBMITTALS**

.1 Product data:
- .1 Submit duplicate copies of manufacturer's Product data in accordance with the Conditions of the Contract indicating:
  - .1 Performance criteria, characteristics, and limitations.
  - .2 Product transportation, storage, handling and installation requirements.

.2 Shop drawings:
- .1 Submit shop drawings in accordance with the Conditions of the Contract indicating:
  - .1 Elevations, sections, materials, details of joint conditions, including door, window, entrance framing, flashings, and roof parapet connection.

.3 Certificates: Submit the following certificates in accordance with the Conditions of the Contract:
- .1 Applicator's current certificate of approval by CUFCA/NECA or BASF Canada's training program.
- .2 Applicator's current certificate of approval from material manufacturer.

1.4 **QUALITY ASSURANCE**

.1 Perform work of this Section by a company that has a minimum of five years proven experience in installations of similar size and nature.

.2 Contractor to be a certified member of the Canadian Urethane Foam Contractors Association/ National Energy Conservation Association (CUFCA/NECA) or be licensed under the BASF Canada Quality and Training Program "Raising Performance to New Heights" and in accordance with CAN/ULC S705.2 installation standard.

.3 Provide quality assurance testing in accordance with CAN/ULC S705.2. Record daily results in a log book for Consultant's review.

.4 Provide adhesion tests on membranes, in accordance with manufacturer's written instructions, at the perimeters of all openings. If the project comprises more than 10 openings, adhesion tests should be conducted on 15% of them. For jobs comprising 10 or fewer openings, 30% of these should undergo adhesion tests. Adhesion tests should be performed on the transition membranes at every tenth column or beam.

.5 Mock-up:
- .1 Construct mock-up of 3 m^2 minimum, of spray-in-place foam insulation to thickness as indicated on drawings, including one inside corner and one outside corner.
- .2 Arrange for Consultant's review and acceptance, allow 24 hours before proceeding with work.
- .3 When accepted, mock-up will demonstrate minimum standard for this work. Mock-up may remain as part of Work if accepted by Consultant. Remove and dispose of mock-ups which do not form part of Work.

1.5 **SITE CONDITIONS**

.1 Do not install work of this Section outside of following environmental ranges without Consultant's and Product manufacturer's written acceptance:
- .1 Ambient air and surface temperature: 5^0C to 40^0C.
- .2 Relative Humidity: Above 85%.

.2 Supply and install temporary protection and facilities to maintain Product manufacturer's, and above specified environmental requirements for 48 hours before, during, and 48 hours after installation.

2 Products

2.1 **MATERIALS**

.1 All materials under work of this Section, including but not limited to, primers and sealants are to have low VOC content limits.

.2 Sprayed foam insulation: Sprayed/frothed polyurethane foam conforming to CAN/ULC S705.1. and utilizing a HFO blowing agent and conforming to the following minimum requirements:

.1 Density (ASTM D1622): 29.6 kg/m3.
.2 Open cell content (ASTMD2856): 5.6%.
.3 Tensile strength (ASTM D1623): 313 kPa.
.4 Compressive strength (ASTM D1621): 236 kPa.
.5 Water absorption (ASTM D2842): 0.6% by volume.
.6 Water vapour permeance (ASTM E96): 50mm sample 56 ng/Pa·s·m2 (0.98 Perms).
.7 Flame spread: <500.
.8 Sprayed urethane foam: 'Walltite CM01' by BASF or 'Heatlok Soya HFO' by Huntsman Building Solutions.

.3 Primers: As recommended by sprayed foam insulation manufacturer.

3 Execution

3.1 **EXAMINATION**

.1 Verify condition and dimensions of previously installed Work upon which this Section depends. Report defects to Consultant. Commencement of work of this Section means acceptance of existing conditions.

3.2 **PREPARATION**

.1 Verify substrate surfaces are solid, free from surface water, frozen matter, dust, oil, grease, scaling or laitance, projections and any other foreign matter detrimental to performance. Obtain manufacturer's approval of substrate in writing, submit copy to Consultant.

.2 Provide ventilation in area to receive sprayed foam insulation, introducing and exhausting fresh air continuously during and for 24 hours after application.

.3 Provide temporary enclosures to prevent spray from contaminating air beyond application area, and damage from overspray and dusting on adjacent surfaces.

.4 Supply and install temporary protection to adjacent surfaces to prevent damage resulting from work of this Section.

.5 If required, apply primer to substrate surfaces in accordance with manufacturer's written instructions.

3.3 **SPRAY INSULATION**

.1 Install insulation in accordance with manufacturer's written instructions.

.2 Apply sprayed foam insulation to thickness indicated on drawings and to provide continuous air retarder in locations indicated on the Drawings. Apply insulation to within 3 mm of thickness indicated on drawings. Provide one measuring pin for every 50 m^2.

.3 Insulation thickness greater than 50 mm shall be completed in a minimum of 2 steps.

.4 Insulation to be continuous, level, plumb and uniform thickness throughout. Insulation shall be free of voids and imbedded foreign materials.

3.4 INSPECTION AND TESTING

.1 Independent Inspection and Testing Consultants will be engaged by the Owner for the purpose of inspecting and/or testing individual portions of the Work

END OF SECTION

1 General

1.1 **SECTION INCLUDES**

.1 Labour, Products, equipment and services necessary for air/vapour barriers Work in accordance with the Contract Documents.

1.2 **REFERENCES**

.1 ASTM E1643, Standard Practice for Selection, Design, Installation, and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs.

.2 ASTM E1745, Standard Specification for Water Vapour Retarders used in contact with Soil or Granular Fill under Concrete Slabs.

.3 CAN/CGSB 19.21-M, Sealing and Bedding Compound, Acoustical.

.4 CAN/CGSB-51.34-M, Vapour Barrier, Polyethylene Sheet, for Use in Building Construction.

1.3 **SUBMITTALS**

.1 Product data:
- .1 Submit duplicate copies of manufacturer's Product data in accordance with the Conditions of the Contract indicating:
  - .1 Performance criteria, compliance with appropriate reference standard, characteristics, and limitations.
  - .2 Product transportation, storage, handling and installation requirements.

.2 Samples: Submit following samples in accordance with the Conditions of the Contract:
- .1 Two 300 x 300 mm samples of vapour retarders.
- .2 Two samples, 300 mm long, of fastening bar.
- .3 Duplicate samples of pipe and conduit boot.

1.4 **QUALITY ASSURANCE**

.1 Mock-up:
- .1 Construct one 10 m2 mock-up of each type air/vapour barrier in location acceptable to Consultant indicating as a minimum one lap joint, one inside corner, one window interface, one wall electrical box, and floor pipe penetration.
- .2 Arrange for Consultant's review and acceptance.
- .3 Mock-up may remain as part of Work if accepted by Consultant. Remove and dispose of mock-ups which do not form part of Work.

1.5 **SITE CONDITIONS**

.1 Do not install the work of this Section outside of environmental ranges as recommended by manufacturer without Consultant's and Product manufacturer's written acceptance.

.2 Supply and install temporary protection and facilities to maintain Product manufacturer's, and above specification, environmental requirements before, during, and after installation.

2 Products

2.1 **WALL AIR/VAPOUR BARRIER MATERIALS**

.1 All materials under work of this Section, including but not limited to, primers and sealants are to have low VOC content limits.

.2 Membrane air/vapour retarder: 1.0 mm thick, single-ply, self adhering, self sealing, rubberised asphalt, bonded to a cross-laminated high density polyethylene film. 'Blueskin SA' by Henry Company Canada Inc., or approved alternative by Soprema or W.R. Meadows.

.1 Primer: 'Blueskin Adhesive' by Henry Company Canada Inc., or approved alternative by Soprema or W.R. Meadows

.2 Mastic: 'Polybitume 570-05' by Henry Company Canada Inc. or approved alternative by Soprema or W.R. Meadows.

.3 Fastening bar: Continuous 25 mm wide x 3 mm thick aluminum bar, predrilled for mechanical attachment.

.4 Fasteners: As specified herein or manufacturer's recommended fastener for attaching to Substrate.

2.2 **SHEET AIR/VAPOUR BARRIER MATERIALS**

.1 Sheet vapour retarder 'Super Six' Polyethylene film to CAN/CGSB-51.34, 0.15 mm (6 mil) thick.

.1 Joint sealing tape: Air and vapour resistant pressure sensitive adhesive tape, type recommended by sheet vapour retarder manufacturer, 50 mm wide for lap joints and perimeter seals, 25 mm wide elsewhere.

.2 Sealant: CAN/CGSB 19.21; One-part, non-sag, non-bleeding, non-drying, non-hardening, sealant shall remain tacky for permanent bonding to all surfaces; 'Tremco Acoustical Sealant' by Tremco Ltd. or approved alternative.

2.3 **UNDERSLAB AIR/VAPOUR BARRIER MATERIALS**

.1 All materials under work of this Section, including but not limited to, primers and sealants are to have low VOC content limits.

.2 Air/vapour barrier (under concrete slab-on-grade): ASTM E1745, Class A, 0.38 mm (15 mil) thick. Permeance as tested after conditioning, less than 0.010 perms (gr/ft^2/hr/in.hg), 0.570 ng/(Pa*s*m^2); 'Stego Wrap Vapor Barrier' by Stego Industries or 'Perminator' by W.R. Meadows.

.1 Joint sealing tape: High density polyethylene tape with pressure sensitive adhesive with minimum width 100 mm. Type recommended by sheet air/vapour retarder manufacturer.

.2 Pipe and conduit boots: Construct pipe and conduit boots from air/vapour retarder material and pressure sensitive tape as recommended by manufacturer.

3 Execution

3.1 **EXAMINATION AND COORDINATION**

.1 Verify condition and dimensions of previously installed Work upon which this Section depends. Report defects to Consultant. Commencement of work of this Section means acceptance of existing conditions.

.2 Verify that existing substrates to receive vapour retarder are clean, dry, sound, smooth, and continuous.

.3 Coordinate installation of vapour retarders with work of other Sections to achieve a vapour tight building envelope.

3.2 **MEMBRANE WALL AIR/VAPOUR RETARDER INSTALLATION**

.1 Fill substrate voids, gaps, depressions, cracks, and joints with mastic until continuous, smooth, substrate for air/vapour barrier is achieved.

.2 Prime substrate surfaces to receive air/vapour barrier in accordance with manufacturer's instructions, at recommended application rate, allow to dry. Vary coverage to suit surface porosity.

.3 Prime surfaces. Re-prime surfaces if not covered with air/vapour barrier within 4 hours.

.4 Install mastic where required to ensure integrity of air/vapour barrier installation at protrusions and other complex details.

.5 Install air/vapour barrier in accordance with manufacturer's instructions in locations indicated.

.6 Lap air/vapour retarder ends and edges 50 mm minimum. Roll air/vapour retarder and laps for continuous adhesion over entire substrate area; use manufacturer's recommended roller.

.7 Extend air/vapour barrier as required to connect to other components of Work comprising air/vapour barrier system.

.8 Provide end-dams and terminations fabricated from same material as membrane air/vapour retarder or material recommended by membrane manufacturer at sills, lintels, openings, and where horizontal surfaces intersect with vertical surfaces to ensure moisture is shed to exterior.

.9 Cut and fit air/vapour retarder as required for passage of protrusions, ensuring continuous adherence to substrate.

.10 At end of days' work, trowel mastic water cut-off along uppermost edge of incomplete air/vapour retarder assembly, to prevent loss of adhesion and damage air/vapour retarder.

.11 Supply and install continuous mechanical fastening bar to clamp air/vapour retarder both sides of unfilled gaps, cracks, and joints.

3.3 SHEET VAPOUR RETARDER INSTALLATION

.1 Ensure services are installed and inspected prior to installation of retarder.

.2 Install sheet vapour retarder on the warm side of exterior wall, roof, and ceiling assemblies, prior to installation of roof insulation or interior finishes to form a continuous vapour retarder.

.3 Use sheets of largest practical size to minimize joints.

.4 Inspect for continuity. Repair punctures and tears with sealing tape before work is concealed.

.5 At exterior surface openings, cut vapour retarder to form openings and ensure material is lapped and sealed to frame.

.6 Ensure continuity of vapour retarder is maintained at junctures with other materials.

.7 At perimeter seals, seal perimeter of sheet vapour retarder as follows:
- .1 Apply continuous bead of sealant to substrate at perimeter of sheets.
- .2 Lap sheet over sealant and press into sealant bead.
- .3 Ensure that no gaps exist in sealant bead. Smooth out folds and ripples occurring in sheet over sealant.

.8 Seal lap joints of sheet vapour retarder as follows:
- .1 Attach first sheet to substrate.
- .2 Apply continuous bead of sealant over solid backing at joint.
- .3 Lap adjoining sheet minimum 150 mm and press into sealant bead.
- .4 Ensure that no gaps exist in sealant bead. Smooth out folds and ripples occurring in sheet over sealant.

.9 Seal electrical switch and outlet device boxes that penetrate vapour retarder as follows:
- .1 Wrap boxes with film sheet providing minimum 300 mm perimeter lap flange.
- .2 Apply sealant to seal edges of flange to main vapour retarder and seal wiring penetrations through box cover.

3.4 UNDERSLAB AIR/VAPOUR BARRIER INSTALLATION

.1 Ensure services are installed and inspected prior to installation of barrier.

.2 Install sheet air/vapour barrier under the floor slab and return up adjacent walls prior to installation of floor slab, to form a continuous air/vapour barrier in accordance with ASTM E1643 and manufacturer's written instructions.

.3 Lap air/vapour barrier over footings and seal to foundation walls.

.4 Overlap joints 150 mm and seal with manufacturer approved sealing tape.

.5 Seal all penetrations (including conduits and pipes) with manufacturer's pipe boot.

.6 Use sheets of largest practical size to minimize joints.

.7 Inspect for continuity. Repair punctures and tears by using patches of air/vapour barrier and overlapping damaged areas by minimum 150 mm on all sides and taping with sealing tape before work is concealed.

3.5 FIELD QUALITY CONTROL

.1 Inspect vapour retarder continuity immediately prior to installation of subsequent construction. Repair punctures, rips and tears to ensure continuity of vapour retarder.

.2 Where punctures and tears are extensive, replace entire damaged section.

.3 Do not cover or permit to be covered any portion of vapour retarder until it has been inspected by Consultant.

END OF SECTION

1 General

1.1 **SECTION INCLUDES**

.1 Design, labour, Products, tools, equipment and services necessary for exterior soffit system work complete in accordance with the Contract Documents.

1.2 **REFERENCES**

.1 AAMA 2604, Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels.

1.3 **DESIGN REQUIREMENTS**

.1 Design soffit system to accommodate expansion and contraction of soffit elements without causing buckling, failure of joints, undue stress on fasteners or other effects detrimental to appearance or performance.

1.4 **SUBMITTALS**

.1 Product data:
- .1 Submit duplicate copies of manufacturer's Product data in accordance with the Conditions of the Contract indicating:
  - .1 Performance criteria, compliance with appropriate reference standard, characteristics, and system limitations.
  - .2 Product transportation, storage, handling and installation requirements.

.2 Shop drawings:
- .1 Submit shop drawings in accordance with the Conditions of the Contract indicating:
  - .1 Details, sections, dimensions, tolerances, connections, terminations, control joints, system components, installation sequence, accessories and other pertinent information required for proper and complete installation.
  - .2 Complete design data to confirm that soffit system meet design requirements specified.

.3 Samples: Submit two 300 x 300 mm samples of complete soffit system in accordance with the Conditions of the Contract.

.4 Reports: Submit written inspection reports within 5 working days after each inspection.

.5 Closeout submittals: Submit maintenance and cleaning instructions for soffit system for incorporation into Operations and Maintenance Manuals in accordance with the Conditions of the Contract.

1.5 **QUALITY ASSURANCE**

.1 Installers qualifications: Perform work of this Section by a company that has a minimum of five years proven experience installing work of similar size and nature and that is approved by system manufacturer. Submit to Consultant, applicator's current certificate of approval by the material manufacturer as proof of compliance.

.2 Soffit system manufacturer shall conduct Site inspections, prepare and submit written inspection reports verifying that this part of Work is in accordance with Contract Documents and reviewed shop drawings. Perform inspections once per week minimum.

.3 Mock-up:
- .1 Construct one 3000 mm minimum mock-up of soffit system in location acceptable to Consultant.
- .2 Arrange for Consultant's review and acceptance.
- .3 Mock-up may remain as part of Work if accepted by Consultant. Remove and dispose of mock-ups which do not form part of Work.

1.6 **SITE CONDITIONS**

.1 Supply and install temporary protection and facilities to maintain Product manufacturer's, and above specified environmental requirements for 24 hours before, during, and 24 hours after installation.

.2 Do not proceed with application of materials immediately prior to, during or immediately after inclement conditions, or if wet weather is anticipated within 24 hours after application. Do not apply materials to wet, frozen, or frosted surfaces.

1.7 **EXTENDED WARRANTY**

.1 Submit an extended warranty for soffit system work in accordance with the General Conditions, except that the warranty period is extended to 5 years from date of Substantial Performance of the Work.
- .1 Warrant against failure to meet the design criteria and requirements such as failure to stay in place, cracking, warping, and finish degradation.
- .2 Coverage: Complete replacement including affected adjacent Work.

2 Products

2.1 **MATERIALS**

.1 All materials under work of this Section, including but not limited to, coatings, sealants, primers, and sealers are to have low VOC content limits.

.2 Exterior soffit: 200 mm wide x 0.61 mm thick steel panels, pre-finished wood-look panels, 135 mm wide profile; 'Bellara' as manufactured by Vicwest or approved equal. Colour to be 'Royal Grey'. Provide perforated sections where indicated on the drawings for soffit venting.

.3 Accessories: Provide accessories as recommended by siding and soffit manufacturer, in locations shown on Contract Drawings.

.4 Fasteners: Provide type 304 stainless steel fasteners.

.5 Sealant and sealant primer: In accordance with Section 07 92 00.

3 Execution

3.1 **EXAMINATION**

.1 Verify condition and dimensions of previously installed Work upon which this Section depends. Report defects to Consultant. Commencement of work of this Section means acceptance of existing conditions.

3.2 **PREPARATION**

.1 Verify substrate surfaces are solid, free from surface water, frozen matter, dust, and other foreign matter detrimental to performance. Ensure environmental and site conditions are suitable for installation of system.

.2 Supply and install temporary protection to adjacent surfaces to prevent damage resulting from work of this Section.

.3 Prepare surfaces in accordance with manufacturer's written instructions.

.4 Protect finished work at end of each day or on completion of each section of work from water penetration. Protect completed installation from moisture for 48 hours minimum.

3.3 **SOFFIT SYSTEM**

.1 Install soffit system in accordance with reviewed shop drawings and manufacturer's written instructions. Comply with system manufacturer's requirements regarding terminations at end of each days work and resumption of work.

3.4 **CONTROL JOINTS**

.1 Install 12.7 mm control joints at the following locations:
- .1 Soffit abuts a structural element, dissimilar wall or other vertical penetration.
- .2 Construction changes within the plane of the soffit.
- .3 Ceiling or soffit dimensions exceed 15 m in either direction.
- .4 Locations indicated on drawings.

END OF SECTION

1 General

1.1 **SECTION INCLUDES**

.1 Design, labour, Products, equipment and services necessary for aluminum composite panel Work in accordance with the Contract Documents.

1.2 **REFERENCES**

.1 AAMA 2605, High Performance Organic Coatings on Architectural Extrusions and Panels.

.2 AAMA CW-10, Care and Handling of Architectural Aluminum from Shop to Site.

.3 ANSI B18.6.4, Screws, Tapping and Metallic Drive, Inch Series, Thread Forming and Cutting.

.4 ASTM C612, Standard Specification for Mineral Fiber Block and Board Thermal Insulation.

.5 ASTM C920, Specification for Elastomeric Joint Sealants.

.6 ASTM D1781, Standard Test Method for Climbing Drum Peel for Adhesives.

.7 CAN/CSA-G40.20/G40.21M, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steels.

.8 CSA S136, Cold Formed Steel Structural Members.

1.3 **DESIGN REQUIREMENTS**

.1 Design aluminum composite panel system as a "dry joint system" and to withstand live, dead, lateral, wind, seismic, handling, transportation, and erection loads, imposed and other loads.

.2 Prevent rain penetration through wall system. Design system based on "Rain Screen Principle" in accordance with the National Research Council. Volume to vent ratio should not exceed 25 m. Panels should be compartmentalized at joints. Incorporate means of draining to the exterior.

.3 Design aluminum composite panel system to support its own weight and the wind load, positive and negative, prevalent for the location of the building, but no less than windgust pressure calculated from National Building Code using 1-10 year probability factor. To minimize the potential for "dished" panels after loading, permanent set of the panel, measured normal to the panel surface after application and removal of the design load, must not exceeding L/800 of distance between supported edges of panel or distance between stiffeners where stiffeners are used. Stiffeners, where used, must not deflect more than L/90 of span under load.

.4 Design aluminum composite panel system to accommodate thermal movements of the components and structural movements to provide an installation free of oil canning, buckling, delamination, failure of joint seals, excessive stress on fasteners or any other detrimental effects.

.5 Design aluminum composite panel system to prevent rattling and vibration of panels, overstressing of fasteners and clips, and other detrimental effects on the system.

.6 Panel removal: System design to allow removal of individual panels within wall system.

.7 Design miscellaneous, additional structural framing members as required to complete composite panel system, where not indicated on Contract Drawings.

.8 The attachment face of subgirts supporting the panel system must not deflect vertically more than 3 mm due to the dead load of the panel system.

.9 Design soffit system to accommodate expansion and contraction of soffit elements without causing buckling, failure of joints, undue stress on fasteners or other effects detrimental to appearance or performance.

1.4 SUBMITTALS

.1 Product data:
- .1 Submit copies of manufacturer's Product data in accordance with the Conditions of the Contract indicating:
  - .1 Performance criteria, compliance with appropriate reference standard, characteristics, limitations.
  - .2 Product transportation, storage, handling and installation requirements.

.2 Shop drawings:
- .1 Submit shop drawings in accordance with the Conditions of the Contract indicating:
  - .1 Elevations, details, profiles, dimensions, thickness of materials, finishes, methods of joining, joint location, special shapes, methods of anchoring, anchor and clip details, types of sealants and gaskets, waterproof connections to adjoining work, details of other pertinent components of the work (i.e. windows, penetrations, membranes, etc), and compliance with design criteria and requirements of related work.
  - .2 Complete design data to confirm that soffit system meet design requirements specified.

.3 Samples: Submit two 300 x 300 mm samples of wall panels in the selected colours and finish for approval.

.4 Closeout Submittals: Provide maintenance instructions for incorporation into Operation and Maintenance Manual, specified in the Conditions of the Contract.

1.5 QUALITY ASSURANCE

.1 Retain a licensed Professional Engineer, registered in Province of Ontario, to perform following services for composite panel work:
- .1 Design of aluminum composite panel system.
- .2 Review, stamp, and sign shop drawings.
- .3 Conduct shop and field inspections and prepare and submit inspection reports.

.2 Perform work of this Section only by a Subcontractor of recognized standing who has adequate plant, equipment, and skilled workers to perform it expeditiously, and is known to have been responsible for satisfactory installations similar to that specified during a period of at least the immediate past ten years.

.3 Execute steel welding to CSA W59-M1989 by fabricators certified by the Canadian Welding Bureau to CSA W47.1.

.4 Execute aluminum welding by fabricators certified by the Canadian Welding Bureau to CSA W47.2-M.

.5 Execute finishing coatings and metal pre-treatments by applicators approved in writing by the manufacturer of the coatings and under the supervision of the manufacturer's qualified representative.

.6 Mock-up:
- .1 Fabricate, deliver, and erect a 1200 mm wide x 1800 mm high mock-up panel of composite panel system in location acceptable to Consultant.
- .2 Construct one 3000 mm minimum mock-up of soffit system in location acceptable to Consultant.
- .3 Demonstrate finish, anchoring devices, air/vapour retarder sealing, and quality of workmanship.
- .4 Mock-up may form part of final Work, if acceptable to Consultant. Remove and dispose of mock-ups which do not form part of Work.

1.6 DELIVERY, STORAGE, AND HANDLING

.1 Handle aluminum work in accordance with AAMA CW-10. Protect aluminum surfaces with strippable coating. Do not use adhesive papers or sprayed coatings which bond when exposed to sunlight or weather. Do not remove before final cleaning of building.

.2 Remove and replace all damaged and unsatisfactory materials which are deemed unsuitable for use at this Section's own expense.

1.7 EXTENDED WARRANTY

.1 Submit an extended warranty for composite panel work in accordance with General Conditions, except that warranty period is extended to 3 years from date of Substantial Performance of the Work.
- .1 Warrant against leaking, warping, twisting, joint, and finish failure.
- .2 Coverage: Complete replacement including affected adjacent parts.

.2 Manufacturer's Warranty: Provide panel manufacturer's written warranty naming Owner as beneficiary and 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 from date Work is certified as substantially performed.

2 Products

2.1 **ACCEPTABLE PRODUCTS AND MANUFACTURERS**

.1 Alucobond by Sobotec Ltd.

.2 Accumet PE by Flynn Canada Ltd.

.3 Alpolic Panels by Vicwest Canada.

2.2 **MATERIALS**

.1 All materials under work of this Section, including but not limited to, sealants, paints, and coatings are to have low VOC content limits.

.2 Composite Material: Two sheets of 0.51 mm thick aluminum alloy 3003, sandwiching a core of extruded thermoplastic formed in a continuous process without the use of glues or adhesives between dissimilar materials. Panel thickness: 4 mm. Bond integrity testing to adhere to ASTM D1781.

.3 Finish:
- .1 Exposed to view: 3-coat Polyvinylidene Flouride finish, meeting requirements of AAMA 2605, minimum thickness 2.4 mil.
- .2 Alucobond colours:
  - .1 Steel City Silver Mica.
  - .2 Tuscan Sun.
  - .3 Cupral.
  - .4 Neon Red.
  - .5 Krispy Green.
  - .6 Image Blue.
  - .7 Just Purple.
- .3 Concealed aluminum finish: Mill finish.

.4 Structural shapes, plates, sag rods, and similar items: CAN/CSA-G40.20-G40.21-M, Grade 350W.

.5 Air/vapour barrier: In accordance with Section 07 26 00.

.6 Z-girts and C channels: CAN/CSA S136-M; Minimum 1.2 mm thick, Z275 galvanized. Depth as indicated on Contract Drawings.

.7 Provide all additional structural supports not shown on Drawings as required.

.8 Fasteners: Concealed, ANSI B18.6.4, stainless steel Type 304.

.9 Semi-rigid insulation: Semi-rigid stone wool insulation conforming to ASTM C612, minimum density 70 kg/m^3. Thickness as indicated on Contract Drawings.
- .1 'CladStone 45' by Johns Manville.
- .2 'Thermafiber RainBarrier 45' by Owens-Corning.
- .3 'CavityRock' by Rockwool Inc.

.10 Insulation fasteners:
- .1 Insulation clips: Galvanized steel clips with self locking type washers; 'Insul-Anchors' by Continental Studwelding Ltd., 'Insulation Hanger Studs' by McMaster-Carr, or 'Stud Welders' by Midwest Fasteners Inc.
- .2 Clip adhesive: High strength adhesive having a bonding time of 0 to 30 minutes (rapid initial set) and 48 hours final set, non-corrosive to galvanized steel, compatible and suitable for use in application.

.11 Flashings, Closure Pieces, Trim, Vented Trim and Cap Flashing: Same material and colour as panels.

.12 Clips and Panel Reinforcement: Extruded aluminum.

.13 Sealants: ASTM C920, Type M, Grade NS, Class 25; Two-part, Polyurethane non-sag type, Sikaflex 2C-NS by Sika Canada Inc. or Dymeric 240 by Tremco Ltd. Colour: As selected by Consultant.

.14 Joint backing: Product as recommended by siding sealant manufacturer.

.15 Touch-up paint: as recommended by panel manufacturer.

.16 Isolation coating: Bituminous coating, acid and alkali resistant material.

.17 Plywood sheathing: In accordance with Section 06 10 00.

2.3 FABRICATION

.1 Fabricate facings and concealed support members in a manner which will provide an installation free of exposed fastenings, with sufficient support and allowance for thermal movement to prevent facing distortion. Take site measurements before proceeding with production.

.2 Fabricate components of the system at factory, ready for field installation. Include full continuous joint reveals within system.

.3 Fabricate facings flat, true, free of marks, without visible distortion and with edges straight and true. Make all planes true, and corners square and bend of minimum radius.

.4 Changes of plans, parallel or transverse to longitudinal axis shall be accomplished as detailed on shop drawings in the factory wherever practical and with a minimum of field fabrication.

.5 Form panels to dimensions indicated with tolerances to accommodate expansion and contraction between panels and structure members. Accurately form shaped panels.

.6 Provide proprietary aluminum extrusions to manufacturer's standard profiles for a complete installation. Extrusions shall be full length around panel perimeter for panel reinforcement and alignment. Intermittent clips are unacceptable.

.7 Changes of plans, parallel or transverse to longitudinal axis shall be accomplished as detailed on shop drawings in the factory wherever practical and with a minimum of field fabrication.

.8 Form panels to dimensions indicated with tolerances to accommodate expansion and contraction between panels and structure members. Accurately form shaped panels.

.9 Fabricate panels with flanges on all sides.

.10 Factory fabricate accessory and trim components ready for installation.

.11 Joint filler strip shall be same material and colour as panels. Use of caulking at joints is not acceptable.

.12 Plastic shims shall be used as thermal separator between extrusions and sub-girts.

.13 Maximum allowable tolerances shall be as follows:
- .1 Panel bow: In a concave or convex direction to be 0.5% of panel dimension width and length.
- .2 Panel flatness: Rises and falls across the panel, (local bumps and depressions) will not be accepted.
- .3 Panel tolerance:
  - .1 Width: 2 mm.
  - .2 Length: 4 mm.
  - .3 Thickness: 0.2 mm.
  - .4 Squareness: 5 mm maximum.

3 Execution

3.1 **EXAMINATION**

.1 Verify condition and dimensions of previously installed Work upon which this Section depends. Report defects to Consultant. Commencement of work of this Section means acceptance of existing conditions.

.2 Verify that backup construction is aligned for proper installation of wall panels before commencing erection.

.3 Protect metal surfaces in contact with concrete, masonry mortar, plaster or other cementitious surface with isolation coating.

3.2 **INSTALLATION**

.1 Supply and install miscellaneous, additional structural framing members, required to complete composite panel system, where not indicated on Contract Drawings.

.2 Apply isolation coating to supporting structural framing to isolate airseal liner panel and to prevent galvanic corrosion.

.3 Supply and install wood sheathing in accordance with Section 06 10 00 and air/vapour retarder in accordance with Section 07 26 00.

.4 Erect wall panels complete with girts, clips, and fasteners, to meet design criteria. Anchor each individual panel over solid backing. Ensure that all penetrations through air/vapour barrier are sealed.

.5 Install panels, support and anchoring system, fasteners, trim and related items to lines and elevations indicated and in strict accordance with reviewed shop/erection drawings and manufacturer's printed instructions. Carefully co-ordinate work with other Sections.

.6 Anchor component parts to transmit wind loading and other stresses to anchorage system.

.7 Erect wall panel system in accordance with manufacturer's instructions and under direct supervision of the manufacturer.

.8 Insulation:
- .1 Install insulation in continuous contact with air/vapour retarder and neatly fitted between girts, supports, and anchoring system.
- .2 Notch semi-rigid insulation at location of thermal spacer clip to match top and bottom of clip.
- .3 Push insulation into place, compressing it at clip location. Ensure there are no linear gaps in adjacent insulation boards on either side of clip.
- .4 Install insulation by adhesive clip method in accordance with manufacturer's written instructions and at 400 mm maximum on centre along centreline of insulation boards.
- .5 Locate clips 100 mm from edges of panels where they abut other materials and at joints between panels otherwise, spaced throughout at 300 mm to 450 mm centres each way.
- .6 At clip locations clean supporting surfaces and apply 50 mm square film of adhesive; coat clips with adhesive and press firmly to wall, holding in place until adhesive exudes through clip base perforations; remove excess adhesive to permit curing; impale insulation panels on clips and secure.

.9 Erect panels and joint filler strip in accordance with manufacturer's details to meet specified design criteria and performance. Use concealed fastening only.

.10 Finished work shall be securely anchored, free of distortion, free of surface imperfections and uniform in colour.

.11 Cut and flash wall penetrations.

.12 Erect wall panels in straight lines, true, level, and plumb.

.13 Site Tolerances: Erection tolerances apply to each individual panel and shall not be accumulative:

.1 Maximum deviation from vertical and horizontal alignment of erected panels 3 mm in 6 m.

.2 Maximum offset from alignment between adjacent wall panels: 1.5 mm.

3.3 SOFFIT SYSTEM

.1 Install soffit system in accordance with reviewed shop drawings and manufacturer's written instructions. Comply with system manufacturer's requirements regarding terminations at end of each days work and resumption of work.

3.4 JOINT BACKING AND SIDING SEALANT

.1 Prepare substrate surface and mask as recommended by sealant manufacturer.

.2 Install joint backing and sealant at perimeter of composite panel system and where indicated on drawings for weathertight installation. Tool sealant to concave profile.

.3 Seal around all openings and all other locations indicated or required to provide weathertight and watertight seal.

3.5 REPAIR

.1 Remove damaged, dented, defaced, defectively finished, or tool marked components and replace with new, unless minor blemishes are approved by Consultant.

.2 Only with approval of Consultant, refinish shop applied finishes in field with compatible materials to manufacturer's written instructions.

3.6 CLEANING

.1 Remove all strippable protective film from the work as it is erected and prior to moving on to the next bay or grid.

.2 Wash down exposed exterior surfaces using solution of mild non-acidic detergent in warm water, applied with soft clean wiping cloths.

.3 As work progresses, remove excess sealant with recommended solvent and which will not affect metal, finished surfaces, or adjacent surfaces and matarials.

END OF SECTION

1 General

1.1 **SECTION INCLUDES**

.1 Design, labour, Products, equipment and services necessary for metal siding work in accordance with the Contract Documents.

1.2 **REFERENCES**

.1 ANSI B18.6.4, Screws, Tapping and Metallic Drive, Inch Series, Thread Forming and Cutting.

.2 ASTM A653/A653M, Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvanealed) by the Hot-Dip Process.

.3 ASTM C612, Standard Specification for Mineral Fiber Block and Board Thermal Insulation.

.4 ASTM C920, Specification for Elastomeric Joint Sealants.

.5 CAN/CGSB-1.40-M, Primer, Structural Steel, Oil Alkyd Type.

.6 CAN/CSA-G40.20/G40.21M, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steels.

.7 CSA S136, Cold Formed Steel Structural Members.

.8 CSA S136.1, Commentary on CAN/CSA S136-M, Cold Formed Steel Structural Members.

1.3 **DESIGN REQUIREMENTS**

.1 Design metal siding system in accordance with CSA S136, S136.1, and to withstand live, dead, lateral, wind, seismic, handling, transportation, and erection loads.

.2 Design metal siding system in accordance with following Climatic Design Data for Napanee contained in Ontario Building Code.
  .1 Design Temperature: January 1%, July 2 ½%.
  .2 Wind (Hourly Wind Pressures): 1 in 50 year occurrence.

.3 Design metal siding system to limit deflection under design loads, to L/240.

.4 Design metal siding system to prevent restriction of thermal induced movement which would induce deformation such as warping, buckling, and failure of joint seals and fasteners. Design metal siding system to prevent vibration when subject to the effects of wind.

.5 Design miscellaneous, additional structural framing members and sag rods, required to complete metal siding system, where not indicated on Contract Drawings.

1.4 SUBMITTALS

.1 Product data:
- .1 Submit copies of manufacturer's Product data in accordance with the Conditions of the Contract indicating:
  - .1 Performance criteria, compliance with appropriate reference standard, characteristics, limitations.
  - .2 Product transportation, storage, handling and installation requirements.

.2 Shop drawings: Submit shop drawings indicating elevations, details, profiles, dimensions, thickness of materials, finishes, methods of joining, arrangement of sheets, joints, and seams, special shapes, methods of anchoring, anchor and clip details, types of sealants and gaskets, waterproof connections to adjoining work, details of other pertinent components of the work (i.e. windows, penetrations, membranes, etc), and compliance with design criteria and requirements of related work in accordance with the Conditions of the Contract

.3 Samples: Submit 600 x 600 mm samples of siding system showing fully assembled components including face sheets, sub-girts, insulation, and concealed sealant. Sample to be fabricated using exact colour and gauges specified in accordance with the Conditions of the Contract.

.4 Reports: Submit written field inspection and test report results after each inspection.

1.5 QUALITY ASSURANCE

.1 Retain a licensed Professional Engineer, registered in Province of Ontario, to perform following services for metal siding work:
- .1 Design of metal siding work.
- .2 Review, stamp, and sign shop drawings.
- .3 Conduct shop and field inspections and prepare and submit inspection reports.

.2 Mock-up:
- .1 Fabricate, deliver, and erect one full scale 3 m^2 high mock-up panel of metal siding construction, in location acceptable to Consultant.
- .2 Demonstrate finish, colours, and quality of workmanship.
- .3 Mock-up may form part of final Work, if acceptable to Consultant. Remove and dispose of mock-ups which do not form part of Work.

.3 Pre-installation meeting: Arrange with manufacturer's representative, Contractor, and Consultant to inspect substrates, and to review installation procedures 48 hours in advance of installation.

1.6 DELIVERY, STORAGE, AND HANDLING

.1 Stockpile panels tilted to provide water run-off, free from ground contact on firm, level, non-staining supports extending full width of sheet and spaced not more than 450 mm apart. Cover components with opaque polyethylene sheet. Vent to allow air movement.

1.7 **EXTENDED WARRANTY**

.1 Submit an extended warranty for metal siding work in accordance with General Conditions, except that warranty period is extended to 2 years from date of Substantial Performance of the Work.
- .1 Warrant against warping, twisting, joint, finish failure and water penetration.
- .2 Coverage: Complete replacement including affected adjacent parts.

2 Products

2.1 **MATERIALS**

.1 All materials under work of this Section, including but not limited to, paints and sealants are to have low VOC content limits.

.2 Metal siding: ASTM A653/A653M, Z275 galvanized steel, 0.76 mm minimum base metal thickness.
- .1 AD300SR by VicWest Steel, 39 mm deep.
- .2 Or approved alternative by Agway Metals Inc., or Roll Form Group.

.3 Metal siding finish: Perspectra Series coating system by ArcelorMittal Dofasco, or WeatherX by Vicwest Steel. Colour to match Vicwest Regent Grey.

.4 Structural shapes, plates, sag rods, and similar items: CAN/CSA-G40.20-G40.21-M, Grade 300W.

.5 Hollow structural sections: CAN/CSA-G40.20/G40.21-M Grade 350W, Class H.

.6 Airseal transition membrane: Blueskin SA by Henry Company Canada Inc., or approved alternative by Soprema or W.R. Meadows. Primer as recommended by membrane manufacturer.

.7 Z-girts and C channels: CAN/CSA S136-M; Minimum 1.2 mm thick, Z275 galvanized. Depth as indicated on Contract Drawings. Z-girts to be thermally broken at mid-point of insulation thickness.

.8 Sprayed foam insulation: In accordance with Section 07 21 19.

.9 Fascia, trim, closures, and flashings: Material, finish, colour, and fasteners to match siding material, 0.76 mm minimum base metal thickness minimum.

.10 Screw fasteners: ANSI B18.6.4, stainless steel Type 304. Exposed locations: With coloured nylon heads to match metal siding.

.11 Primer paint: CAN/CGSB-1.40-M.

.12 Isolation coating: Black bituminous coating, acid and alkali resistant material.

.13 Joint backing: Product as recommended by siding sealant manufacturer.

.14 Siding sealant: ASTM C920, Type S, Grade NS; One-part, ultra-low modulus, moisture curing silicone sealant, 790 Silicone by Dow Corning or Spectrem 1 by Tremco Ltd. Colour: As selected by Consultant.

.15 Thermal Separation: Continuous 3 mm thick x 38 mm wide self adhering cork.

3 Execution

3.1 **EXAMINATION**

.1 Verify condition and dimensions of previously installed Work upon which this Section depends. Report defects to Consultant. Commencement of work of this Section means acceptance of existing conditions.

3.2 **STRUCTURAL FRAMING**

.1 Supply and install miscellaneous, additional structural framing members, required to complete metal siding system, where not indicated on Contract Drawings.

3.3 **AIRSEAL TRANSITION MEMBRANE**

.1 Install primer and airseal transition membrane with 150 mm overlap of metal airseal, continuously onto entire head, jamb, and sill surfaces of openings such as doors, windows, louvres and similar items, and metal siding system perimeter.

.2 Install additional layer of airseal transition membrane to serve as flashing over openings in, and at bottom side termination of metal siding panel system.

.3 Overlap airseal transition membrane 50 mm along sidelaps and 75 mm on end laps and lap in direction of waterflow.

.4 Coordinate airseal transition to adjacent parts of Work.

.5 Provide end-dams and terminations fabricated from same material as airseal transition membrane or material recommended by membrane manufacturer at sills, lintels, openings, and where horizontal surfaces intersect with vertical surfaces to ensure moisture is shed to exterior.

3.4 **GIRTS AND CHANNELS**

.1 Notch Z girts and C channels as required to allow drainage of cavity.

.2 Provide thermal break between sub-girts. Direct metal-to-metal contact between exterior sheets will not be accepted.

.3 Install Z girts, fastened into structural framing beneath. Orient Z girts to drain water from cavity.

.4 Install C channels to frame openings such as doors, windows, and louvre openings, and orient channel webs to form heads, jambs and sills of openings.

3.5 **SPRAYED FOAM INSULATION**

.1 Install sprayed foam insulation in accordance with Section 07 21 19.

3.6 **FASCIA, TRIM, CLOSURES, AND FLASHINGS**

.1 Install fascia and trim including inside and outside corners, flashing, edgings, cap strips, drips, under-sill trim, fillers, closure strips, starter strips, and window or door trim, carefully formed and profiled.

3.7 **METAL SIDING**

.1 Install metal siding in accordance with reviewed shop drawings and manufacturer's written instructions.

.2 Install metal siding in one piece, full height, except as indicated otherwise.

.3 Maintain joints in exterior siding, plumb, true to line, tight fitting, hairline joints.

.4 Attach metal siding system components to prevent warping, buckling, and deformation induced by restriction of thermal induced movement .

.5 Install corner pieces, closures, flashings, etc, where shown and where required. Provide formed steel closures around opening.

.6 Bed flashings, closures, and corner pieces in sealant to provide a weathertight installation.

3.8 **JOINT BACKING AND SIDING SEALANT**

.1 Prepare substrate surface and mask as recommended by sealant manufacturer.

.2 Install joint backing and sealant at siding system joints and perimeter for weathertight installation. Tool sealant to concave profile.

3.9 **TOUCH UP**

.1 Touch up marred surfaces with air dry formulation to match pre-finished siding if approved by Consultant, otherwise remove and replace damaged metal siding.

.2 Clean and touch up marred galvanized surfaces after installation, with zinc rich primer.

END OF SECTION

1 General

1.1 **SECTION INCLUDES**

.1 Labour, Products, equipment and services necessary for modified bituminous roofing work in accordance with the Contract Documents.

1.2 **REFERENCES**

.1 ASTM C1177/C1177M, Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing

.2 ASTM D6162/D6162M, Standard Specification for Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using a Combination of Polyester and Glass Fiber Reinforcements

.3 CSA A123.21, Standard Test Method for the Dynamic Wind Uplift Resistance of Membrane-Roofing Systems.

.4 CGSB 37-GP-9Ma, Primer, Asphalt, Unfilled, for Asphalt Roofing, Dampproofing and Waterproofing.

.5 CGSB 37-GP-15M, Application of Asphalt Primer for Asphalt Roofing, Dampproofing and Waterproofing.

.6 CAN/ULC S107, Fire Test For Roof Coverings.

.7 CAN/ULC S704, Standard for Thermal Insulation, Polyurethane and Polyisocyanurate, Boards, Faced.

.8 OIRCA, Ontario Industrial Roofing Contractors Association.

1.3 **SUBMITTALS**

.1 Product data:
  .1 Submit copies of manufacturer's Product data in accordance with the Conditions of the Contract indicating:
    .1 Systems, materials, and methods of installation proposed for use, showing system and each component. Certify compliance of each component with applicable standards.
    .2 Submit cold weather construction procedures and methods of protection which will be initiated, installed and maintained when ambient temperature falls below 0^0C.

.2 Shop Drawings: Submit Shop Drawings in accordance with the Conditions of the Contract indicating roof layout, sections, details, materials, fastener layout, flashings and membrane terminations, perimeter securement, vapour barrier terminations, insulation wrapping procedures, tapered insulation layout, membrane penetrations, control joints, roof walkway system, and roof accessories.

.3 Samples:
- .1 Submit following samples in accordance with the Conditions of the Contract:
  - .1 Substrate board and adhesive.
  - .2 Vapour retarder and adhesive.
  - .3 Insulation boards.
  - .4 Tapered insulation.
  - .5 Insulation protection board.
  - .6 Roofing membranes.
  - .7 Roof accessories.

.4 Reports and Certificates:
- .1 Submit copy of membership in good standing of OIRCA
- .2 Submit certification from manufacturer that roof system has a minimum Class C classification in accordance with CAN/ULC-S107.
- .3 Submit Pre-Installation Notice (PIN): Copy to show that manufacturer's required Pre-Installation Notice (PIN) has been accepted and approved by the manufacturer.
- .4 Submit project specific report, issued by certified material testing laboratory, confirming that proposed roofing assembly conforms to CSA A123.21. As a minimum report shall indicate uplift pressures for field of roof, perimeter of roof and corners of roof.
- .5 Submit written inspection reports in duplicate from manufacturer, stating that materials proposed for use on this project meet criteria specified and are compatible with each other.

.5 Project close-out submittals:
- .1 Submit close-out submittals in accordance with the Conditions of the Contract.
- .2 Submit membrane manufacturer's certificate that membrane has been installed in accordance with Contract Documents.

1.4 QUALITY ASSURANCE

.1 Qualification: Perform work of this Section by a company that is a member in good standing of the Ontario Industrial Roofing Contractors Association (OIRCA) and has a minimum of 5 years proven acceptable roofing experience on installations of similar complexity and scope.

.2 Testing: Provide flood testing conducted by an independent testing agency of the specified roofing products.

.3 Perform roofing work in accordance with the CRCA Roofing Specifications Manual and in accordance with membrane manufacturer's printed installation instructions.

.4 Ensure roofing system has been tested and conforms to CAN/CSA A123.21 to ensure wind uplift resistant applicable to the Place of Work.

.5 Roof system shall have a minimum Class C classification in accordance with CAN/ULC-S107.

.6 Ensure torching is performed by skilled workers who have successfully completed and passed a course of instruction by membrane manufacturer in torch-applied-membrane techniques.

.7 Ensure membrane manufacturer's representative has full access to this work for proper inspection prior to and during membrane installation. Roof inspections shall be conducted when the roof is 10%, 50%, and 100% complete minimum. Membrane manufacturer to certify that roof installation was in conformance to manufacturer's written requirements.

.8 Pre-installation meetings: Arrange meeting on Site to be attended by Consultant, Contractor, and roofing manufacturer's representative to inspect substrates, and to review installation procedures 48 hours in advance of installation.

1.5 DELIVERY, STORAGE, AND HANDLING

.1 Deliver Products in original containers and keep in protective storage until used.

.2 Indicate on containers or wrappings of Products:
- .1 Manufacturer's name and brand.
- .2 Compliance with applicable standard.
- .3 Weight of material, where applicable.

.3 Handle and store Products to prevent damage. Keep manufacturer's labels and seals intact. Store roofing rolls on end to prevent flattening. Ensure that shelf life of Products has not expired.

.4 Protect Products from inclement weather. Keep insulation, protection board, and roofing membranes absolutely dry. Remove from storage only as much Product as can be applied, made weathertight, and covered with roofing in same day. Do not install Products which are damp at time of installation or showing evidence of having been damp or exposed to moisture.

.5 Store roofing membranes for 24 hours minimum in area kept at 10^0C minimum and remove for application with minimum exposure to low temperatures. Keep membranes dry, stored off-the-ground, on end and well ventilated.

.6 Do not store more than one day's supply of Products on the roof at any time. Stack materials on pallets on roof. Cover Products with incombustible waterproof tarpaulin whenever work is interrupted, or when there is precipitation of any kind.

.7 Distribute Products stored on roof. Install bases under equipment and Products to distribute weight. Do not store Products on, or transport materials across, completed roof areas.

.8 Place 19 mm thick plywood runways over work to enable movement of Products and other traffic.

.9 Where hoisting or pumping occurs adjacent to construction, hang tarpaulins to protect walls and other surfaces. Locate kettle so smoke will not discolour adjacent building surfaces.

.10 Locate a 9 kg fire extinguisher fully charged and in operable condition at installation location, of proper type for Products being used and stored.

.11 Cover walls and adjacent work where Products are hoisted or used.

.12 Use warning signs and barriers and maintain in good order until completion of work.

.13 Clean off drips and smears of bituminous immediately.

.14 Dispose of rain water off roof and away from face of building until roof drainage system has been installed and connected.

.15 At end of each day's work or when stoppage occurs due to inclement weather, protect completed work and Products.

1.6 **SITE CONDITIONS**

.1 Install roofing on dry deck, free of snow and ice, use only dry Products and apply only during weather that will not introduce moisture into roofing system.

.2 Apply roofing only when air and surface temperatures are above 4^0C, have been so for at least 48 hours and are not likely to go below 4^0C, until work is completed.

.3 Proceed with work when temperatures are below 4^0C only with mutual documented agreement between Contractor and Consultant.

1.7 **EXTENDED WARRANTY**

.1 At completion of this work, provide a signed OIRCA warranty to the Owner covering defects of workmanship for a period of 2 years commencing from Contract Completion. Agree to make good promptly any defects which occur or become apparent within the warranty period in conjunction with the membrane manufacture's warranty. Defects shall include but not be limited to leakage, failure to stay in place, lifting, and deformation.

.2 At completion of this work, provide a signed warranty from the roofing system manufacturer to the Owner covering defects in workmanship and materials for a period of 10 years commencing from Contract Completion. Warranty shall include vapour retarder, membrane, roof insulation, sloped insulation, and all other products supplied by roofing system manufacturer. Scope of coverage: Repair and/or replace damaged roofing material caused by the ordinary wear and tear of the elements, manufacturing defect, and the workmanship used to install these materials.

2 Products

2.1 **MATERIALS**

.1 All materials under work of this Section, including but not limited to, adhesives and primers are to have low VOC content limits.

.2 Acceptable membrane manufacturers:
- .1 Henry Company Canada Inc.
- .2 Iko Industries Canada.
- .3 Soprema.
- .4 Tremco Incorporated.

.3 Roof sheathing board: ASTM C1177/C117M, 12.7 mm thick, unless otherwise indicated, 'Dens Deck' by G-P Products, 'Securock Gypsum Fiber Roof Board' by CGC, or approved alternative by CertainTeed.

.4 Sheathing fasteners and plates: Conforming to manufacturers recommended layout for wind uplift and corrosion resistance, furnish fasteners of length required by sheathing thickness.

.5 Insulation and protection board adhesive (where roof deck is exposed to view from below): Single component polyurethane adhesive as recommended by roof system manufacturer.

.6 Asphalt primer: CGSB 37-GP-9Ma; Asphalt modified bitumen with thermoplastic polymers.

.7 Vapour retarder: Minimum 0.8 mm thick self adhesive membrane consisting of SBS modified bitumen adhesive bottom and tri-laminated woven polyethylene top with silicone release film. 'Vapour Block SA' by Henry, 'M.V.P.' by IKO, or 'Sopravap'r by Soprema.

.8 Vapour retarder primer: 'Blueskin Adhesive' by Henry Company, 'Elastocol Stick' by Soprema, or approved alternative by Siplast

.9 Insulation:
- .1 Polyisocyanurate insulation: CAN/ULC S704, rigid, closed cell, polyisocyanurate foam insulation integrally laminated to perforated black glass reinforced felt facers, square edges, thickness as indicated on Drawings, use maximum size board possible. Insulation thickness under 50 mm use single layer board. Insulation thickness over 50 mm use two equal thickness boards.
- .2 Tapered Insulation: Factory pre-engineered tapered polyisocyanurate insulation in thickness sufficient for slopes shown on Contract Drawing; manufactured by Accu-Plane Systems Inc., Posi-Slope Manufacturing Ltd.

.10 Protection board:
- .1 Bituminous Board; Multi-ply, semi-rigid asphaltic roofing substrate board composed of a mineral fortified asphaltic core formed between two asphaltic saturated fibreglass liners. 1200 x 1500 x 3.2 mm thick; 'IKO Protection Board' by IKO or 'Sopraboard' by Soprema or approved alternate.

.11 Base sheet membrane and flashing: ASTM D6162, Type 1, Grade S, Styrene-Butadiene-Styrene (SBS) elastomeric polymer, prefabricated sheet, non-woven polyester and glass fiber composite reinforcing, having the following minimum characteristics:
- .1 Thickness: 2.2 mm.
- .2 Reinforcing fabric weight: 200 g/m^2.

.3 Cold flex: -18 deg. C.
.4 Tensile strength: 13 kN/m.
.5 Ultimate elongation: 26%.
.6 Tensile-tear: 289 N.
.7 Bottom and top surfaces: Sanded/Polyethylene.

.12 Cap sheet membrane and flashing: ASTM D6162, Type 1, Grade S, Styrene-Butadiene-Styrene (SBS) elastomeric polymer, prefabricated sheet, non-woven polyester and glass fiber composite reinforcing, having the following minimum characteristics:
.1 Thickness: 4.0 mm.
.2 Reinforcing fabric weight: 200 g/m^2.
.3 Cold flex: -18 deg. C.
.4 Tensile strength: 13 kN/m.
.5 Ultimate elongation: 26%.
.6 Tensile-tear: 289 N.
.7 Granule loss: 2.0 g maximum.
.8 Bottom and top surfaces: Polyethylene/Granules.
.9 Top surface to providing a minimum SRI of 78.

.13 Plastic cement: Trowel grade asphalt mastic.

.14 Roofing nails: Galvanized steel, minimum 19 mm head of length to penetrate wood nailer minimum 19 mm.

.15 Roof drains: In accordance with Division 22 - Mechanical.

.16 Stack flashing units: In accordance with Division 22 - Mechanical.

.17 Stack Jacks: to CSA-B272, insulated aluminum stack jacks complete with bitumen protection dam and screw-secured cover;
.1 SJ-26/SJ-27, by Thaler Metal Industries Ltd.
.2 Flash-Tite VSC-S Series, by Lexcor.

.18 Roof Penetration Flashings: to CSA-B272, insulated aluminum, complete with bitumen protection dam and screw-secured cover. Acceptable products and manufacturers by Thaler Metal Industries Ltd. or Flash-Tite by Lexcor as follows:
.1 Rigid Conduits: MEF-AE1.
.2 Flexible Conduits: MEF-2A.
.3 Gas Pipe Protrusion: MEF-9.
.4 Mechanical Unit Supply Piping & Tubing: MEF-AE2/AE4 series.

.19 Irregular Roof Protrusion Flashings: Pre-fabricated mastic sealer pockets; 127 mm high x appropriate diameter to exceed diameter or width of protrusion by 50 mm. Pockets to be sealed with pourable self-leveling sealant;
.1 Chemlink Advanced Construction Products.
.2 Hi-Tuff TPO Molded Sealant Pockets by Lexcan Limited.

.20 Gas Line supports: PPH Portable Pipe Hangers Ltd. Model PP10 with strut and Hanger.

3 Execution

3.1 **EXAMINATION**

.1 Verify condition of previously installed Work upon which this Section depends. Report defects to Consultant. Commencement of work of this Section means acceptance of existing conditions.

3.2 **PREPARATION**

.1 Prior to commencement of work ensure:
- .1 Environmental and Site conditions are suitable for material installation in accordance with manufacturer's recommendations.
- .2 Decks are sound, straight, smooth, dry, free of oils, grease, snow, ice or frost, and swept clean of dust and debris.
- .3 Curbs have been built and plywood and lumber nailer plates have been installed.

.2 Supply to trades concerned in ample time, inserts, reglets and accessories to be built into Work. Assist in setting such items.

.3 Cooperate with respective trades to determine methods and procedures to ensure watertight junctions to items passing through roof.

3.3 **DECK SHEATHING**

.1 Over metal deck, Install sheathing in straight parallel rows, with long dimension perpendicular to metal roof deck rib direction, and with short dimension edges centred on and supported by ribs of metal deck in both directions.

.2 Place sheathing in moderately tight contact at joints between boards and abutting surfaces with gaps between boards not exceeding 3 mm. Under no circumstances shall the roofing membrane be left unsupported over a space greater than 3 mm.

.3 Mechanically fasten sheathing to metal deck not exposed to view with in accordance with sheathing manufacturer's written instructions.

.4 Adhere sheathing to metal deck where roof deck will be exposed to view from below in accordance with sheathing and adhesive manufacturer's written instructions

3.4 **PRIMING**

.1 Perform priming at rate and to surfaces recommended by the manufacturer in accordance with CGSB 37-GP-15M.

3.5 **VAPOUR RETARDER**

.1 Primer substrate to manufacturers recommendations.

.2 Install vapour retarder in accordance with manufacturers written instructions.

.3 Lap vapour retarder ends and edges 50 mm minimum. Roll vapour retarder and laps for continuous adhesion over entire substrate area; use manufacturer's recommended roller.

.4 Cut and fit vapour retarder as required for passage of protrusions, ensuring continuous adherence to substrate.

.5 At junction of deck to vertical surfaces and along perimeter of roof deck, extend vapour retarder, set in adhesive, beyond the point where insulation will terminate.

.6 Seal penetrations, end and side laps, and ends of vapour retarder to substrates and to wall system air/vapour retarder to maintain continuity of building air/vapour retarder system.

3.6 **INSULATION**

.1 Prior to installation of insulation, examine vapour retarder and make good damage.

.2 Use full size insulation boards wherever possible, and minimum half boards at abutting vertical surfaces.

.3 Install insulation promptly to avoid possibility of condensation beneath vapour retarder.

.4 Install insulation in straight parallel rows, with long dimension parallel to long dimension of roof. Stagger end joints of insulation boards in adjacent rows 50%.

.5 Place insulation boards in moderately tight contact at joints between boards and abutting surfaces with gaps between boards not exceeding 1.5 mm. Under no circumstances shall the roofing membrane be left unsupported over a space greater than 3 mm.

.6 When cutting insulation board cut completely through board thickness; do not break or tear insulation board to fit a detail. Any areas of insulation system having voids will be rejected.

.7 When installing multiple layers of insulation, all joints between layers shall be staggered at least 300 mm.

.8 Do not lay more insulation than can be completely covered as finished roofing system on the same day.

.9 Do not cut off insulation in straight lines at the end of a work period, allow stepped boards for toothing-in.

.10 Install Polyisocyanurate insulation in a minimum of two layers.

.11 Install Polyisocyanurate insulation, in adhesive, in straight parallel rows, with long dimension parallel to long dimensions of roof.

.12 Install subsequent layers of insulation, in adhesive, in straight parallel rows, with long dimension parallel to previous layer of insulation with joints offset as recommended by insulation manufacturer.

.13 Install tapered insulation in accordance with manufacturer's details and instructions. Miter roof insulation edges at ridge, valley and other similar non-planar conditions.

.14 Install protection board over tapered insulation in straight parallel rows, with long dimension parallel to long dimensions of insulation. Stagger side joints in adjacent rows minimum 50%.

.15 Mechanically fasten protection boards to vertical surfaces of upturns and on top of parapet substrates in accordance with manufacturer's written instructions.

3.7 MEMBRANE INSTALLATION

.1 Install materials in accordance with manufacturer's instructions.

.2 Install membrane free of blisters, wrinkles and fishmouths in accordance with membrane manufacturer's instructions. Avoid asphalt seepage at seams in cap sheet greater than 5 mm.

.3 Base sheet application:
- .1 Starting at low point of roof, perpendicular to slope, unroll base sheet dry over substrates, align and reroll for both ends.
- .2 Unroll and install membrane in full moppings of asphalt. Extend base sheet to base of cant.
- .3 Lap sheets 75 mm minimum for side and 150 mm minimum for end laps.

.4 Cap sheet application:
- .1 Starting at low point on roof, perpendicular to slope, unroll cap sheet, dry over base sheet, align and reroll from both ends.
- .2 Unroll and torch cap sheet onto base sheet extending to base of upturns taking care not to burn membrane or its reinforcement.
- .3 Lap sheets 75 mm minimum for side laps and 150 mm minimum for end laps. Offset joints in cap sheet 300 mm minimum for those in base sheet.
- .4 Embed surface granules on end laps by heating and using a round-nosed roofing trowel, prior to installation of following sheet.

3.8 FLASHING INSTALLATION

.1 Install flashing free of blisters, sags, wrinkles and fishmouths in accordance with the manufacturer's recommendations. Avoid asphalt seepage at seams greater than 5 mm.

.2 Base flashing:
- .1 Lay base flashings in vertical strips 1000 mm wide to curb surfaces as shown.
- .2 Extend on to flat roof surface minimum 100 mm from toe of cant.
- .3 Make 75 mm side laps and 100 mm end laps from laps in base sheet of roof membrane.
- .4 Install flashings in full moppings of asphalt directly to substrates, proceeding from bottom to top.

.5 Nail top leading edge to nailer at 300 mm o.c.

.3 Cap flashing:
- .1 Lay cap flashing in vertical strips 1000 mm wide to curb surfaces as shown.
- .2 Extend on to flat roof surface minimum 300 mm from base of upturn.
- .3 Make 75 mm side laps and 100 mm end laps from cap sheet laps and base flashing laps.
- .4 Embed surface granules on laps over cap sheet roofing by heating and use of round-nosed roofing trowel.
- .5 Torch cap flashing directly to cap sheet roofing and to base sheet flashing proceeding from bottom to top.
- .6 Soften underside of membrane by torching, without overheating, resulting in uniform adhesion over surface of base flashing.
- .7 Extend cap up and over parapets and nail leading edge to face of nailers 300 mm o.c.

3.9 ROOF ACCESSORIES

.1 Prior to application of membrane set stack flashing units, prefabricated equipment curbs, and other roof penetration accessory units in accordance with manufacturer's Product data. Install removable cap per accessory manufacturer's Product data as applicable.

.2 Seal joints at items projecting through membrane watertight to acceptance of Consultant.

3.10 FIELD QUALITY CONTROL

.1 Check completed membrane welds for continuity after cooling by use of screw driver run along welded seams and showing uninterrupted extrusion of melted asphalt material.

.2 Inspect completed membrane and flashings for punctures, tears and discontinuous weld seams. Apply additional layer of cap sheet membrane over punctures and tears, extending beyond damaged area or open seam in all directions, torch in-place.

3.11 CLEANING

.1 Clean roofing, metal, masonry, and similar items of dirt, cuttings, stains and foreign matter upon completion of the work.

END OF SECTION

1 General

1.1 **SECTION INCLUDES**

.1 Labour, Products, equipment and services necessary for flashing and sheet metal Work in accordance with the Contract Documents.

1.2 **REFERENCES**

.1 CSA A123.3-M Asphalt or Tar Saturated Roofing Felt.

.2 ASTM A653/A653M, Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvanealed) by the Hot-Dip Process.

.3 ASTM C920, Specification for Elastomeric Joint Sealants.

.4 OIRCA, Ontario Industrial Roofing Contractors Association.

1.3 **DESIGN REQUIREMENTS**

.1 Design flashing elements and fastenings to withstand wind loading and perimeter and corner uplift pressures for roof system in accordance with CSA A123.21.

1.4 **SUBMITTALS**

.1 Shop drawings:
- .1 Submit shop drawings in accordance with the Conditions of the Contract indicating:
  - .1 Proposed method of shaping, forming, jointing.
  - .2 Fastening, and application of flashing and sheet metal Work.

.2 Samples:
- .1 Submit following samples in accordance with the Conditions of the Contract:
  - .1 50 x 50 mm samples of sheet metal material, colour and finish.
  - .2 Representative sample section of prepainted metal flashing illustrating S locking jointing method, minimum 600 mm long.

1.5 **EXTENDED WARRANTY**

.1 Submit an extended warranty for flashing and sheet metal work in accordance with General Conditions, except that warranty period is extended to 5 years from date of Substantial Performance of the Work.
- .1 Warrant against warping, twisting, joint, finish failure and water penetration.
- .2 Coverage: Complete replacement including affected adjacent parts.

2 Products

2.1 **MATERIALS**

.1 All materials under Work of this Section, including but not limited to, sealants and paints are to have low VOC content limits.

.2 Prepainted sheet steel: ASTM A653/A653M; Classification LFQ, Grade A, Z275 zinc coating designation, 0.76 mm (22 ga.) minimum base steel thickness, commercial quality, prefinished with Perspectra Series coating system by U.S. Steel Canada, or WeatherX by Vicwest Steel. Colour: To be Vicwest Charcoal.

.3 Plastic cement: Trowel grade asphalt mastic.

.4 Sealant: ASTM C920, Type S, Grade NS, Class 25; High-performance, medium-modulus, one-part, neutral-cure silicone sealant. 'CWS' by Dow Corning, 'Sikasil 305CN' by Sika, or 'Tremsil 400' by Tremco.

.5 Cleats and starter strips: Starter strips to be continuous, of same material as flashing used, 1.2 mm thick.

.6 Fasteners: Flat head roofing nails of length, type and thickness suitable for metal flashing application.

.7 Washers: of same material as sheet metal, 1 mm thick with rubber packings.

.8 Touch-up paint: Same colour and material as prepainted sheet steel, as recommended by prefinished coating manufacturer.

2.2 **FABRICATION**

.1 Fabricate copings, flashings, curb counter flashings, starter strips and miscellaneous flashings in accordance with OIRCA and to details shown.

.2 Breakform prepainted sheet material at shop to shapes shown. Make end joints where adjacent lengths of metal flashing meet, in accordance with jointing method specified.

.3 Form pieces in 2400 mm maximum practical lengths. Make allowance for expansion at joints.

.4 Hem exposed edges 13 mm minimum on underside for appearance and stiffness. Mitre and seal corners with sealant.

.5 Reglets and Cap flashing: Form flashings of as detailed and in accordance with OIRCA. Provide slotted fixing holes and steel/plastic washer fasteners.

3 Execution

3.1 **EXAMINATION**

.1 Verify condition and dimensions of previously installed Work upon which this Section depends. Report defects to Consultant. Commencement of Work means acceptance of existing conditions.

3.2 **INSTALLATION**

.1 Install coping flashings, curb counter flashings, starter strips and miscellaneous flashings to details shown on the Contract Drawings and in accordance with OIRCA.

.2 Use concealed fasteners. Exposed fasteners such as pop rivets are not allowed.

.3 Install continuous starter strips to present a true, non-waving, leading edge. Anchor to back-up for a rigid, secure installation.

.4 Counterflash bituminous flashings at intersections of roof with vertical surfaces and curbs. Flash joints using S-lock forming tight fit over hook strips.

.5 Make end joints using an S lock joint. Execute by inserting end coping length in 25 mm deep S lock formed in end of adjacent length. Extend concealed portion of S lock 25 mm outwards and nail to substrate. Face nailing of joints will not be permitted.

.6 Seal where necessary to form weathertight seal between flashing and adjoining surfaces and between flashing and other Work. Sealing Work consists of bedding between members where possible. Tool sealant to concave profile where exposed.

.7 Insert metal flashing under cap flashing to form weathertight junction.

.8 Caulk flashing at cap flashing with sealant.

END OF SECTION

1 General

1.1 **SECTION INCLUDES**

.1 Labour, Products, equipment and services necessary for firestopping and smoke seals Work in accordance with the Contract Documents.

1.2 **REFERENCES**

.1 ASTM E814, Test Method for Fire Tests of Through-Penetration Fire Stops.

.2 CAN/CGSB 19.13, Sealing Compound, One Component, Elastomeric, Chemical Curing.

.3 CAN/ULC S102, Surface Burning Characteristics of Building Materials and Assemblies.

.4 CAN/ULC S115, Standard Method of Fire Tests of Firestop Systems.

.5 CAN/ULC S702, Thermal Insulation, Mineral Fibre for Buildings.

1.3 **DEFINITIONS**

.1 Fire Separation: A construction assembly, plane or device, either vertical or horizontal, which is required to prevent the passage of fire and smoke for a prescribed period of time. Proof of compliance to required time rating shall be by ULC, Warnock Hersey (or similar approved) certification or shall be as listed in the Ontario Building Code Supplementary Standard SB-2.

.2 Smoke Separation: A construction assembly, plane or device, either vertical or horizontal, which is not required to prevent the passage of fire for a prescribed period of time but is required to prevent the passage of smoke. A "Smoke Separation" is also known as a "Fire Separation with No Rating" or a "Zero Hour Rated Separation".

.3 Non-Rated Separation: A construction assembly, plane or device, either vertical or horizontal, which is not required to prevent the passage of fire for a prescribed period of time and is not required to prevent the passage of smoke.

1.4 **SUBMITTALS**

.1 Product data:
- .1 Submit copies of manufacturer's Product data in accordance with the Conditions of the Contract indicating:
  - .1 Performance criteria, compliance with appropriate reference standard, characteristics, limitations.
  - .2 Product transportation, storage, handling and installation requirements.
  - .3 Submit firestop and smoke seal manufacturer's Product data for materials and prefabricated devices, including manufacturer's printed installation instructions.

.2 Shop drawings:
- .1 Submit shop drawings in accordance with the Conditions of the Contract indicating:
  - .1 Fire rated and smoke sealed systems for each typical application.
  - .2 Construction details, accurately reflecting actual job conditions.
  - .3 ULC or Intertek Testing assembly listing.

.3 Certification:
- .1 Submit certified documentation from manufacturer for each worker performing Work of this Section.
- .2 Submit installer's and Product manufacturer's certification verifying compliance with the Contract Documents and conformance with ASTM E814 and CAN/ULC S115.

1.5 QUALITY ASSURANCE

.1 Perform Work of this Section by manufacturer-approved, skilled, qualified, and experienced workers trained in installation of Work of this Section.

1.6 SITE CONDITIONS

.1 Conform to manufacturer's requirements and maintain a minimum temperature of 5^0 C for a minimum period of 24 h before application, during, and until application is fully cured.

.2 Maintain sealant at a minimum 18° C for best workability.

2 Products

2.1 ACCEPTABLE MANUFACTURERS

.1 Acceptable manufacturers of rated systems include:
- .1 AD Fire Protection Systems Inc.
- .2 Hilti Canada Corporation.
- .3 3M Canada Inc.
- .4 Tremco Ltd.

2.2 MATERIALS

.1 All materials under Work of this Section, including but not limited to, primers and sealants are to have low VOC content limits.

.2 Firestop sealant: single component, low modulus, silicone rubber, moisture curing, ULC labelled to CAN/CGSB 19.13-M and CAN/ULC S115.

.3 Firestop insulation: to CAN/ULC-S702, Type 2; mineral fibre manufactured from rock or slag, suitable for manual application.
- .1 Density: Minimum 64 kg/m^3 when tested to ASTM C303.
- .2 Combustibility: Noncombustible to CAN/ULC S114.
- .3 Melt temperature: >1175 degrees C.

.4 Surface burning characteristics: to CAN/ULC S102, maximum flame spread of 0, smoke developed of 0.
.5 Moisture Absorption: 0.04 percent when tested to ASTM C1104.
.6 Smoulder Resistance: 0.01 percent when tested to CAN/ULC S129.

.4 Damming, back-up, supports, and anchorage: In accordance with manufacturer's fire rated systems and to acceptance of authorities having jurisdiction.

.5 Primer: As recommended by firestopping sealant manufacturer.

2.3 **SYSTEMS**

.1 Firestopping and smoke seals: ULC or Intertek Testing Services listed Products and systems in accordance with CAN/ULC S115 suitable to actual application and installation conditions.

.2 Do not use Products containing asbestos.

.3 Firestopping components shall not contain volatile solvents or require special application to protect plastic pipe from firestopping compound.

3 Execution

3.1 **EXAMINATION**

.1 Verify condition and dimensions of previously installed Work upon which this Section depends. Report defects to Consultant. Commencement of Work means acceptance of existing conditions.

.2 Verify that substrates and surfaces to receive firestopping and smoke seals are clean, dry, and frost free.

3.2 **FIRESTOP AND SMOKE SEAL LOCATIONS AND RATINGS**

.1 Install ULC firestop and smoke seal systems rated to match fire resistance design rating of assemblies into which they are installed.

.2 Install firestop and smoke seal systems. Use systems with required ratings at following typical locations, including but not limited to:
.1 Gaps at intersections of fire-resistance rated masonry and gypsum board partitions.
.2 Control and sway joints in fire-resistance rated walls and partitions such as masonry and gypsum board.
.3 Gaps at top of fire-resistance rated partitions such as masonry and gypsum board partitions.
.4 Penetrations through fire-resistance rated walls and partitions including mechanical and electrical services and openings and sleeves for future use.
.5 Penetrations through fire-resistance rated floor slabs, ceilings, and roofs.
.6 Gaps at edge of floor slabs at exterior walls such as curtain wall and precast concrete panels.

.7 Perimeter of retaining angles on rigid ducts greater than 0.012 m^2, firestopping material between retaining angle and fire separation and between retaining angle and duct, on each side of fire separation.

3.3 PREPARATION

.1 Prepare, modify, and adjust void sizes, proportions, and conditions to conform to fire rated and smoke sealed assembly requirements such as assembly opening size and dimensional restrictions.

.2 Mask adjacent surfaces to avoid spillage and over-coating of adjacent surfaces. Remove stains from adjacent surfaces.

3.4 INSTALLATION

.1 Install firestopping and smoke seal systems in accordance with manufacturer's instructions and fire rated assembly to establish continuity and integrity of fire separations.

.2 Install firestop insulation in compacted thicknesses required by ULC design. Compress insulation approximately 50 percent.

.3 Install primers as recommended by firestop and smoke seal Product manufacturers.

.4 Install temporary forming, damming, back-up as required, remove after materials have achieved initial cure and will resist displacement.

.5 Install firestop and smoke seal filler in horizontal joints providing 25% compression fit.

.6 Use resilient, elastomeric firestopping and smoke seal systems in following locations:
- .1 Openings and sleeves for future use.
- .2 Penetration systems subject to vibration or thermal movement.
- .3 Penetration systems in acoustical containment enclosures.

.7 Trowel and tool exposed firestop and smoke seal Product surfaces to uniform, smooth finish.

.8 Repair damaged firestopped and smoke sealed surfaces to acceptance of Consultant.

.9 Identify each firestop and smoke seal penetration assembly with permanent label listing following:
- .1 Assembly and rating in hours.
- .2 Date of installation.
- .3 Installing company's name and telephone number.

.10 Do not cover materials until full cure has taken place.

3.5 **CLEAN-UP**

.1 Remove excess materials and debris and clean adjacent surfaces immediately after application.

END OF SECTION

1 General

1.1 **SECTION INCLUDES**

.1 Labour, Products, equipment and services necessary for sealant Work in accordance with the Contract Documents.

.2 Work of this Section does not include sealants in firestopping and smoke sealed assemblies.

.3 Work of this Section does not include sealant work identified in individual specification sections.

1.2 **REFERENCES**

.1 ASTM C834, Specification for Latex Sealants.

.2 ASTM C920, Specification for Elastomeric Joint Sealants.

.3 ASTM C1330, Specification for Cylindrical Sealant Backing for Use with Cold Liquid Applied Sealants.

1.3 **SUBMITTALS**

.1 Product data: Submit copies of Product data in accordance with the Conditions of the Contract describing type, composition and recommendations or directions for surface preparation, material preparation and material installation.

.2 Samples:
.1 Submit following samples in accordance with the Conditions of the Contract.
.1 Two samples of sealant/caulking, for colour selection.
.2 Two samples of back-up material and primer for physical characteristics.

1.4 **QUALITY ASSURANCE**

.1 Qualifications: Work of this Section shall be executed by trained applicators approved by sealant manufacturer and having a minimum of 5 years proven experience.

1.5 **SITE CONDITIONS**

.1 Do not install materials when ambient air temperature is less than 5°C, when recesses are wet or damp, or to manufacturer's recommendations.

1.6 **DELIVERY, STORAGE AND HANDLING**

.1 Arrange delivery of materials in original, unopened packages with labels intact, including batch number, and ensure that on-site storage is kept to a minimum. Do not store materials on site where there exists any danger of damage from moisture, direct sunlight, freezing and other contaminants.

1.7 **EXTENDED WARRANTY**

.1 Submit a extended warranty for Sealant Work in accordance with General Conditions, except that warranty period is extended to 5 years. Warrant against leakage, cracking, crumbling, melting, shrinkage, running, loss of adhesion and staining adjacent surfaces. Warranty shall be for complete replacement including affected adjacent Work.

2 Products

2.1 **MATERIALS**

.1 General:
- .1 All materials under Work of this Section, including but not limited to, primers and sealants are to have low VOC content limits.
- .2 Use materials as received from manufacturers, without additives or adulterations. Use one manufacturer's Product for each kind of Product specified.

.2 Sealant **Type 1**: ASTM C920, Type M, Grade NS, Class 50; Multi-Component, polyurethane sealant, in standard colours selected.
- .1 'DC CWS' by Dow Corning Inc.
- .2 'Dymeric 240' by Tremco.
- .3 Or approved alternative by Sika.

.3 Sealant **Type 2**: ASTM C920, Type S, Grade NS, Class 25; One-Component, polyurethane sealant, in standard colours selected.
- .1 'DC CWS' by Dow Corning Inc.
- .2 'Dymonic' by Tremco.
- .3 'Novalink' by Chemlink Advanced Architectural Products.

.4 Sealant **Type 3**: ASTM C834; Pure acrylic siliconized sealant; in standard white colour (paintable).
- .1 'Tremflex 834 Silconized Sealant' by Tremco Ltd.
- .2 Or approved alternative by Dow Corning Inc. or Sika.

.5 Sealant **Type 4**: ASTM C920, Type S, Grade NS; One-part mildew-resistant silicone, in standard colours selected.
- .1 '786 Mildew Resistant Silicone Sealant' by Dow Corning Inc.
- .2 'Tremsil 200 Silicone Sealant' by Tremco Ltd.
- .3 Or approved alternative by Sika.

.6 Sealant **Type 5**: ASTM C920, Type S, Grade NS, Class 50; One-part neutral-cure silicone, in standard colours selected.
- .1 '795 Weather Sealant' by Dow Corning Inc.
- .2 'Spectrum 2' by Tremco Ltd.
- .3 Or approved alternative by Sika.

.7 Sealant **Type 6**: Acoustical sealant in accordance with Section 09 21 16.

.8 Sealant **Type 7**: ASTM C920, Type S, Grade NS, Class 50; One-part neutral-cure, low modulus silicone, in standard colours selected.
- .1 '791 Sealant' by Dow Corning Inc.
- .2 'Spectrum 3' by Tremco Ltd.
- .3 Or approved alternative by Sika.

2.2 **ACCESSORIES**

.1 Primers: Type recommended by material manufacturers for various substrates, primers to prevent staining of adjacent surfaces encountered on project.

.2 Joint backing: ASTM C1330; Round, solid section, closed cell, skinned surface, soft polyethylene foam gasket stock, compatible with primer and sealant materials, 30 to 50% oversized, Shore A hardness of 20, tensile strength 140 to 200 kPa. Bond breaker type surface.

.3 Bond breaker: Type recommended by material manufacturers.

.4 Void filler around the window frames to be one part expanding polyurethane foam.

.5 Cleaning agents: As recommended by material manufacturer, non-staining, harmless to substrates and adjacent finished surfaces.

2.3 **MIXING**

.1 Follow manufacturers instructions on mixing, shelf and pot life.

3 Execution

3.1 **EXAMINATION**

.1 Verify condition and dimensions of previously installed Work upon which this Section depends. Report defects to Consultant. Commencement of Work means acceptance of existing conditions.

3.2 **PREPARATION**

.1 Prepare joints to receive sealants to manufacturer's instructions. Ensure that joints are clean and dry and ferrous surfaces are free from rust and oil.

.2 Clean recesses to receive sealant, to be free of dirt, dust, loose material, oil, grease, form release agents and other substances detrimental to sealant's performance.
- .1 Remove lacquer or other protective coatings from metal surfaces, without damaging metal finish, using oil-free solvents. Remove rust, mill scale and coatings from ferrous metals by wire brush, grinding or sand blasting.
- .2 Ensure recess is dry.
- .3 Do not apply sealants to joint surfaces treated with sealer, curing compound, water repellent, or other coatings. Remove incompatible coatings as required.

.3 Ensure that all materials in contact with sealant are compatible. Test substrate for adhesion.

.4 Depth of recess: Maintain depth to ½ joint width up to a maximum of 13 mm and not less than 6 mm at centre of joint. For greater depth, use joint backing under. Where recess is less than specified depth, cut back surface of recess to specified recess depth.

.5 Install polyethylene backing rod in joints 6 mm or more in width. Roll backing rod into joint. Do not stretch or bend backing rod. Install bond breaker to back of recess.

.6 Prime sides of recess, in accordance with sealant manufacturer's instructions.

.7 Condition products for use in accordance with manufacturer's recommendations.

3.3 INSTALLATION

.1 Apply sealant immediately after adjoining Work is in condition to receive such Work. Apply sealant in continuous bead using gun with correctly sized nozzle. Use sufficient pressure to evenly fill joint.

.2 Ensure sealant has full uniform contact with, and adhesion to, side surfaces of recess. Superficial painting with skin bead is not acceptable. Tool sealant to smooth surface, free from ridges, wrinkles, sags, air pockets, embedded impurities, dirt, stains or other defects.
- .1 At recesses in angular surfaces, finish sealant with flat profile, flush with face of material at each side.
- .2 At recesses in flush surfaces, finish compound with concave face, flush with face of material at each side.

.3 Make sealant bead uniform in colour.

.4 Cure sealants in accordance with sealant manufacturer's instructions. Do not cover up sealants until proper curing has taken place.

.5 Immediately remove excess compound or droppings which would set up or become difficult to remove from adjacent finished surfaces, using recommended cleaners, as work progresses. Do not use scrapers, chemicals or other tools which could damage finished surfaces. Remove defective sealant.

.6 Clean recesses and re-apply sealant.

.7 Remove masking tape immediately after joints have been sealed and tooled.

3.4 CLEANING

.1 Clean surfaces adjacent to joints, remove sealant smears or other soiling resulting from application of sealants. At metal surfaces, remove residue. Do not mar or damage finishes on materials adjacent to joints. Repair or replace marred or damaged materials.

3.5 SCHEDULE OF LOCATIONS

.1 Following sealant location schedule is included for convenience and may not be complete. Examine Contract Drawings and other specification sections and determine entire extent of Work of this Section. Generally seal following locations:
- .1 Concrete, masonry and wood to metal.
- .2 Wood to masonry and concrete.
- .3 Metal to metal.
- .4 All dissimilar materials.

.2 Sealant **Type 1 or Type 2**:
- .1 Interior joints between dissimilar materials.
- .2 Interior joints at perimeter of all built-in equipment.
- .3 Interior joints at perimeter of metal door and window frames.

.3 Sealant **Type 3**:
- .1 Interior non-movement joints 6mm or less for painting (painter's caulk).

.4 Sealant **Type 4**:
- .1 Interior joints where mildew resistance is required.
- .2 Interior joints at perimeter of all plumbing fixtures.
- .3 Interior joints between counter backsplash and wall surfaces.

.5 Sealant **Type 5:**
- .1 Glass to glass joints.
- .2 Glass to metal joints.
- .3 Interior face of metal panel joints.

.6 Sealant **Type 6:**
- .1 Perimeter of all gypsum board partitions where sound insulation is indicated.
- .2 All vapour barrier seams and seals.

.7 Sealant **Type 7:**
- .1 Exterior joints between dissimilar building veneer materials.
- .2 Exterior control joints in building veneers.
- .3 Exterior joints at perimeter of all door and window frames.
- .4 Exterior joints in metal panel systems.

END OF SECTION

1 General

1.1 **SECTION INCLUDES**

.1 Labour, Products, equipment and services necessary for expansion joint cover assemblies work in accordance with the Contract Documents.

1.2 **REFERENCES**

.1 ASTM B221M, Specification for Aluminum-Alloy Extruded Bars, Rods, Wires, Shapes and Tubes.

1.3 **DESIGN REQUIREMENTS**

.1 Joint Movement: Design to permit unrestricted omnidirectional movement of up to ±50% of joint width without disengagement of cover.

.2 Joint Cover Movement: Design exterior joint cover assemblies to accommodate expansion and contraction within service temperature range of -35ºC to 65ºC.

1.4 **SUBMITTALS**

.1 Product data:
- .1 Submit duplicate copies of manufacturer's Product data in accordance with the Conditions of the Contract indicating:
  - .1 Performance criteria, compliance with appropriate reference standard(s), characteristics, and limitations.
  - .2 Product transportation, storage, handling and installation requirements.

.2 Shop drawings:
- .1 Submit shop drawings in accordance with the Conditions of the Contract.
- .2 Submit following for each type of cover assembly and joint condition:
  - .1 Elevations, sections, lengths, details, materials, dimensions, gauges, anchoring and fasteners, accessories, seals, finishes and relationship to adjacent construction.

.3 Samples: Submit two 300 mm long sample of each cover assembly in accordance with the Conditions of the Contract.

1.5 **QUALITY ASSURANCE**

.1 Installers qualifications: Perform work of this Section by a company that has a minimum of five years proven experience in the installation of expansion joint cover assemblies of a similar size and nature and that is approved by manufacturer. Submit to Consultant, applicator's current certificate of approval by the material manufacturer as proof of compliance.

.2 Mock-up:
- .1 Construct one mock-up of each different type of expansion joint cover assemblies in location acceptable to Consultant.

.2 Arrange for Consultant's review and acceptance, allow 48 hours after acceptance before proceeding with work.

.3 Mock-up may remain as part of Work if accepted by Consultant. Remove and dispose of mock-ups which do not form part of Work.

.4 Upon acceptance, mock-up shall serve as a minimum standard of quality for the balance of the work of this Section.

2 Products

2.1 **MATERIALS**

.1 General: All materials under work of this Section, including but not limited to, adhesives are to have low VOC content limits.

.2 Aluminum extrusions: ASTM B221, AA6063 alloy, T5 temper.

2.2 **ACCESSORIES**

.1 Firebarrier: Floor and wall joints shall be complete with fire barrier and fire-rated for 2 hours and UL or Warnock Hersey listed designs. Extend fire barrier beyond expansion joint cover, in concealed locations to maintain fire rating, for full length of expansion joint.

.2 Spring Clips: Stainless steel to manufacturer's standard.

.3 Concealed fasteners and anchors to manufacturer's standard.

.4 Filler strip adhesive to manufacturer's standard.

2.3 **FABRICATION**

.1 Verify dimensions of existing work before commencing fabrications and report discrepancies to Consultant.

.2 Fabricate work in accordance with reviewed shop drawings.

.3 Fabricate expansion joint covers, square, true, straight and accurate to required sizes and profiles.

.4 Fabricate lengths in continuous runs up to 6000 mm.

.5 Shop assemble covers ready for installation where practicable.

.6 Fabricate floor joint cover assemblies with anchors, levelling nuts, filler inserts etc. as required for a complete installation to suit installation and project requirements.

.7 Fabricate work free from defects impairing function, appearance, strength and durability.

2.4 **FINISHES**

.1 Aluminum:
- .1 Hidden components: Mill finish, AA-M10 designation.
- .2 Exposed components: Clear anodized, Class II, AAM12C22A31.
- .3 In contact with concrete: Prime painted.

3 Execution

3.1 **EXAMINATION**

.1 Verify condition and dimensions of previously installed Work upon which this Section depends. Report defects to Consultant. Commencement of work of this Section means acceptance of existing conditions.

3.2 **PREPARATION**

.1 Verify substrate surfaces are solid, free from surface water, frozen matter, dust, oil, grease, scaling or laitance, projections and any other foreign matter detrimental to performance.

.2 Supply and install temporary protection to adjacent surfaces to prevent damage resulting from work of this Section.

3.3 **INSTALLATION**

.1 Install expansion joint cover assembles in accordance with reviewed shop drawings and manufacturer's written instructions.

.2 Set work plumb, square, level, free from distortion.

.3 Secure work accurately to structure in manner not restricting joint movement.

.4 Provide acceptable means of anchorage, such as anchor clips, expansion bolts and shields, welded studs or toggles.

.5 Seal butt joints to manufacturer's instructions to provide watertight and lightight joints.

.6 Adjust joint cover to freely accommodate joint movement.

.7 Install corner bead sealant in accordance with Section 07 92 00.

3.4 **SCHEDULE**

.1 Interior floor joint: Extruded aluminum frame, flush finish can be recessed to accept floor finish, seals have flexible core with shore hardness of 65A, capable of approximately 50% movement, all aluminum in contact with concrete to have zinc chromate finish and mill finish on exposed; 'Type GFP series ' by C/S Construction Specialties Ltd. or approved alternative by MM Systems.

.2 Interior wall joint: Extruded aluminum retainer, capable of 25 to 50% movement, all aluminum in contact with concrete to have zinc chromate finish and mill finish on exposed; 'Type FWF series' by C/S Construction Specialties Ltd. or approved alternative by MM Systems.

.3 Exterior wall joint: Extruded aluminum frame with continuous extruded flexible gray primary seal and continuous PVC secondary seal, capable of approximately ± 50% movement, all aluminum in contact with concrete to have zinc chromate finish and mill finish on exposed; 'SF Series' by C/S Construction Specialties Ltd. or approved alternative by MM Systems or Watson Bowman Acme.

END OF SECTION

1 General

1.1 **SECTION INCLUDES**

.1 Labour, Products, equipment and services necessary for the metal doors and frames Work in accordance with the Contract Documents.

1.2 **REFERENCES**

.1 ASTM A653/A653M, Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvanealed) by the Hot-Dip Process.

.2 ASTM A568/A568M, Specification for General Requirements for Steel, Carbon and High-Strength Low-Alloy, Hot-Rolled Sheet and Cold-Rolled Sheet.

.3 CAN/ULS-S102, Standard Method of Test for Surface Burning Characteristics of building Materials and Assemblies.

.4 CAN4/ULC-S104M, Standard Method for Fire Test of Door Assemblies.

.5 CAN4/ULC-S105M, Standard Specification for Fire Door Frames, Meeting the Performance Required by CAN4/ULC-S104M.

.6 CAN/ULC-S704, Standard For Thermal Insulation, Polyurethane and Polyisocyanurate, Boards, Faced.

.7 CAN/CGSB-1.198, Cementitious Primer, (for Galvanized Surfaces).

.8 CGSB 41-GP-19Ma, Rigid Vinyl Extrusions for Windows and Doors.

.9 CSA W47.1, Certification of Companies for Fusion Welding of Steel Structures.

.10 CSA W59-M, Welded Steel Construction (Metal Arc Welding).

.11 NFPA 80, Standard for Fire Doors and Other Opening Protectives.

.12 NFPA 252, Standard Methods of Fire Tests of Door Assemblies.

1.3 **DESIGN REQUIREMENTS**

.1 Design exterior frame assemblies to accommodate expansion and contraction when subjected to minimum and maximum surface temperature of -35°C to 35°C.

1.4 **SUBMITTALS**

.1 Product data: Submit manufacturer's Product data in accordance with the Conditions of the Contract indicating door and frame construction.

.2 Shop drawings:
- .1 Submit shop drawings in accordance with the Conditions of the Contract for each type of door and frame indicating:
  - .1 Thickness and type of steel.
  - .2 Thickness and type of core.
  - .3 Thickness and type of steel stiffeners and location of them within the door.
  - .4 Thickness and type of metal facing on edges of door and method of fastening.
  - .5 Location of mortises, reinforcement, anchorages, joining, welding, sleeving, exposed fasteners, openings and arrangement for hardware.
- .2 Include schedule identifying each unit with door marks and numbers relating to numbering on Contract Drawings and in door schedule. Indicate doors and frames to be fire rated.

1.5 QUALITY ASSURANCE

.1 Perform Work in accordance with requirements by a member of the Canadian Steel Door and Frame Manufacturers Association.

.2 Label and list fire rated doors and frames by an organization acceptable to authorities having jurisdiction and accredited by the Standards Council of Canada in conformance with CAN4/ULC-S104M and CAN4/ULC-S105M for ratings indicated, Labelling shall be in accordance with NFPA 80.

2 Products

2.1 ACCEPTABLE MANUFACTURERS

.1 Baron Metal Industries Inc.

.2 Daybar Industries Limited

.3 Fleming Doors Products.

2.2 MATERIALS

.1 General:
- .1 All materials under Work of this Section, including but not limited to, primers are to have low VOC content limits.
- .2 Wherever possible, metals used in work of this Section are to contain recycled content.

.2 Steel: ASTM A568/A568M, Class 1; Commercial grade steel, hot dip galvanized to ASTM A653/A653M, ZF120 galvanized coating for interior doors and frames. Z90 for exterior doors and frames.

.3 Minimum base steel thickness:

.1	Frames	1.6 mm
.2	Typical doors	1.2 mm

.3	Interior stiffeners	0.9 mm
.4	Lock/strike reinforcements	1.6 mm
.5	Hinge reinforcements	2.7 mm
.6	All other reinforcement	1.6 mm
.7	Top and bottom channels	1.2 mm
.8	Glazing stops	0.9 mm
.9	Guard boxes	0.9 mm
.10	Jamb spreaders	0.9 mm

.4 Top caps and thermal breaks: CGSB 41-GP-19Ma; Rigid PVC extrusions.

.5 Primer: CAN/CGSB 1.198.

.6 Core material:
- .1 Interior doors: Mineral fibre insulation with a minimum face density of 24 kg/m^3.
- .2 Exterior doors: Polyisocyanurate to CAN/ULC-S704, Type 1, Class 1 closed-cell polyisocyanurate foam manufactured using HCFC-free blowing agents and as follows;
  - .1 Compressive strength: 140kPa minimum.
  - .2 Flame Spread: 500 to CAN/ULC-S102.
  - .3 Vapour Permeance: 1.5 ng/Pa-s-m² maximum.
  - .4 Dimensional stability: 1.5% maximum linear change at 70°C and 97% relative humidity for 7 days.
  - .5 Curing Time: minimum 24 hours, plus 24 hours per 25 mm of thickness before shipment from manufacturer.
  - .6 Long Term Thermal Resistance (LTTR)
    - .1 RSI 1.04 for 25mm board thickness.
    - .2 RSI 2.09 for 50mm board thickness.
    - .3 RSI 3.18 for 75mm board thickness.

.7 Screws: Stainless steel screws with countersunk flat head.

.8 Door silencers: Type 6-180, black neoprene.

.9 Frame anchors:
- .1 Frames in masonry: 1.2 mm minimum, adjustable T-strap jamb anchors.
- .2 Frames in steel stud partitions: 0.9 mm minimum steel anchors of suitable design securely welded inside each jamb.
- .3 Labeled frames: In accordance with ULC requirements.

.10 Floor anchors: 1.6 mm minimum adjustable floor clip angles with 2 holes for anchorage to floor.

.11 Labels for fire doors and door frame: Brass plate, riveted to door and door frame.

.12 Glass and glazing: In accordance with Section 08 80 00.

.13 Door hardware: In accordance with Section 08 70 00.

2.3 FABRICATION

.1 General
- .1 Fabricate doors and frames in accordance with reviewed shop drawings.
- .2 Welding: CSA W59-M to produce a finished unit with no visible seams or joints, square, true and free of distortion.
- .3 Welding: Continuous unless specified otherwise. Execute welding by a firm fully acceptable to the Canadian Welding Bureau to requirements of CSA W47.1.
- .4 Form profiles accurately to details shown on Contract Drawings.
- .5 Ream and remove burrs from drilled and punched holes.
- .6 Grind welded corners and joints to a flat plane and fill with metallic filler and sand to a uniform smooth finish. Apply one coat of primer.

.2 Frames, windows, and screens:
- .1 Fabricate frames of welded construction. Cut mitres and joints accurately and weld continuously on inside of frame profile. Exterior frames to be thermally broken.
- .2 Construct large frame sections with provision for on Site assembly to suit Site conditions.
- .3 Blank, reinforce, drill and tap frames for mortised, templated hardware. Protect mortised cut-outs with guard boxes.
- .4 Reinforce frames where required for surface mounted hardware.
- .5 Reinforce frames over 1200 mm wide with roll formed steel channels or hollow structural sections specified in Section 05 50 00 and as indicated on drawings.
- .6 Furnish exterior door frames with a continuously welded integral steel weather drip at head of frame.
- .7 Prepare each door opening for single stud rubber door silencers, 3 for single door openings located in strike jamb, and 2 for double door openings located in head.
- .8 Install 2 channel or angle spreaders per frame, to ensure correct frame alignment. Install stiffener plates or spreaders between frame trim where required, to prevent bending of trim and to maintain alignment when setting in place.
- .9 Form channel glazing stops minimum 16 mm height, accurately cut, mitred, fitted and fastened to frame sections with stainless steel counter-sunk, flat head screws spaced at maximum 450 mm throughout and 50 mm from each end.

.3 Anchorage:
- .1 Anchor units to floor and wall construction. Locate each wall anchor immediately above or below each hinge reinforcement on hinge jamb and directly opposite on strike jamb, minimum number of anchors for each jamb:
  - .1 Frames up to 2285 mm — 3 anchors.
  - .2 Frames from 2285 mm to 2440 mm — 4 anchors.
- .2 Where frames are to be set in masonry or concrete, supply adjustable anchors to trade installing frame.
- .3 Fabricate frames for installation in steel stud partitions with steel anchors of suitable design, minimum number of anchors for each jamb :
  - .1 Frames up to 2285 mm height — 4 anchors.
  - .2 Frames 2285 mm to 2440 mm — 5 anchors.

.4 General Door Requirements:
- .1 Hollow steel construction, flush swing type, of sizes to conform to details, schedules and reviewed shop drawings with provisions for cut-outs for glass and grilles and reinforced to receive hardware fastenings.
- .2 Blank, reinforce, drill and tap doors for mortised, templated hardware. Where required, reinforce doors for surface mounted hardware and door closers.
- .3 Reinforce oversized doors with steel channels and plates specified in Section 05 50 00 and as indicated on drawings.
- .4 Where openings are required, form integral cut-outs with framing, glass stop moldings and division bars.
- .5 Install grilles to fit tight and secure into openings.
- .6 Bevel both stiles of single doors 1 in 16.
- .7 Reinforce doors with galvanized metal stiffeners at 150 mm o.c.

.5 Interior Doors:
- .1 Supply and install inverted, recessed, mechanically interlocked with tack welded channels at top and bottom of doors.
- .2 Fabricate doors with joints between front and back panels meeting on stile edges. Make joints mechanically interlocked and tack welded for entire height of door. After welding has been completed, grind joints smooth to match metal. Ensure that no filler is used in joints.
- .3 Fill hollow space within door and vertical stiffeners from top to bottom with mineral fibre batt insulation.

.6 Exterior Doors:
- .1 Supply and install inverted, recessed, mechanically interlocked with tack welded channels at top and bottom of doors.
- .2 Fabricate doors with joints between front and back panels meeting on stile edges. Make joints mechanically interlocked and tack welded for entire height of door. After welding has been completed, grind joints smooth to match metal. Ensure that no filler is used in joints.
- .3 Fill void between door faces with polyisocyanurate insulation as specified, thermally bonded to door skins.

.7 Fire Rated Doors:
- .1 Supply and install inverted, recessed, spot welded channels at top and bottom of doors. Supply and install steel flush top caps on exterior doors.
- .2 Fabricate doors with joints between front and back panels meeting on stile edges. Make joints mechanically interlocked and tack welded for entire height of door. After welding has been completed, grind joints smooth to match metal. Ensure that no filler is used in joints.
- .3 Fabricate doors to achieve fire rating as indicated on drawings and in accordance with ULC. Provide ULC label plate on door at hinged edge midway between top hinge and head of door.
- .4 Fabricate door from temperature rise rated core laminated under pressure to each face.

3 Execution

3.1 **EXAMINATION**

.1 Verify condition and dimensions of previously installed Work upon which this Section depends. Report defects to Consultant. Commencement of Work means acceptance of existing conditions.

3.2 **HOLLOW METAL DOOR, FRAME, WINDOW AND SCREEN INSTALLATION**

.1 Install hollow metal doors, frames, windows, and screens plumb, square, level, secure, and at correct elevation.

.2 Install doors clear of floor finishes, and with the correct rebate opening for the door installation. Install door silencers.

.3 Secure anchorages and connections to adjacent construction. Brace frames rigidly in position while building-in. Remove temporary steel shipping jamb spreaders. Install wood spreaders at third points of frame rebate height to maintain frame width. Supply and install vertical supports as indicated on drawings for openings over 1200 mm in width. Remove wood spreaders after frames have been built-in.

.4 Allow for structural deflection and prevent structural loads from being transmitted to hollow metal frames.

.5 Touch-up areas where galvanized coating has been removed or damaged with primer.

.6 Fire rated doors: Install fire rated doors and frames in accordance with requirements of NFPA 80.

.7 Door hardware: To be supplied and installed under Cash Allowance.

3.3 **ADJUSTING AND CLEANING**

.1 Adjust doors for smooth and balanced door movement.

.2 Clean doors, frames and screens.

END OF SECTION

1 General

1.1 **SECTION INCLUDES**

.1 Labour, Products, equipment and services necessary for the wood doors Work in accordance with the Contract Documents.

1.2 **REFERENCES**

.1 ANSI A208.1, Particleboard.

.2 Architectural Woodwork Standards (AWS) - Quality Standards for Architectural Woodwork.

.3 CSA O112 Series, Wood Adhesives.

.4 CAN4 S104-M, Standard Method for Fire Tests of Door Assemblies.

.5 NFPA 80, Standard for Fire Doors and Other Opening Protectives.

1.3 **SUBMITTALS**

.1 Shop drawings: Submit shop drawings of wood doors in accordance with the Conditions of the Contract indicating detail thicknesses, core construction, veneers, finish, door sizes, quantities, fastenings and finishes.

.2 Samples: Submit the following samples in accordance with the Conditions of the Contract:
.1 Two minimum 300 x 300 mm door samples for each type of finish and cut-a-way corners showing construction and materials.

1.4 **QUALITY ASSURANCE**

.1 Perform Work in accordance with requirements of AWS, Quality Standards for Architectural Woodwork, Premium Grade, except as indicated otherwise.

.2 Regulatory Requirements For Fire Rated Doors:
.1 Fire Rating & Labeling: Fire rated doors shall be labelled and listed by an organization accredited by Standards Council of Canada in conformance with CAN4-S104 for ratings specified or indicated.
.2 Provide fire doors for stairwell enclosures that will limit maximum transmitted temperature to door surface on opposite fire side of door to less than 232°C above ambient temperature after 30 minutes of fire exposure.

1.5 **DELIVERY, STORAGE, AND HANDLING**

.1 Deliver, store, and handle wood doors in accordance with the AWS Quality Standards amended as follows:
.1 Wrap wood doors individually in protective wrapping for shipment and Site storage.

.2 Handle wood doors carefully to prevent damage; replace damaged doors.
.3 Store doors flat on a dry, level surface. Ventilate and maintain recommended relative humidity before, during and after installation.

1.6 **EXTENDED WARRANTY**

.1 Provide a Warranty certificate from the door manufacturer which binds the manufacturer to replace all doors found to have defects in factory workmanship or materials, or which warp more than 6mm out of plane, under normal use, for a minimum of five (5) years from the Date of Substantial Performance. Replacement doors shall bear same warranty from date of replacement.

.2 "Replace" as used herein, does not include hanging, installation or field finishing. This work shall be performed by the Contractor for the warranty period stipulated in the General Conditions of the Contract. If doors were originally supplied factory finished, manufacturer must supply replacement doors with same finish.

2 Products

2.1 **ACCEPTABLE MANUFACTURERS**

.1 Baillergeon.

.2 Lambton Doors.

2.2 **MATERIALS**

.1 General: All materials under Work of this Section, including but not limited to, adhesives are to have low VOC content limits.

.2 Wood doors (solid core):
- .1 5 ply wood door: As manufactured by Baillargeon Doors Inc. or Lambton Doors.
- .2 Core: To ANSI A208.1, minimum density 513 kg/m^3 minimum, sanded faces, of thickness to fill void. Extruded particle board cores with voids are not permitted.
- .3 Rails:
  - .1 Top: 35 mm structural composite lumber.
  - .2 Bottom: 35 mm structural composite lumber.
- .4 Stiles
  - .1 16 mm hardwood laminated to 19 mm structural composite lumber.
  - .2 Edge detail: AWMAC No.2.
- .5 Crossbanding: Minimum 2.2 mm thick minimum wood based composite.
- .6 Door facing: Minimum 0.8 mm paint grade birch Veneer finished in accordance with Section 09 91 00.

.3 Wood doors (fire rated):
- .1 'Fire Door Series' by Baillargeon Doors Inc. or 'Fire Door' by Lambton Doors.
- .2 Core: Fire rated mineral core. Density of 28-32 lbs per cubic foot.
- .3 Internal blocking: AWS Option #3; Manufacturers' standard fire resistant blocking.

.4 Top and Bottom Rails: 85 mm laminated strand lumber bonded with type1 water-resistant adhesive as per ASTM-D1037 and ASTM-D198.
.5 Stiles: 107 mm including 85 mm laminated strand lumber bonded with type 1 water-resistant adhesive as per ASTM-D1037 and ASTM-D198.
.6 Crossbanding: Minimum 2.2 mm thick HDF composite.
.7 Door facing: Minimum 0.8 mm birch veneer finished in accordance with Section 09 91 00.

.4 Edge finish: To match door facings.

.5 Adhesive: CSA O112 Series, Type I; Waterproof.

.6 Door frames: Metal door frames in accordance with Section 08 11 13.

.7 Glass and glazing: In accordance with Section 08 80 00.

.8 Door Hardware: To be supplied and installed under Cash Allowance.

2.3 **FABRICATION**

.1 Fabricate doors to sizes indicated on drawings.

.2 Fabricate doors square, true, and free from distortion waves, ridges or core ghost lines. Factory machine doors for finish hardware and flooring.

.3 Fabricate doors using hot press construction technology. Bond stiles and rails to core using adhesive. Sand for uniform thickness. Laminate door facing and trim, to assembled core in hot press.

.4 Cut and bevel stile edges as follows:
.1 Lock side: 3 mm in 50 mm.
.2 Hinge side: 1.5 mm in 50 mm.

.5 Finish wood doors in factory and deliver to site ready for hanging.

2.4 **FIRE RATED DOORS**

.1 Fabricate and label fire rated wood doors with plate label indicating fire protection rating as indicated on door schedule.

3 Execution

3.1 **EXAMINATION**

.1 Verify condition and dimensions of previously installed Work upon which this Section depends. Report defects to Consultant. Commencement of Work means acceptance of existing conditions.

3.2 INSTALLATION

.1 Install doors plumb, rigid, square, clear of floor finishes, and with correct rebate opening for door installation.

.2 Conform to requirements of AWS Quality Standard, for wood door installation.

3.3 FIRE RATED DOORS

.1 Install fire rated doors in accordance with the requirements of ULC and NFPA 80.

3.4 ADJUSTING AND CLEANING

.1 Replace the following wood doors:
- .1 Warped more than 3 mm, measured at any point on door, relative to perfectly flat surface.
- .2 Core telegraphing visible at 1500 mm distance, under final Site lighting conditions.

.2 Adjust doors for smooth and balanced door movement.

END OF SECTION

1 General

1.1 **SECTION INCLUDES**

.1 Labour, Products, equipment and services necessary for access panel Work in accordance with the Contract Documents.

1.2 **SUBMITTALS**

.1 Product data:
- .1 Submit copies of manufacturer's Product data in accordance with the Conditions of the Contract indicating:
  - .1 Performance criteria, compliance with appropriate reference standard, characteristics, limitations.
  - .2 Product transportation, storage, handling and installation requirements.

.2 Shop Drawings: Submit Shop Drawings in accordance with the Conditions of the Contract indicating elevations, details, profiles, dimensions, thickness of materials, finishes, and methods of joining.

.3 Closeout submittals: Provide maintenance data for hardware complete with pertinent details, spare parts lists and warnings against harmful maintenance materials and practices for incorporation into Operation and Maintenance Manual in accordance with the Conditions of the Contract.

1.3 **QUALITY ASSURANCE**

.1 Installer's qualifications: Perform work of this Section by a company that has a minimum of five years proven experience in the installation of access panel work of a similar size and nature and that is approved by the manufacturer.

2 Products

2.1 **ACCESS PANELS**

.1 Access door (fire rated):
- .1 Gypsum board partitions and ceilings: Fire rated, prime coat steel flush mounted access door constructed of 0.91 mm thick (20 ga.) door with fire rated insulation and perforated taping bead flange. Frame to be one piece 1.5 mm thick (16 ga.) frame with 25 mm flange. Door to have continuous concealed hinge and universal self-latching bolt operated by a knurled knob. 'FW-5050-DW' by Acudor Access Doors or approved alternative. Finish: Paint finish to match adjacent surfaces.
- .2 Masonry partition / Tile finish locations: Fire rated, steel flush mounted access door constructed of 1.5 mm thick (16 ga.) door with fire rated insulation and one piece 1.2 mm thick (18 ga.) frame. Door to have continuous concealed hinge and universal self-latching bolt operated by a knurled knob. 'FW-5050' by Acudor Access Doors or approved alternative.
  - .1 Paint Finish: Where adjacent finish is paint provide prime coated steel door with paint finish.

.2 Stainless Finish: Where adjacent finish is tile provide Type 304 stainless steel door.

2.2 **FABRICATION**

.1 Fabricate components free of twists, bends, or visual distortion and insulated. Weld corners and joints.

3 Execution

3.1 **EXAMINATION**

.1 Verify condition of previously installed Work upon which this Section depends. Report defects to Consultant. Commencement of Work means acceptance of existing conditions.

3.2 **INSTALLATION**

.1 Install access panels and associated components in accordance with reviewed shop drawings and manufacturer's written instructions.

.2 Erect components plumb, level and in proper alignment.

.3 Repair finishes damaged during installation.

3.3 **CLEANING**

.1 Upon completion of installation, remove surplus materials, rubbish, tools and equipment barriers.

END OF SECTION

1 General

1.1 **SECTION INCLUDES**

.1 Design, labour, Products, tool, equipment and services necessary for Aluminum Work in accordance with the Contract Documents.

1.2 **REFERENCES**

.1 AAMA 611, Voluntary Standards for Anodized Architectural Aluminum.

.2 AAMA CW-10, Care and Handling of Architectural Aluminum from Shop to Site.

.3 CAN/CSA-A440-M/A440.1-M, Windows / User Selection Guide to CSA Standard CAN/CSA A440-M Windows.

.4 CSA A440/A440.1, Windows, Special Publication.

.5 ANSI H35.1M, Alloy and Temper Designation Systems for Aluminum (Metric).

.6 ASTM A167, Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet and Strip.

.7 ASTM B209M, Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

.8 ASTM B221M, Specification for Aluminum-Alloy Extruded Bars, Rods, Wires, Profiles and Tubes.

.9 ASTM C920, Specification for Elastomeric Joint Sealants.

.10 ASTM E283, Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.

.11 ASTM E330, Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference.

.12 ASTM E331, Standard Test Method for Water Penetration of Exterior Windows, Curtain Walls and Doors by Uniform Static Air Pressure Difference.

.13 ASTM F738M, Specification for Stainless Steel Metric Bolts, Screws, and Studs.

.14 CAN/CGSB 1.108-M, Bituminous Solvent Type Paint.

.15 CAN/CGSB 79.1-M, Insect Screens.

.16 CAN/ULC S702, Thermal Insulation, Mineral Fibre, for Buildings.

1.3 DEFINITION(S)

.1 Aluminum Work: Shall mean aluminum curtainwall, windows, skylight, doors, and framing mentioned in Part 2 of this Specification Section.

1.4 DESIGN REQUIREMENTS

.1 Design Aluminum work to meet requirements of AAMA/WDMA/CSA 101/I.S.2/A440, AAMA CW-DG-1, ASTM E283, ASTM E330, ASTM E331, NFRC 100, NFRC 200 and to meet performance and energy requirements specified herein and as required by authorities having jurisdiction.

.2 Design Aluminum Work in accordance with following Climatic Design Data for Napanee contained in the Ontario Building Code:
- .1 Design temperature: January 1%, July 2 1/2% .
- .2 Hourly wind pressures: 1 in 50 year occurrence.

.3 Design Aluminum Work to accommodate following without producing detrimental effect:
- .1 Cyclic 40°C daily thermal swing of components.
- .2 Cyclic, dynamic loading and release of loads such as wind loads.
- .3 13 mm vertical deflection in supporting structure and movement of supporting structure due to live, dead load, and creep or deflections, seismic load, sway displacement and similar items.

.4 Design to prevent accumulation of condensate on interior side of Aluminum Work framing under the following service conditions:
- .1 Interior temperature: 25°C.
- .2 Exterior temperature: -25°C.
- .3 Interior RH: 35%.

.5 Design complete aluminum window systems, including glazing, to meet the following performance criteria:
- .1 U-factor: Maximum [...].
- .2 SHGC: Maximum [...].

.6 Design complete aluminum entrance door systems, including glazing, to meet the following performance criteria:
- .1 U-factor: Maximum [...].
- .2 SHGC: Maximum [...].

.7 Design windows in accordance to AAMA/WDMA/CSA -101/I.S.2/ A440, to the following performance levels:
- .1 Performance class: CW.
- .2 Minimum performance grade (PG): 30.
- .3 Minimum positive design pressure: 1440 Pa.
- .4 Minimum negative design pressure: - 1440 Pa.
- .5 Minimum water penetration test pressure: 260 Pa.
- .6 Minimum air infiltration/exfiltration: A2.
- .7 Condensation resistance: I57

.8 Restrict air infiltration/exfiltration, through Aluminum Work in accordance with ASTM E283 at pressure differential as indicated:
- .1 Curtainwall assemblies: 0.0003 $m^3/s\ m^2$ at differential of 300 Pa.
- .2 Skylights: 0.003 L/s m^2 at differential of 500 Pa.
- .3 Doors (per door): 2.78 m^3/h m per linear metre of crack at differential of 75 Pa.

.9 Design and detail controlled drainage path to actively discharge water, which enters into or forms within Aluminum Work, to exterior; prevent accumulation or storage of water within Aluminum Work. Prevent water from entering interior when tested in accordance with ASTM E331.

.10 Design and detail air barrier, vapour retarder, and rainscreen products and assemblies into continuous and integrated Aluminum Work envelope. Optimize Aluminum Work design to align envelope layers and to minimize thermal bridges.

.11 Prevent deflection and permanent or progressive glazing displacement. Restrict horizontal and vertical mullion deflection to less than L/175 and 19 mm maximum for heights under 4115 mm and L/240 and 25 mm maximum for heights over 4115 mm.

.12 When tested at 150 percent of positive and negative wind-load design pressures, systems, including anchorage, do not evidence material failures, structural distress, and permanent deformation of main framing members exceeding 0.2 percent of span in accordance with ASTM E330.

.13 Design anchorage inserts for installation as part of other Sections of Work. Design anchorage assemblies to accommodate construction and installation tolerances.

.14 Provide all reinforcing within aluminum members as required by design and OBC to provide structurally sound assembly. In any case, mullion size shall not be increased due to provision of reinforcing.

.15 Design Aluminum Work and connections to substrate where the bottom of the Aluminum Work extends to a point below 1070 mm above finished floor level and separates a floor level from an adjacent interconnected space to withstand the required guard and handrail loads in accordance with the OBC and applicable local regulations. When requested by Consultant, provide a letter signed and sealed by a Professional Engineer certifying that the Aluminum Work conforms to the OBC requirements.

.16 Design operable windows within reach of occupants with limiting stops conforming to requirements of OBC.

.17 Design Aluminum Work to support weight of supported items such as exterior signage in accordance with Section 10 14 19.

1.5 SUBMITTALS

.1 Shop drawings:
- .1 Submit shop drawings in accordance with the Conditions of the Contract indicating:
  - .1 Plans, sections, details, type of extrusions, profiles, finishes, panels, spandrels, operating components, doors, related flashings, closures, fillers, and end caps, and sealants.
  - .2 Suspended cross and support framing.
  - .3 Products and glazing types.
  - .4 Anchorage inserts, system installation tolerances.
  - .5 Section and hardware reinforcement, anchorage, assembly fixings.
  - .6 Detailing, locations, and allowances for movement, expansion, contraction.
  - .7 Path of cavity drainage and air pressure equalization.

.2 Samples:
- .1 Submit two samples of following in accordance with the Conditions of the Contract:
  - .1 250 mm long samples of each type of extrusion and finish.
  - .2 250 x 200 mm samples of insulating glass unit.
  - .3 One complete corner detail of door frame, glazing, and finish for each door type.
  - .4 Each door hardware item for Consultant's approval.
  - .5 250 x 200 mm sample of aluminum panel.

.3 Reports:
- .1 Submit substantiating engineering data, and independent test results of pre-tested, Aluminum Work to substantiate compliance with the design criteria including air leakage and water penetration conforming to ASTM E283 and ASTM E331.
- .2 Engineering data demonstrating compliance with test procedures outlined in AAMA 501 including as a minimum air leakage resistance, static pressure water penetration resistance, dynamic pressure water penetration resistance, wind load resistance, vertical live load deflection movement and lateral (horizontal) movement, and condensation resistance.
- .3 Submit documentation to substantiate ten years of experience in Aluminum Work manufacture and installation.

.4 Close-out submittals: Submit Aluminum Work data for incorporation into the Operations and Maintenance Manual as part of the Conditions of the Contract.

1.6 QUALITY ASSURANCE

.1 Retain a Professional Engineer, licensed in Province of Ontario, with experience in Aluminum Work of comparable complexity and scope to perform the following services as part of the Work of this Section:
- .1 Design of Aluminum Work.
- .2 Review, stamp, and sign shop drawings.

.3 Conduct on-Site inspections and prepare and submit inspection reports. Number and frequency of inspection to be sufficient to satisfy Engineer that Aluminum Work is being fabricated and installed in accordance with reviewed shop drawings and design intent.

.2 Mock-up:
- .1 Fabricate, deliver, and erect one, full scale mock-up of each type of Aluminum Work, in location acceptable to Consultant.
- .2 Demonstrate full range of Products, finishes, textures, quality of fabrication, and workmanship.
- .3 Mock-up may form part of final Work, if acceptable to Consultant. Remove and dispose of mock-ups which do not form part of Work.

1.7 DELIVERY, STORAGE, AND HANDLING

.1 Handle Aluminum Work in accordance with AAMA CW-10.

.2 Protect aluminum surfaces with strippable coating. Do not use adhesive papers or sprayed coatings which bond when exposed to sunlight or weather. Do not remove before final cleaning of building.

1.8 EXTENDED WARRANTY

.1 Submit a extended warranty for Aluminum Work in accordance with General Conditions, except that warranty period is extended to 10 years.
- .1 Warrant against failure to meet the design criteria and requirements such as interior leakage, insulating glass unit failure, finish degradation, frame condensation.
- .2 Coverage: Complete replacement including affected adjacent Work.

.2 Glazing:
- .1 Provide a 10 year warranty, commencing from date of Substantial Performance, against defects in the insulating glass units and warrant them to be free from material obstruction of vision as a result of dust or film formation on the internal glass surfaces by any cause, under normal design conditions. Warrant the following:
  - .1 The insulating glass units shall be free from condensation, fogging material obstruction of vision as a result of dust or film formation on the internal glass surfaces by any cause under design conditions.
  - .2 The insulating glass units shall not change their mechanical design properties and shall not in any way deteriorate, degrade, delaminate or change their visual appearance.
  - .3 The glass units will not break due to thermal shock and temperature differential due to inherent glass faults, other than extrinsic glass breakage.
  - .4 Internal fogging shall be deemed to occur when light transmission of the glass is reduced by 5% ina any 50 mm x 50 mm area.
  - .5 Failure will be deemed to occur when the internal dew point exceeds -40oC in a 21oC ambient temperature (when tested in accordance with ASTM E576).

.2 Warrant that glazing work is water and weather tight and free from distortion; that glazing materials will not deteriorate from exposure to the atmosphere and weather, will not be displaced, and will be free from permanent deformation under load; and that glass and insulating glass units will not be broken, cracked or scratched by causes resulting from defects in material, workmanship or design of glazing installation.

.3 Cracked or scratched glass, shrinking, cracking, staining, hardening, sagging of glazing materials; loosening or rattling of glass; and leaking of glazed joints will be considered defective work.

.4 Warranty shall provide for the removal of defective Products, replacement with new Products conforming to the specifications, and restoration of work damaged by removal and replacement including labour and installation costs.

2 Products

2.1 **ACCEPTABLE MANUFACTURER(S) AND SYSTEM(S)**

.1 Curtain Wall: 'ThermaWall 2600 Series' by Alumicor Limited, '1600UT Curtain Wall' by Kawneer or approved alternative by Aerloc or US Aluminum (C.R. Lawrence).

.2 Aluminum windows: In accordance with Section 08 51 13.

.3 Aluminum doors: 'ThermaPorte 7700' by Alumicor Limited, or approved alternative by Kawneer Company Canada Limited or US Aluminum (C.R. Lawrence).

.4 Skylight framing: Custom skylight as manufactured by Alumicor Limited, or approved alternative by Kawneer Company Canada Limited or US Aluminum (C.R. Lawrence).

2.2 **MATERIALS**

.1 All materials under Work of this Section, including but not limited to, sealants are to have low VOC content limits.

.2 Aluminum extrusions and channels: ASTM B221 and ANSI H35.1 AA6063 alloy, T6 temper.

.1 Profile and dimensions: Refer to Contract Drawings.

.2 Thermal breaks in frame members: Vertically aligned with glazing.

.3 Aluminum sheet: ASTM B209 and ANSI H35.1 AA1100 aluminum alloy, H14 temper, minimum 1.29 mm for sheets less than 610 mm wide and minimum 2.05 mm for sheets of a greater dimension.

.4 Reinforcements and anchors: ASTM A167, Type 304 to AISI No. 2B finish. Size as shown.

.5 Glass and glazing materials: As specified in Section 08 80 00.

.6 Spandrel panel airseal backpan: ASTM A653/A653M; 0.9 mm thick, Z275 galvanized steel sheet.

.7 Airseal and Aluminum Work sealant: ASTM C920, Type S, Grade NS, Class 100/50; One-part, low-modulus, moisture-curing, silicone. 'Dow Corning 790' by Dow Corning; 'Spectrem 1' by Tremco. Verify compatibility with insulating glass unit manufacturer's secondary sealant. Colour as selected by Consultant. Primer as recommended by manufacturer.

.8 Frame sealant: Type as recommended by the Aluminum Work manufacturer.

.9 Joint backing: Closed cell foam polyethylene rod, outsized minimum 30-50% larger than joint width and compatible with joint sealant. Product as recommended by sealant manufacturer.

.10 Joint Primer, Surface Conditioners and Cleaning Agents: As recommended by respective glazing and sealant compound manufacturer.

.11 Airseal transition membrane: To match products provided under Section 07 26 00 - Air/Vapour Barriers.

.12 Anchors, clips, and angles: Extruded aluminum or stainless steel.

.13 Shims and blocking for frame: Rigid plastic, wood is not permitted.

.14 Flashings, closures and trim: 1.0 mm minimum aluminum sheet, finish to match curtain wall extrusion finish.

.15 Screws, bolts and other fasteners: ASTM F738M; Stainless Steel Type 304.

.16 Isolation coating: CAN/CGSB-1.108-M; Bitumastic coating, acid and alkali resistant material.

.17 Spandrel panel insulation: CAN/ULC S702; Semi-rigid mineral fibre.
- .1 Type 703 by Owens-Corning.
- .2 CurtainRock by Rockwool Inc.
- .3 Thickness: As required to fill void.
- .4 Insulation fasteners: Stik-Clip with retaining washer.

.18 Foam Insulation: One component polyurethane foam-in-place moisture cured caulking sealant insulation, 16 kg per m^3 to 32 kg per m^3 density; injected from prepackaged pressurized containers for installation within closures and fillers; foam shall be CFC free. Enerfoam by Dow Chemical Canada Inc. or approved alternative.

.19 Door hardware: Supplied by finish hardware supplier under Section 08 70 00 for installation by door manufacturer.

.20 Screens: Fiberglass yarn 14 X 18 mesh screen, conforming to CAN/CGSB 79.1-M, in an extruded aluminium frame finish to match window frame.

.21 Weatherstripping: Durable, non-absorbing material resistant to deterioration by aging and weathering. Weather stripping shall provide complete air-tight seal at jambs and head of opening. Adapt weatherstripping as required to maintain required performance and provide any/all necessary accessories.

2.3 FABRICATION

.1 Fabricate sections true to detail, free from defects impairing appearance, strength and durability. Fabricate extrusions with sharp, well defined corners.

.2 Fabricate Aluminum Work in accordance with reviewed shop drawings and manufacturer's written instructions.

.3 Fabricate, fit, and secure framing joints and corners accurately, with flush surfaces, and hairline joints. Apply frame sealant at joints for weatherproof seams.

.4 Conceal anchors, reinforcement and attachments from view. Fabricate reinforcement in accordance with design requirements.

.5 Do not expose manufacturer's identification labels on aluminum assemblies.

.6 Fabricate continuous sill flashings with intermediate anchor clips, and joint reinforcing, form to profile shown. Fabricate filler and closure pieces as necessary for a complete and weather tight installation.

.7 Certify aluminum windows as complying with the CAN/CSA-A440-M/A440.1-M design criteria and requirements using an easily removable label located on the inside face of glazing.

.8 Fabricate doors and frames complete with internal reinforcements, cut-outs, and recesses to accommodate finish hardware. Reinforce cut-outs to assure adequate strength.

.9 Fabricate Aluminum Work closures and trim from aluminum sheet. Form to profile shown. Make weathertight.

.10 Double weatherstrip windows and doors. Install weatherstripping in specially extruded ports and secure to prevent shrinkage or movement.

.11 Fabricate glazing recess with drainage to exterior.

.12 Fabricate skylights with an integral interior condensation gutter.

2.4 ALUMINUM DOORS

.1 Fabricate doors of welded construction.

.2 Glazing stop: Aluminum, square, snap-on type, designed for glazing system.

2.5 INFILL (SPANDREL) PANELS

.1 Fabricate insulated spandrel panel inner facing of galvanized sheet to form an airseal backpan. Wrap edges with galvanized sheet, enabling installation and minor movement of perimeter seal.

.2 Accurately fit and secure joints and corners. Make joints flush, hairline, and weatherproof.

.3 Provide integral reinforcing and stiffeners as required to reinforce panel against deflection caused by wind and suction loads.

.4 Place continuous layer of insulation to airseal backpan with adhesive and impale clips and fasteners. Ensure there are not gaps between the insulation and airseal backpan.

.5 Provide spacers as necessary to separate dissimilar metals.

.6 Ventilate and pressure equalize the air space outside the exterior surface of the insulation, to the exterior.

.7 Arrange fasteners and attachments to ensure concealment from view.

.8 Glass panels: Consists of 6 mm thick spandrel glass to the exterior with insulated backpan to the inside. Insulation shall be in thickness as indicated on Contract Drawings, retained with stick clips. Seal all joints in shop with high grade butyl sealant, including perimeter seal at backpan. Colour to later selection by Consultant.

.9 Metal panels: Consists of an exterior prefinished flush aluminum panel with panel stiffeners as required, to match colour of window framing, with insulation core in thickness as indicated on Contract Drawings and galvanized sheet back-pan.

2.6 **FINISH**

.1 Extrusion finish: Clear anodized to AAMA 611 per Aluminum Association Designation System for Aluminum Finishes AA-M12C22A31.

.2 Doors: Clear anodized to AAMA 611 per Aluminum Association Designation System for Aluminum Finishes AA-M12C22A31.

.3 Panel and sheet finish: As indicated on drawings to match adjacent extrusion finish.

3 Execution

3.1 **EXAMINATION**

.1 Verify condition and dimensions of previously installed Work upon which this Section depends. Report defects to Consultant. Commencement of Work means acceptance of existing conditions.

3.2 **INSTALLATION**

.1 Install Aluminum Work in accordance with reviewed shop drawings, manufacturer's written instructions, and CAN/CSA-A440-M/A440.1-M.

.2 Install work of this Section securely, in correct location, level, square, plumb, at proper elevations, free of warp or twist.

.3 Apply isolation coating at 0.8 mm dry film thickness to prevent corrosive or electrolytic action between dissimilar materials such as aluminum to concrete, masonry, galvanized steel and similar conditions.

.4 Install flashings, closures, and trim pieces.

.5 Fill voids between aluminum framing and adjacent construction with foam insulation.

.6 Install sills in maximum lengths possible. For sills over 1200 mm in length, maintain 3 mm to 6 mm space at each end.

.7 Refer to Contract Drawings for glazing type locations. Install glazing in accordance with Section 08 80 00.

.8 Spandrel panels:
- .1 Set back pans to framing, apply sealant to cover screw heads to maintain air tight seal between back pans and framing.
- .2 Adhere stick clips to metal back pans at 300 mm o.c. both ways. Apply insulation adhesive over entire surface of barrier and around clips held with adhesive.
- .3 Cut insulation slightly over-size and press insulation boards firmly to barrier impaling them on clips without bending clips. Butt insulation boards tightly. install retainers to clips.

.9 Install aluminum door weatherstripping at door frame perimeter. Install weatherstripping throughout entire length and width of doors at jambs and heads.

.10 Install doors and hardware to manufacturers' written instructions. Clean and adjust hardware for correct performance.

.11 Install hardware in accordance with hardware templates.

.12 Adjust fixed and operable hardware for correct clearances and function.

.13 Remove damaged or unacceptable Products and assemblies from Site and replace to Consultant's acceptance.

.14 Install glass presence markers, in two cross stripes extending from diagonal corners. Maintain markers until final clean-up.

3.3 ERECTION TOLERANCES

.1 Tolerances: Non-cumulative.
- .1 Maximum variation from plumb: 1.5 mm/3 m non-cumulative or 12 mm/30 m, whichever is less.
- .2 Maximum misalignment of two adjoining members abutting in plane: 0.8 mm.
- .3 Vertical and horizontal positions: +/- 3 mm.
- .4 Racking of face: 6 mm, nil in elevation.
- .5 Operable components: Consistent with smooth operation and weatherproof performance.

.6 Maximum perimeter sealant joint between Aluminum Work and adjacent construction: 13 mm.

3.4 GLAZING PERIMETER AIRSEAL

.1 Install glazing perimeter airseal at entire perimeter of each insulating glass unit to achieve an airseal from insulating glass unit to curtain wall frame. Do not obstruct path of cavity drainage and air pressure equalization.

.2 Perform sealant work in accordance with manufacturer's written requirements.

3.5 AIRSEAL TRANSITION MEMBRANE

.1 Install primer and airseal transition membrane in accordance with manufacturer's instructions. Install airseal transition membrane into extrusion reglet as indicated on drawings. If there is no extrusion reglet, mechanically fasten airseal transition membrane to frame with batten bar fastened at 150 mm o.c.

.2 Overlap airseal transition membrane 75 mm minimum and lap in direction of waterflow.

.3 Coordinate airseal transition to adjacent parts of Work.

3.6 JOINT BACKING AND ALUMINUM WORK SEALANT

.1 Prepare substrate surface and mask as recommended by sealant manufacturer.

.2 Install joint backing and sealant at Aluminum Work and perimeter joints for weather tight installation in accordance with sealant manufacturer's instructions. Tool sealant. Remove excess sealant.

.3 Seal joints between windows and window sills with sealant. Bed sill expansion joint cover plates and drip deflectors in sealant. Seal between sill upstand and window-frame. Seal butt joints in continuous sills.

3.7 ADJUSTING

.1 Adjust operable units to move smoothly, with proper tension, throughout their full range of motion and to fit tightly when closed and locked.

.2 Lubricate hardware in accordance with manufacturer's instructions.

.3 Ensure that weatherstripping makes weathertight contact and does not cause binding to affect closing and locking.

3.8 CLEANING

.1 Maintain Aluminum Work, inside and outside, in clean condition throughout construction period.

.2 Remove labels, protective material, and glass presence markers from prefinished surfaces.

.3 Remove CAN/CSA-A440-M/A440.1-M certification labeling when directed by Consultant, in writing.

.4 Wash Aluminum Work with solution of mild detergent in warm water, with particular attention to recesses and corners. Wipe surfaces clean and dry.

END OF SECTION

1 General

1.1 **SECTION INCLUDES**

.1 Design, labour, Products, equipment and services necessary for aluminum window work in accordance with the Contract Documents.

1.2 **REFERENCE**

.1 AAMA 611, Voluntary Standards for Anodized Architectural Aluminum.

.2 AAMA/WDMA/CSA 101/I.S.2/A440, Standard Specification for Windows, Doors, and Unit Skylights.

.3 ANSI H35.1M, Alloy and Temper Designation Systems for Aluminum (Metric).

.4 ASTM B209M, Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

.5 ASTM B211, Specification for Aluminum-Alloy Extruded Bars, Rods, Wires, Shapes and Tubes.

.6 ASTM C920, Specification for Elastomeric Joint Sealants.

.7 ASTM F738M, Specification for Stainless Steel Metric Bolts, Screws, and Studs.

.8 IGMA, Insulating Glass Manufacturers Alliance.

.9 NFRC 100, Procedure for Determining Fenestration Product U-factors.

.10 NFRC 200, Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence.

1.3 **DESIGN REQUIREMENTS**

.1 Design windows to meet requirements of AAMA/WDMA/CSA 101/I.S.2/A440, NFRC 100, NFRC 200 and to meet performance and energy requirements specified herein and as required by authorities having jurisdiction.

.2 Design complete window systems, including glazing, to meet the following performance criteria:
.1 U-factor: Maximum to follow.
.2 SHGC: Maximum to follow.

.3 Design aluminum work in accordance with following Climatic Design Data for Napanee contained in the Ontario Building Code:
.1 Design temperature: January 1%, July 2 1/2%.
.2 Hourly wind pressures: 1 in 50 year occurrence.

.4 Design aluminum work to accommodate following without producing detrimental effect:
.1 Cyclic 40 degrees C daily thermal swing of components.
.2 Cyclic, dynamic loading and release of loads such as wind loads.

.3 13 mm vertical deflection in supporting structure and movement of supporting structure due to live, dead load, and creep or deflections, seismic load, sway displacement and similar items.

.5 Design to prevent accumulation of condensate on interior side of aluminum work framing under the following service conditions:
- .1 Interior temperature: 25ºC.
- .2 Exterior temperature: -25ºC.
- .3 Interior RH: 35%.

.6 Design and detail controlled drainage path to actively discharge water, which enters into or forms within aluminum work, to exterior; prevent accumulation or storage of water within aluminum work.

.7 Design windows in accordance to AAMA/WDMA/CSA -101/I.S.2/ A440, to the following performance levels:
- .1 Performance class: CW.
- .2 Minimum performance grade (PG): 35.
- .3 Minimum positive design pressure: 1680 Pa.
- .4 Minimum negative design pressure: - 1680 Pa.
- .5 Minimum water penetration test pressure: 300 Pa.
- .6 Minimum air infiltration/exfiltration: 0.12 L/s m^2.
- .7 Condensation resistance: I57

.8 Design and detail air barrier, vapour retarder, and rainscreen products and assemblies into continuous and integrated aluminum work envelope. Optimize aluminum work design to align envelope layers and to minimize thermal bridges.

.9 Prevent deflection and permanent or progressive glazing displacement. Restrict horizontal and vertical mullion deflection to less than L/175 (under uniformly distributed positive design wind load), and 10 mm maximum regardless of span.

.10 Design anchorage inserts for installation as part of other Sections of Work. Design anchorage assemblies to accommodate construction and installation tolerances.

1.4 SUBMITTALS

.1 Shop drawings: Submit shop drawings in accordance with the Conditions of the Contract indicating:
- .1 Fabrication and erection of glazing elements indicating materials, thicknesses, finishes, connections, joints, method of anchorage, number of anchors, supports, reinforcement, details, and accessories.
- .2 Calculations or modelling confirming windows conforms to specified performance and energy requirements.

.2 Samples:
- .1 Submit following samples in accordance with the Conditions of the Contract.
- .2 Submit one 300 x 300 mm of each type of insulating glass unit.

.3 Certificates: Submit manufacturer's certification that glass and glazing materials are compatible.

.3 Submit compatibility and adhesion test reports from sealant manufacturer indicating that glazing materials were tested for compatibility and adhesion with glazing sealants. Include sealant manufacturer's interpretation of test results relative to sealant performance and recommendations for primers and substrate preparation needed for adhesion.

.4 Compatibility test report from manufacturer of insulating glass edge sealant, indicating that glass edge sealants were tested for compatibility with other glazing materials including sealants, setting blocks, edge blocks and any other material that contacts or can affect the edge seal.

.5 IGMA Compliance Audit: Submit in accordance with the Conditions of the Contract, a written certification of successful completion of a Compliance Audit within the last six months.

.6 Extended warranty: Submit extended warranty signed and registered by the manufacturer providing the warranty in the name of the Owner for the timeframe and coverage specified in this Section.

1.5 QUALITY ASSURANCE

.1 Installers qualifications: Perform work of this Section by a company that has a minimum of five years proven experience in the installations of a similar size and nature and that is approved by manufacturer. Submit to Consultant, applicator's current certificate of approval by the material manufacturer as proof of compliance. Submit proof of experience upon Consultant's request.

.2 Independent inspection:
- .1 Inspection and testing of windows may be performed by an inspection and testing firm designated and paid for by the Owner.
- .2 Inspection and testing by the independent inspection company may be performed on or off site. Inspection and testing will be performed to ensure that windows meet specified design criteria. Coordinate with inspection and testing company.
- .3 Tested windows shall meet or exceed requirements of this Section.
- .4 Copies of test reports will be provided to Contractor.
- .5 Air infiltration test will be performed before water resistance test.
- .6 At conclusion of tests there shall be no glass breakage, damage of fasteners, hardware parts, or any other damage.
- .7 Windows not meeting design criteria will be replaced at no cost to Owner.

.3 Mock-up:
- .1 Construct one field sample mock-up of window in location acceptable to Consultant.
- .2 Demonstrate installation of anchoring devices and air/vapour retarder sealing and relation of window to surrounding construction.
- .3 Arrange for Consultant's review and acceptance.
- .4 Mock-up may remain as part of Work if accepted by Consultant. Remove and dispose of mock-ups which do not form part of Work.
- .5 Upon acceptance, mock-up shall serve as a minimum standard of quality for the balance of the work of this Section.

1.6 **DELIVERY, STORAGE, AND HANDLING**

.1 Handle aluminum work in accordance with AAMA CW-10.

.2 Protect aluminum surfaces with strippable coating. Do not use adhesive papers or sprayed coatings which bond when exposed to sunlight or weather. Do not remove before final cleaning of building.

1.7 **EXTENDED WARRANTY**

.1 Submit an extended warranty for aluminum work in accordance with General Conditions, except that warranty period is extended to 5 years.
- .1 Warrant against failure to meet the design criteria and requirements such as interior leakage, insulating glass unit failure, finish degradation, frame condensation.
- .2 Coverage: Complete replacement including affected adjacent work.

2 Products

2.1 **ACCEPTABLE MANUFACTURERS**

.1 Fixed windows: 'Rainblade 1970' by Alumicor Limited, '516 Isoport Windows' by Kawneer Company Canada Limited, or approved alternative.

.2 Operable Windows: 'UniVent 1350 Series' by Alumicor Limited, '526 Windows' by Kawneer Company Canada Limited or approved alternative.

2.2 **MATERIALS**

.1 All materials under work of this Section, including but not limited to, primers and sealants are to have low VOC content limits.

.2 Unless detailed or specified herein, standard products in accordance with AAMA/WDMA/CSA -101/I.S.2/ A440 will be acceptable if construction details and installation meet intent of Drawings and Specifications.

.3 Aluminum extrusions and channels: ASTM B211 and ANSI H35.1 AA6063 alloy, T6 temper.
- .1 Profile and dimensions: Refer to Contract Drawings.
- .2 Thermal breaks in frame members: Vertically aligned with glazing.

.4 Aluminum sheet: ASTM B209 and ANSI H35.1 AA1100 aluminum alloy, H14 temper, minimum 2.38 mm thickness for all sheet widths.

.5 Glass and glazing materials: In accordance with Section 08 80 00.

.6 Weatherstripping: Woven polypropylene pile, Fin-Seal by Schlegel. Do not use open cell plastic foam.

.7 Screens: Fiberglass yarn 14 X 18 mesh screen, conforming to CAN/CGSB 79.1-M, in an extruded aluminium frame finish to match window frame.

.8 Window hardware:
- .1 Heavy duty window hardware to include all components as required for smooth, secure and complete operation and to be reviewed by the Consultant prior to ordering.
- .2 Open-out vents: Pivot shoe heavy duty roto operator in conjunction with friction arms, aluminum hinges, and concealed allen key with removable handle and all required additional components.
- .3 Limiting stops: All operable window within reach of occupants to have limiting stops to OBC requirements.
- .4 Verify all site conditions regarding location and exact assembly requirements.

.9 Joint backing: Closed cell foam polyethylene rod, outsized minimum 30-50% larger than joint width and compatible with joint sealant. Product as recommended by sealant manufacturer.

.10 Joint Primer, Surface Conditioners and Cleaning Agents: As recommended by respective glazing and sealant compound manufacturer.

.11 Sealant: ASTM C920, Type S, Grade NS, Class 100; One-part, Moisture -curing silicone, 'Dowsil 790' by Dow Consumer Solutions or Spectrum 1 by Tremco. Colour: As selected by Consultant.

.12 Screws, bolts and other fasteners: ASTM F738M; Stainless Steel Type 304. Aluminum; screws and bolts, AS2024 or 6061, and nuts AS6262.

.13 Foam insulation: One component polyurethane foam-in-place moisture cured caulking sealant insulation, 16 kg per m^3 to 32 kg per m^3 density; injected from prepackaged pressurized containers for installation within closures and fillers; foam shall be CFC free. Enerfoam by DuPont de Nemours Inc. or approved alternative.

2.3 FABRICATION

.1 Fabricate sections true to detail, free from defects impairing appearance, strength and durability. Fabricate extrusions with sharp, well defined corners.

.2 Fabricate panel system in accordance with reviewed shop drawings.

.3 Fabricate, fit, and secure framing joints and corners accurately, with flush surfaces, and hairline joints. Apply frame sealant at joints for weatherproof seams.

.4 Conceal anchors, reinforcement and attachments from view. Fabricate reinforcement in accordance with design requirements.

.5 Fabricate continuous sill flashings with intermediate anchor clips, and joint reinforcing, form to profile shown. Fabricate filler and closure pieces as necessary for a complete and weather tight installation.

.6 Do not expose manufacturer's identification labels on aluminum window assemblies.

.7 Certify aluminum windows as complying with the AAMA/WDMA/CSA -101/I.S.2/ A440 design criteria and requirements using an easily removable label located on the inside face of glazing.

.8 Position operable windows on main frame to provide direction of opening specified, free and smooth operation, without binding or sticking against main frame members.

.9 Double weatherstrip windows. Install weatherstripping in specially extruded ports and secure to prevent shrinkage or movement.

.10 Fabricate window closures and trim from aluminum sheet. Form to profile shown. Make weathertight.

.11 Fabricate glazing recess with drainage to exterior.

2.4 **FINISH**

.1 Extrusion finish: Clear anodized to AAMA 611 per Aluminum Association Designation System for Aluminum Finishes AA-M12C22A31.

.2 Panel and sheet finish: As indicated on drawings to match adjacent extrusion finish.

3 Execution

3.1 **EXAMINATION**

.1 Verify condition and dimensions of previously installed Work upon which this Section depends. Report defects to Consultant. Commencement of work of this Section means acceptance of existing conditions.

3.2 **INSTALLATION**

.1 Install windows in accordance with AAMA/WDMA/CSA -101/I.S.2/ A440, reviewed shop drawings and manufacturer's instructions.

.2 Install work of this Section securely, in correct location, level, square, plumb, at proper elevations, free of warp or twist.

.3 Install reinforcing and supporting members as specified or indicated as part of the work of this Section.

.4 Do not force units into place, nor subject them to loads for which they were not designed.

.5 Install window flashings, closures, and trim pieces.

.6 Provide for thermal movement to take place between units and adjacent construction.

.7 Conceal anchors, clips, blocking, and all other attachments. Provide all fastenings or anchors to be built in under other Sections.

.8 Fill voids between framing and adjacent construction with foam insulation.

.9 Install sills in maximum lengths possible. For sills over 1200 mm in length, maintain 3 mm to 6 mm space at each end.

.10 Install units with consideration for finish variations. Abrupt variations of appearance or colour in adjacent components will not be acceptable without approval of Architect before installation.

3.3 **GLAZING**

.1 In accordance with Section 08 80 00.

3.4 **ERECTION TOLERANCES**

.1 Tolerances: Non-cumulative.

.2 Maximum variation from plumb: 1.5 mm/3 m non-cumulative .

.3 Maximum misalignment of two adjoining members abutting in plane: 0.8 mm.

.4 Vertical and horizontal positions: +/- 3 mm.

.5 Racking of face: 6 mm, nil in elevation.

.6 Maximum perimeter sealant joint between window and adjacent construction: 13 mm.

3.5 **JOINT BACKING AND SEALANT**

.1 Prepare substrate surface, mask as recommended by sealant manufacturer.

.2 Install joint backing and frame sealant at window system joints and perimeter for weathertight installation in accordance with window sealant manufacturer's instructions. Remove excess sealant.

.3 Seal joints between windows and window sills with sealant. Bed sill expansion joint cover plates and drip deflectors in sealant. Seal between sill upstand and window-frame. Seal butt joints in continuous sills.

3.6 **ADJUSTING**

.1 Adjust operable units to move smoothly, with proper tension, throughout their full range of motion and to fit tightly when closed and locked.

.2 Lubricate hardware in accordance with manufacturer's instructions.

.3 Ensure that weatherstripping makes weathertight contact and does not cause binding to affect closing and locking.

3.7 CLEANING

.1 Maintain windows, inside and outside, in clean condition throughout duration of work.

.2 Remove protective material, and glass presence markers from surfaces.

.3 Remove AAMA/WDMA/CSA -101/I.S.2/ A440 certification labeling when directed by Consultant, in writing.

.4 Wash windows with solution of mild detergent in warm water, with particular attention to recesses and corners. Wipe surfaces clean and dry.

END OF SECTION

1 General

1.1 **SECTION INCLUDES**

.1 Labour, Products, equipment and services necessary for finish hardware work in accordance with the Contract Documents.

1.2 **REFERENCES**

.1 BHMA, Builders Hardware Manufacturing Association.

.2 NFPA 80, Standard for Fire Doors and Other Opening Protectives.

1.3 **SUBMITTALS**

.1 Product data: Submit manufacturer's Product data in accordance with the Conditions of the Contract indicating compliance with reference standards, transportation, storage, handling and installation requirements.

.2 Shop Drawings:
- .1 Submit Shop Drawings and 3 complete hardware lists in accordance with the Conditions of the Contract indicating:
  - .1 Door locations, sizes, hardware manufacturer's catalogue numbers, finish symbols and quantities required.
  - .2 Locations and mounting heights of each type of hardware.
- .2 Supply templates and required information to door and frame manufacturer to enable accurate sizes, locations of cut-outs and reinforcement for hardware.
- .3 Submit templates to required trade to arrange for provisions for accurate setting and fitting of hardware.

.3 Samples:
- .1 Submit 2 samples in accordance with the Conditions of the Contract of each item that is different from hardware specified and include manufacturer's parts lists and installation instructions.
- .2 Submit hardware component samples illustrating style, colour and finish. Tag samples identifying applicable Specification article number, brand name and number, finish, building location, date and catalogue number.
- .3 Do not order hardware until samples have been accepted. Submit new samples to replace rejected samples. Supply hardware and finishes identical to each accepted sample.

.4 Closeout submittals:
- .1 Submit the following in accordance with the Conditions of the Contract for each Product for incorporation into Operation and Maintenance Manual:
  - .1 Maintenance data.
  - .2 Operating instructions and safety precautions.
  - .3 Parts list with name and address of supplier.
  - .4 Lubrication schedule and type of lubricant recommended.
  - .5 Keys, tools and special devices.
  - .6 Inspection procedures related to preventive maintenance.

1.4 **QUALITY ASSURANCE**

.1 General:
- .1 Manufacturers: Companies specializing in manufacturing door hardware and registered with BHMA.
- .2 Hardware supplier: Company specializing in supplying commercial door hardware and acceptable to manufacturer.

.2 Certifications:
- .1 Employ an Architectural Hardware Consultant to inspect completed installation and certify that hardware has been installed in accordance with manufacturer's printed instructions, Authorities having Jurisdiction and as specified.
- .2 Submit manufacturer's certificate that finish hardware and fire rated hardware meets specified requirements.

1.5 **DELIVERY, STORAGE, AND HANDLING**

.1 Be responsible for packaging of hardware, on a set by set basis. As material is received from various manufacturers identify it to correspond to Hardware List symbols.

.2 Label packages legibly, indicating manufacturer's number, types, sizes, opening number and Hardware List reference number. Wrap hardware and include in package, screws, bolts and fastening necessary for correct installation. If hardware package is not complete, pay additional charges incurred by installer.

.3 Deliver hardware to Site packaged, labelled and cross-referenced to hardware list for each item and its scheduled installation location.

.4 Accept Products of this Section on Site and ensure that each item is undamaged.

.5 Catalogue and store hardware in secure area.

2 Products

2.1 **GENERAL**

.1 Carefully check and verify Hardware List against Contract Drawings to ensure that hardware listed can be used as specified. Inform Consultant of concerns regarding quality, quantity, operation or function of hardware selected:
- .1 Verify hand of doors, examine details on Contract Drawings and at Site to ensure hardware supplied can be correctly installed and is correct for work as constructed.
- .2 Select hardware in accordance with applicable codes and regulations and to approval of local Fire Marshal.
- .3 Replace and pay for defective hardware including hardware which was incorrectly selected, and remedial and installation costs.

.2 Ensure that hardware selected will function correctly, meets Contract requirements and Ontario Building Code and authorities having jurisdiction.

.3 Ensure that each hardware item is of same type, design and by same manufacturer.

.4 Manufacturer's names or trade marks are not permitted on exposed surfaces of hardware.

.5 Include in packing slip a list of parts, name of supplier and door number in which lock is to be installed.

.6 Hardware for fire rated and labelled door and frame assemblies: ULC listed or as accepted by authorities having jurisdiction.

.7 Fire rated assemblies:
- .1 Hardware: Selected and installed in accordance with applicable codes and regulations, NFPA-80 and to approval of Ontario Fire Marshal.
- .2 Fire rated doors: ULC labelled hardware. Submit written certification of conformance to ULC requirements for each type of hardware prior to delivery.
- .3 Locksets and latchsets on fire rated doors: 19 mm throw minimum.

2.2 ACCESSORIES

.1 Items to be attached to masonry or concrete with expandable shields, lag screws, bolts or other fastening devices as required. Exposed screws: Stainless steel, Phillips or Robertson heads.

2.3 FINISHES

.1 Metal finishes: Free from defects, clean, unstained and of a uniform colour for each type of finish required. Exposed surfaces and anchors: Specified finish symbol of item.

3 Execution

3.1 EXAMINATION

.1 Verify condition and dimensions of previously installed Work upon which this Section depends. Report defects to Consultant. Commencement of work of this Section means acceptance of existing conditions.

3.2 INSTALLATION

.1 Install hardware in accordance with reviewed Shop Drawings, manufacturer's installation instructions, and applicable Codes and regulations.

.2 Install hardware in accordance with hardware templates.

.3 Adjust fixed and operable hardware for correct clearances and function.

.4 Mount hardware measured from finished floor to centre of hardware, unless indicated otherwise or required by Code:
- .1 Top hinge: 250 mm from head of door to top.
- .2 Bottom hinge: 265 mm from finished floor to bottom of hinge.

.3 Intermediate hinge: Equal distance between top and bottom hinge.
.4 Locksets, latchsets: 1000 mm.
.5 Panic device crossbar: 1000 mm.
.6 Push plates: 1100 mm to bottom of plates.
.7 Guard bars: 1100 mm.
.8 Door pulls: 1100 mm to bottom of pulls.
.9 Blank strike: 1450 mm.
.10 Blank fronts: 1450 mm.

.5 Include for supply and installation of wiring for electric strikes from electrical junction box to electric strike hardware.

.6 Locate door stops to contact doors 75 mm from latch edge.

.7 Install hardware and trim square and plumb to doors.

.8 Replace wrappings for hardware provided by manufacturer after installation.

.9 Safeguard keys to keep them out of unauthorized hands, tag them with door number, and deliver them to person designated by Consultant at building completion.

3.3 FIELD QUALITY CONTROL

.1 Have hardware inspected after installation by hardware supplier's representative, obtain certification in writing that hardware has been supplied and installed in accordance with Specifications and hardware manufacturer's instructions and is functioning correctly.

.2 Inspect fire rated openings to ensure they are installed in compliance with NFPA 80 requirements and Authorities having Jurisdiction.

.3 Test access control system and electrified hardware devices for proper operation. Verify electric door release hardware operates properly upon activation of fire alarm system.

3.4 ADJUSTING

.1 Verify under work of this Section, that installed hardware functions properly.

.2 Adjust hardware so that latches and locks operate smoothly and without binding, and closers act positively with the least possible resistance in use. Lubricate hardware if required by manufacturer's instructions.

.3 Adjust doors with self closing devices or automatic closing devices for proper operation after the HVAC system is balanced and adjusted. Verify spring power of non sized door closers is properly adjusted.

3.5 CLEANING

.1 Remove wrappings at completion of the Project and clean hardware in accordance with manufacturer's instructions.

3.6 HARDWARE GROUPS/SCHEDULE

.1 Hardware groups/schedule: Refer to hardware groups/schedule appended to this Section.

END OF SECTION

1 General

1.1 **SECTION INCLUDES**

.1 Design, labour, Products, equipment, tools, and services necessary for glass and glazing Work in accordance with the Contract Documents.

1.2 **REFERENCES**

.1 ASTM C1048, Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass.

.2 ASTM D2240, Test Method for Rubber Property - Durometer Hardness.

.3 CAN/CGSB-12.1-M, Tempered or Laminated Safety Glass.

.4 CAN/CGSB-12.8, Insulating Glass Units.

.5 Glass Association of North America (GANA) Glazing Manual.

.6 ULC CAN4 S104-M, Standard Method for Fire Tests of Door Assemblies.

.7 ULC CAN4 S106-M, Standard Method for Fire Tests of Window and Glass Block Assemblies.

1.3 **DESIGN REQUIREMENTS**

.1 Glass Design:
- .1 Design glass using a probability of breakage of 8 lites per 1000 at the first application of design load.
- .2 Perform stress analysis. Design units to accommodate live, dead, lateral, wind, seismic, handling, transportation, and erection loads.
- .3 Perform a thermal stress analysis on each glass unit with Low-E coating and provide heat strengthening and/or tempered units as necessary to prevent thermal breakage.
- .4 Perform a thermal stress analysis on each insulating thermal unit and provide heat strengthening and/or tempered units as necessary to prevent thermal breakage.
- .5 Where required, design glazing units so as not to allow thermal stress fracture due to heat build-up behind insulating units.

.2 Limit glass deflection to flexural limit of glass with full recovery of glazing materials.

.3 Utilize inner light of multiple light sealed units for continuity of air and vapour seal.

1.4 SUBMITTALS

.1 Shop drawings:
- .1 Submit shop drawings in accordance with the Conditions of the Contract indicating as a minimum:
  - .1 Fabrication and erection of glazing elements indicating materials, thicknesses, finishes, connections, joints, method of anchorage, number of anchors, supports, reinforcement, details, and accessories.
  - .2 To sealant manufacturer for their review and approval of tensile bead contact/bite dimension and thickness.

.2 Samples:
- .1 Submit following samples in accordance with the Conditions of the Contract.
- .2 Submit one sample of each type of glass.
  - .1 300 x 300 mm of each type of insulating glass unit, complete with each different Low-E coating.
  - .2 300 x 300 mm of each colour of spandrel glass.

.3 Certificates: Submit manufacturer's certification that glass and glazing materials are compatible.

.3 Reports:
- .1 Submit compatibility and adhesion test reports from sealant manufacturer indicating that glazing materials were tested for compatibility and adhesion with glazing sealants. Include sealant manufacturer's interpretation of test results relative to sealant performance and recommendations for primers and substrate preparation needed for adhesion.
- .2 Compatibility test report from manufacturer of insulating glass edge sealant, indicating that glass edge sealants were tested for compatibility with other glazing materials including sealants, setting blocks, edge blocks and any other material that contacts or can affect the edge seal.

.4 IGMA Compliance Audit: Submit in accordance with the Conditions of the Contract, a written certification of successful completion of a Compliance Audit within the last six months.

1.5 QUALITY ASSURANCE

.1 Insulating glass unit fabricators shall be a certified member of the Insulating Glass Manufacturer's Alliance (IGMA). IGMA members must participate in the certification program and shall have successfully passed a Compliance Audit within the last six months.

.2 Installers qualifications: Perform Work of this Section by a company that has a minimum of five years proven experience in the installation of glazing units of a similar size and nature.

.3 Fire Protective Rated Glass: Each lite shall bear permanent, nonremovable label of ULC certifying it for use in tested and rated fire protective assemblies.

1.6 **SITE CONDITIONS**

.1 Glaze with compounds, sealants, or tapes only when glazing surfaces are at temperatures over 4°C, and when positive that no moisture is accumulating on them from rain, mist, or condensation.

.2 When temperature of glazing surfaces is below 4°C, obtain from Consultant approval of glazing methods and protective measures which will be used during glazing operations.

1.7 **EXTENDED WARRANTY**

.1 In accordance with Section 08 51 13.

2 Products

2.1 **ACCEPTABLE MANUFACTURERS**

.1 Glass manufacturers:
- .1 AGC Flat Glass.
- .2 Cardinal Glass Industries.
- .3 Guardian Industries.
- .4 PPG Industries Ltd.
- .5 Viracon Inc.

2.2 **MATERIALS**

.1 All materials under Work of this Section, including but not limited to, primers, coatings, sealers, sealants, adhesives and cleaners are to have low VOC content limits.

.2 Tempered glass **(TG)**: CAN/CGSB-12.1-M, Type 2, Class B, Category II, clear, minimum 6 mm thick.

.3 Fire rated glass **(FRGL)**: 20 min. to 90 min. fire rating tested to ULC CAN4 S104-M and ULC CAN4 S106-M, 5 mm thick or as otherwise noted on Door Schedule with appropriate labelling stating fire rating and approval, clear polished glass. Firelite by Nippon Electric Glass Company Ltd. or approved alternative.

.4 Spandrel glass **(SGL)**: ASTM C1048, Condition B, 6 mm thick heat strengthened or tempered glass, with water-based silicone emulsion coating applied to backside, 'Opaci-Coat 300' by ICD High Performance Coatings or approved alternative. Colour: To match PT-5, PT-6, PT-7, PT-8, PT-9, and PT-10 per room finish and colour schedule.

.5 Insulating glass units: To CAN/CGSB-12.8-M and IGMA requirements utilizing approved non-metallic PVC or Fibreglass edge spacer in black. Dual seal with a PIB primary seal and silicone secondary seal.

.6 Argon gas: 90% argon and 10% air mixture. Argon gas to be used to fill air space at all insulated glass units.

.7 Low-E coating: High performance sputtered low-E coating. Provide insulating glass units with low-E coating edge deletion and low-E coating. Apply low-E coating to second surface unless otherwise indicated. 'EnergySelect 36' by AGC Flat Glass, 'Cardinal LoE-270' by Cardinal Glass Industries, 'SN 68' by Guardian Industries or 'Solarban 60' clear by PPG Industries Inc.

.8 Glazing types:
- .1 GL-1: Clear TG exterior lite with low-E coating, argon filled air space, clear TG interior lite. Standard throughout unless noted otherwise. 25 mm overall thickness.
- .2 GL-2: 6 mm clear TG used at interior glass lites in non-rated doors and screens.
- .3 GL-3: 5 mm FRGL used at interior fire-rated doors and screens.

.9 Glazing and rebate primers, sealants, sealers, and cleaners: Compatible with each other. Type as recommended by glass manufacturer.

.10 Glazing sealant: Silicone sealant as recommended by glazing manufacturer. Verify compatibility with insulating glass unit secondary sealant.

.11 Heel & toe bead: Silicone sealant as recommended by glazing manufacturer.

.12 Glazing gasket: 'Visionstrip' by Tremco Ltd., extruded composite glazing seal, size as recommended by manufacturer.

.13 Glazing tape: 'Polyshim II' glazing tape EPDM shim.

.14 Glazing tape (fire rated glass): Closed cell polyvinyl chloride (PVC) foam, coiled on release paper over adhesive on two sides, maximum water absorption by volume of 2 percent. Glass panels that exceed 1,393 sq. inches for 90-minute ratings must be glazed with fire-rated glazing tape supplied by manufacturer.

.15 Glazing splines: EPDM or neoprene, extruded shape to suit glazing channel retaining slot, colour as selected.

.16 Setting blocks (regular): EPDM, 80 - 90 Shore A durometer hardness to ASTM D2240, sized to suit glazing method, glass unit weight and area.

.17 Edge blocks: EPDM, 60-70 Shore A Durometer hardness, sized with 3 mm clearance from glass edge and spanning glass thickness(es). Capable of withstanding weight of glass unit, self adhesive on face.

.18 Silicone Sealant (fire rated glazing): One-part neutral curing silicone, medium modulus sealant, Type S; Grade NS; Class 25 with additional movement capability of 50 percent in both extension and compression (total 100 percent):
- .1 Dow Corning 795 - Dow Corning Corp.
- .2 Silglaze-II 2800 - General Electric Co.
- .3 Spectrem 2 - Tremco Inc.

.19 Glass presence markers: Easily removable, non-residue depositing.

.20 Screws, bolts and fasteners: Type 304 stainless steel.

2.3 **FABRICATION**

.1 Verify glazing dimensions on Site.

.2 Clearly label each glass lite with maker's name and glass type. Ensure labels are easily removable, non-residue depositing type. Do not remove labels until after Work is accepted by Consultant.

.3 Fabricate glazing not less than 3 mm smaller than rebate size in either dimension; allow for edge spacers, shims, and setting blocks as necessary.

.4 Work shall have smooth finished surfaces free from distortion and defects detrimental to appearance and performance.

.5 Carefully make and fit details. Take special care with exposed finished Work to produce a neat and correct appearance to the Consultant's acceptance.

.6 Fabricate argon filled thermal units with air space filled minimum 90% with argon gas.

3 Execution

3.1 **EXAMINATION**

.1 Verify condition and dimensions of previously installed Work upon which this Section depends. Report defects to Consultant. Commencement of Work means acceptance of existing conditions.

.2 Verify that openings for glazing are correctly sized and within tolerance.

.3 Verify that surfaces of glazing channels or recesses are clean, free of obstructions, and ready to receive glazing.

.4 Laminated glass edges shall be completely covered by tape to protect against sealants and water if required by Manufacturer.

3.2 **PREPARATION**

.1 Clean contact surfaces with solvent and wipe dry.

.2 Seal porous glazing channels or recesses with substrate compatible primer or sealer.

.3 Prime surfaces scheduled to receive sealant.

3.3 **INSTALLATION**

.1 Provide glazing in accordance with IGMA recommendations. Provide continuous contact between glazing tapes and gasket to the glazing.

.2 Install glazing to the Work of Sections 08 11 13, 08 14 16, 08 44 00, 08 51 13 and 10 22 19.

.3 Provide neat, straight sight lines. Trim excess glazing material flush with top of stops and fixed leg of frames.

.4 Remove protective coatings, glazing stops, clean rebate and glass contact surfaces with solvent, wipe dry.

.5 Apply primer/sealer to contact surfaces, prior to glazing.

.6 Apply glazing tape as per manufacturer's instructions including recommended corner sealant.

.7 Use setting blocks at 1/4 points and spacers to centre glass unit in frame.

.8 Install glazing in accordance with reviewed shop drawings and manufacturer's written instructions. Install glazing with full contact and adhesion at perimeter. Maintain edge clearance recommended by glass manufacturer.

.9 Apply a continuous heel bead of sealant around perimeter of inboard lite of the sealed unit and the metal framing.

.10 Re-install glazing stops ensuring continuous contact and rattle-free installation. Do not distort glass. Trim tape protruding more than 2 mm above stop.

.11 Install glazing gasket in accordance with manufacturer's recommendations.

.12 Do not cut or abrade tempered, heat treated, or coated glass.

.13 Install glass presence markers in two cross stripes extending from diagonal corners. Maintain markers until final clean-up.

.14 Remove, dispose of, and replace broken, cut, abraded glass, and defective glass including but not limited to production dimples, 'tiger-stripping', chips, cracks, etc.

.15 Exterior glass: Glaze units with gasket on exterior side and glazing tape on interior side. Seal gap between glazing and stop with sealant to depth equal to bite of frame. Apply cap head of sealant along void between stop and glazing, to uniform line, flush with sight line. Tool or wipe sealant surface smooth.

.16 Interior glass: Glaze interior glass using glazing gasket glazing tape.

.17 Fire rated glass:
- .1 Place setting blocks located at quarter points of glass with edge block no more than 150 mm from corners.
- .2 Cut glazing tape to length and set against permanent stops, flush with sight lines to fit openings exactly, with stretch allowance during installation.
- .3 Glaze vertically into labeled fire-rated metal frames or partition walls with same fire rating as glass and push against tape for full contact at perimeter of pane or unit.
- .4 Place glazing tape on free perimeter of glazing in same manner described above.
- .5 Install removable stop and secure without displacement of tape.

.6 Install so that appropriate ULC markings remain permanently visible.

3.4 CLEANING

.1 Immediately remove sealant and compound droppings from finished surfaces.

.2 Remove labels, protective material, and glass presence markers from prefinished surfaces.

.3 Clean glass surfaces with cleaning agents and methods in accordance with Manufacturer's written instructions.

END OF SECTION

1 General

1.1 **SECTION INCLUDES**

.1 Design, labour, Products, equipment and services necessary for gypsum board Work.

1.2 **REFERENCES**

.1 ASTM A653/A653M, Specification for Steel Sheet, Zinc-coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvanealed) by the Hot-Dip Process.

.2 ASTM C475, Specification for Joint Compound and Joint Tape for Finishing Gypsum Board.

.3 ASTM C645, Specification for Nonstructural Steel Framing Members.

.4 ASTM C665, Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.

.5 ASTM C754, Specification for Steel Framing Members to Receive Screw-Attached Gypsum Board.

.6 ASTM C834, Standard Specification for Latex Sealants.

.7 ASTM C840, Specification for Application and Finishing of Gypsum Board.

.8 ASTM C1002, Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs.

.9 ASTM C1178, Specification for Glass Mat Water-Resistant Gypsum Backing Board.

.10 ASTM C1278, Specification for Fiber-Reinforced Gypsum Panel.

.11 ASTM C1396, Specification for Gypsum Board.

.12 ASTM E84, Standard Test Method for Surface Burning Characteristics of Building Materials.

1.3 **DESIGN REQUIREMENTS**

.1 Design gypsum board wall and ceiling systems with a maximum deflection of l/360.

.2 Design ceiling suspension system in accordance with manufacturer's printed directions and ASTM C754.

.3 Design ceiling system for adequate support of electrical fixtures as required by the current bulletin of the Electrical Safety Authority.

.4 Design hanger anchor and entire suspension system static loading not to exceed 25% of their ultimate capacity including lighting fixture dead loads.

.5 Design suspension system to support weight of mechanical and electrical items such as air handling boots and lighting fixtures, and with adequate support to allow rotation/relocation of light fixtures.

.6 Design subframing as necessary to accommodate, and to circumvent, conflicts and interferences where ducts or other equipment prevent the regular spacing of hangers.

.7 Design of wall assemblies with a height greater than 3000 mm incorporating non-standard gypsum board assemblies including, but not limited to, assemblies incorporating abuse resistant gypsum board and large format tile applications.

1.4 REGULATORY REQUIREMENTS

1. Provide fire separations and fire protection exactly as specified in test design specification that validates the specified rating. Verify that work specified in other Sections, as a part of the entire assembly, meets applicable validating test design specification.

1.5 SUBMITTALS

.1 Product data:
- .1 Submit copies of manufacturer's Product data in accordance with the Conditions of the Contract indicating:
  - .1 Performance criteria, compliance with appropriate reference standard, characteristics, and limitations.
  - .2 Product transportation, storage, handling and installation requirements.

.2 Shop drawings:
- .1 Submit shop drawings in accordance with the Conditions of the Contract indicating:
  - .1 Wall assemblies, suspension systems, adjacent construction, elevations, sections and details, dimensions, thickness, finishes and relationship to adjacent construction.
  - .2 Framing and blocking for items being supported of wall systems.
  - .3 Fire rated designs.

.3 Certifications: Submit written certification stating that suspended ceiling system is designed for adequate support of electrical fixtures as required by the current bulletin of the Electrical Safety Authority.

1.6 QUALITY ASSURANCE

.1 Qualifications: Execute the Work of this Section by skilled, qualified, and experienced workers trained in the installation of the Work of this Section.

.2 Retain a Professional Engineer, licensed in Province of Ontario, with experience in Work of comparable complexity and scope, to perform following services as part of Work of this Section:
- .1 Design of wall systems with height greater than 3000 mm and at non-standard gypsum board assemblies including, but not limited to, assemblies incorporating abuse resistant gypsum board and large format tile applications.

.2 Design of suspended gypsum board assemblies.
.3 Review, stamp, and sign Shop Drawings and design calculations.
.4 Conduct shop and on-site inspections, prepare and submit written inspection reports verifying that this part of Work is in accordance with Contract Documents and reviewed Shop Drawings.

1.7 **SITE CONDITIONS**

.1 Do not begin Work of this Section until:
.1 Mechanical and electrical Work above the ceiling is complete.
.2 Substrate and ambient temperature is above 15°C.
.3 Relative humidity is below 80 %.
.4 Ventilation is adequate to remove excess moisture.

.2 Install temporary protection and facilities to maintain Product manufacturer's, and above specification, environmental requirements 24 h before, during, and 24 h after installation.

2 Products

2.1 **MATERIALS**

.1 General: All materials under Work of this Section, including but not limited to, sealants, adhesives, and primers are to have low VOC content limits.

.2 Steel framing: ASTM C754; ASTM A653/A653-M, Z275; cold rolled, galvanized steel sheet.
.1 Bailey Metal Products Limited
.2 Corus Metal Profiles

.3 Steel studs and track runners: ASTM C645; Galvanized steel studs and runners, 32 mm wide x depth as indicated on Contract Drawings. Formed from galvanized steel sheet, thicknesses as follows:
.1 Studs less than 3000 mm: Minimum 0.53 mm (25 ga.).
.2 Studs greater than 3000 mm and non-standard assemblies: Minimum 0.91 mm (20 ga.), unless stud thickness of greater thickness is required to accommodate intended loading, spans, or conditions.
.3 Track runners and ancillary components to match stud thickness.

.4 Main carrying channels: ASTM C645; Formed from galvanized steel sheet, 38 x 19 mm cold rolled, channels.

.5 Resilient channel: ASTM C645; 0.5 mm thick galvanized metal, 57 mm wide x 12 mm deep for walls and ceiling to reduce sound transmission.

.6 Furring channels: ASTM C645; Formed from galvanized steel sheet, 22 mm winged flange type, cold rolled.

.7 Furring channels (hat type): ASTM C645; 0.5 mm base steel thickness, galvanized. 70 mm wide x 22 mm deep hat shaped channel.

.8 Heavy duty furring channels: ASTM C645; 0.9 mm steel thickness, galvanized hat shaped channel with a wider and deeper size as required by manufacturers.

.9 Hanger wires: 4.1 mm minimum diameter galvanized pencil rod.

.10 Tie wire: 1.6 mm thick minimum diameter, soft annealed, galvanized steel wire.

.11 Corner bead, casing bead, and special shapes: Formed from 0.6 mm thick minimum, galvanized steel sheet, designed to be concealed by joint compound.

.12 Control joint strip: Roll formed from galvanized steel sheet, with a tape protected recess, 6 mm wide x 11 mm deep.

.13 Screw fasteners: ASTM C1002 Type S; Corrosion resistant.

.14 Concrete anchors: tie wire sleeve anchors, 'Redi-Drive Anchors' by ITW Red Head or approved alternative.

.15 Acoustic/Fire insulation: ASTM C665, Paperless, semi-rigid, spun stone wool fibre mats, of thickness as indicated on Contract Drawings, 'MinWool SAFB' by Johns Manville, 'SAFB Thermafiber' by Owens Corning Inc. or 'Rockwool AFB' by Rockwool.

.16 Sealants:
- .1 Acoustic sealant (non-rated): Non-hardening acoustic sealant for use at non-rated assemblies, ASTM C834; Acrylic, mould resistant sealant, paintable. 'Smoke and Acoustic Sealant CP506' by Hilti or approved alternative by Sika or Tremco.
- .2 Sealant (fire-rated): Non-hardening sealant for use at fire-rated assemblies: ASTM E84; Acrylic based firestop sealant, colour: red or white as selected by Consultant. 'Flexible Firestop Sealant CP606' by Hilti or approved alternative by Sika or Tremco.
- .3 Standard sealants: In accordance with Section 07 92 00.

.17 Fire rated gypsum board: ASTM C1396; gypsum board 15.9 mm thick of maximum practical lengths to minimize end joints, unless indicated otherwise. Furnish Type X Board by Certainteed Gypsum Canada, CGC Inc., or Georgia-Pacific Canada LP.

.18 Abuse Resistant Panels: 15.9 mm thick unless indicated otherwise on drawings; 'AirRenew Extreme Abuse Resistant Type X Gypsum Board with M2Tech' by Certainteed Gypsum Canada, 'Sheetrock AR' by CGC Inc. or 'ToughRock' by G-P Products.

.19 Moisture, mould, and abuse resistant panels: 15.9 mm thick unless indicated otherwise on drawings; 'AirRenew Extreme Impact Resistant with M2Tech' by Certainteed Gypsum Canada, 'Sheetrock Mold Tough AR' by CGC Inc. or 'DensArmor Plus Abuse-Resistant Interior Panel' by Georgia-Pacific Canada LP.

.20 Tile Backer: Water resistant tile backer board meeting ASTM C1178 or ASTM C1278, thickness as indicated. 'Diamondback Tile Backer' by Certainteed Gypsum Canada, 'Fiberock Aqua-Tough Underlayment' by CGC Inc. or 'Dens Shield' by Georgia-Pacific Canada LP.

.21 Shaftwall gypsum system:
- .1 Steel J-Runner: ASTM C645; Rolled formed sheet steel, 25 gauge, by CGC, Gypsum Corporation or approved alternative.
- .2 C-H stud: hot-dipped galvanized by CGC, Gypsum Corporation or approved alternative.
- .3 Liner Panel: ASTM C1396; Gypsum wallboard panel, Thickness: 25.4 mm, Width: 610 mm. 'M2Tech Shaftliner Type X' by Certainteed Gypsum Canada, or approved alternative by CGC or Gypsum Corporation.
- .4 Face Panel: ASTM C1396; Gypsum wallboard panel, 1 layer, Thickness: 15.9 mm, Width: 1219 mm. 'GlasRoc Shaftliner Type X' by Certainteed Gypsum Canada, or approved alternative by CGC or Gypsum Corporation

22. Primer: Where indicated by board manufacturer, provide primer as required to achieve finishes as defined in ASTM C840.

.23 Joint reinforcing tape:
- .1 Standard gypsum board: ASTM C475; 50 mm wide x 0.25 mm thick, perforated paper, with chamfered edges.
- .2 Moisture resistant and tile backer boards: ASTM C475; fibreglass mat joint tape as recommended by board manufacturer to suit location.

.24 Joint and patching compound: ASTM C475; Asbestos-free, supplied by manufacturer of gypsum board used.

.25 Fast setting patching compound: ASTM C475; Asbestos-free, Sheetrock or Durabond by CGC Inc., 'Moisture and Mold Resistant Setting Compound with M2Tech' by Certainteed Gypsum Canada or approved alternative.

.26 Access doors: Supplied by other Sections for installation as part of the Work of this Section.

3 Execution

3.1 **EXAMINATION**

.1 Verify condition and dimensions of previously installed Work upon which this Section depends. Report defects to Consultant. Commencement of Work means acceptance of existing conditions.

3.2 **SUSPENSION FRAMING**

.1 Install ceiling systems in accordance with reviewed Shop Drawings and manufacturer's written instructions.

.2 Install hanger wires plumb and securely anchored to the building structural framing, independent of walls, pipes, ducts, and metal deck; install additional framing and hangers to bridge interference items.

.3 Install hanger wires at 1200 mm maximum centres along carrying channels, not less than 25 mm, and not more than 150 mm from channel ends.

.4 Install additional hangers at lighting fixture and ductwork locations. Do not attach hanger wires to mechanical or electrical equipment. Do not support mechanical and electrical fixtures and fitting on ceiling without the ceiling manufacturer's written acceptance.

.5 Install main carrying channels transverse to structural framing members. Lap main carrying channels 200 mm minimum at splices and wire each end with two loops and prevent clustering or lining-up of splices.

.6 Install furring channels at 400 mm o.c., not less than 25 mm, and not more than 150 mm from perimeter walls, at openings, at interruptions in ceiling continuity, and at change in plane. Install furring channels to a tolerance of 3 mm maximum in 3600 mm.

.7 Install additional main carrying and furring channels to frame and to reinforce openings such as recessed lighting fixtures, access hatches, ceiling grilles, outlet boxes, ventilating outlets and similar items.

3.3 STEEL STUDS AND FURRING

.1 Install steel studs and furring in accordance with reviewed Shop Drawings and manufacturer's written instructions.

.2 Install steel stud partitions to underside of structure unless indicated otherwise.

.3 Install track runners at floors, ceilings, and underside of structure; align track runners accurately and secure to structure at 600 mm centres maximum.

.4 Install double top track runner assembly to prevent the transmission of structural loads to steel studs.

.5 Install steel studs vertically at 400 mm o.c., unless otherwise indicated, and not more than 50 mm from abutting walls, at openings, and at each side of corners. Install studs securely to track runners.

.6 Schedule and coordinate steel framing installation with mechanical and electrical services installation.

.7 Install full height, double studs at door and service openings, fastened together and stiffened back to the structure to prevent vibration when doors close.

.8 Provide double studs boxed together at all openings, sill, head and jambs and at door jambs, fastened together and stiffened back to the structure to prevent vibration. At each opening exceeding 900 mm in width, double studs shall be 20 ga. extending to structure above, and adequately anchored at each end. Provide steel studs above and below openings spaced at 400 mm oc maximum. All metal stud partitions above doors and screens over 1220 mm wide shall be secured to structure over and reinforced with sway bracing to stabilize walls to prevent lateral movement.

.9 Erect three studs at corner and intermediate intersections of partitions. Space 50 mm apart and brace together with wired 19 mm channels.

.10 Stiffen partitions over 2440 mm high or 3000 mm long, or both, with horizontal bracing extended for full length of partitions. Provide one line of bracing in partitions. Space lines to provide equal unbraced panels. Provide bracing for portions of partitions over door openings in partitions over 3000 mm high, and bracing both above and below openings in partitions located no greater than 150 mm from top and bottom of opening, and extending two stud spaces beyond each edge of opening for both doors and windows. Wire tie or weld bracing to studs.

.11 Frame control joints using back to back double studs at abutting structural elements, at dissimilar backup interface, at dissimilar walls and ceilings, at structural expansion and control joints, at door and other openings, and at 9000 mm maximum spacing in continuous runs. Install control joint strips and secure in place.

.12 Install additional support framing at openings and cutouts for built-in equipment, upper cabinet support, access panels and similar items.

.13 Attach to framing adequate steel reinforcing members or an 1.2 mm (18 ga.) steel stud mounted horizontally and notched around furring members to support the load of, and to withstand the withdrawal and shear forces imposed by, items installed upon the work of this Section. Such items include, but are not restricted to, miscellaneous metals, coat hooks, washroom accessories, handrail anchors, rub rails, grab bars, guards, wall-hung cabinets and fitments, shelving, curtain and drape tracks, miscellaneous specialties; Owner supplied equipment; and minor mechanical and electrical work. Heavy mechanical and electrical equipment shall be self-supporting in Divisions 21, 22, 23 and 26.

.14 Provide for support and incorporation of flush-mounted and recessed mechanical and electrical equipment and fixtures only after consultation and verification of methods with those performing the work of Divisions 21, 22, 23 and 26.

.15 Install cross bracing in accordance with the steel stud manufacturer's recommendations.

3.4 FIRE RATED ASSEMBLIES

.1 Install Products in fire rated assemblies in strict accordance with reviewed Shop Drawings and applicable tested and approved designs required by Authorities Having Jurisdiction.

.2 Install firestop fill material behind fire rated acoustical sealant and provide firestop identification tag.

.3 Stiffen fire rated walls over 3.66 m high, where linear length of wall is greater than 2.44 m between perpendicular wall supports, with diagonal bracing above the ceiling extending perpendicular to wall at a 45° angle to structure above. Locate diagonal bracing at maximum 2.44 m o.c.

.4 Where double layers of gypsum board are shown, and required for fire rating, screw first layer to studs and furring and laminate the second layer to the first using joint filler as an adhesive. Stagger joints between first and second layers.

3.5 ACOUSTICAL INSULATION

.1 Install acoustic insulation in partitions, between steel studs, and as indicated on Contract Drawings and in accordance with the manufacturer's instructions. Fill stud cavities to full height of partitions and carefully cut and fit acoustic insulation around services and protrusions.

3.6 ACOUSTICAL SEALANT

.1 Install acoustical sealant to acoustically insulated partitions in accordance with the manufacturer's instructions and Contract Drawings.

.2 Install acoustical sealant under floor runner track, at partition perimeter both sides and at openings, cut-outs, and penetrations, concealed from view in the final installation.

.3 Install firestop fill material behind fire rated acoustical sealant and provide firestop identification tag.

.4 Smooth acoustical sealant with trowel prior to skin forming.

3.7 GYPSUM BOARD

.1 Comply with ASTM C840. Install gypsum board in accordance with reviewed Shop Drawings and manufacturer's written instructions.

.2 Install gypsum board vertically or horizontally, whichever results in fewer end joints. Locate end joints over supporting members.

.3 Install gypsum board in lightly butted contact at edges and ends and with 1.6 mm maximum open space between boards; do not force gypsum board into place. Do not install imperfect, damaged or damp boards.

.4 Install gypsum board butting paired tapered edge joints, and mill-cut or field-cut end joints; do not place tapered edges against cut edges or ends.

.5 Install vertical joints minimum 300 mm from the jamb lines of openings and stagger vertical joints over different studs on opposite sides of partitions.

.6 Do not locate joints within 200 mm of corners or openings, except where control joints occur at jamb lines or where openings occur adjacent to corners. Where necessary, place a single vertical joint over the centre of wide openings.

.7 Cut, drill and patch gypsum board as may be necessary to accommodate the Work of other trades.

8. Fire Separations:
   1. Construct gypsum board assemblies, where located, in accordance with tested assemblies to obtain required or indicated fire rated assemblies. As a minimum fire separations shall consist of metal framing covered on both sides by fire-rated gypsum board.

2. Install assemblies tightly to enclosing constructions to maintain integrity of the separations. Install casing beads at all perimeter edges.

3.8 SHAFTWALL LINER

.1 Plan and lay out metal framing components to ensure that all wall sections are plumb and properly aligned.

.2 Install J-track along the ceiling line and vertically at columns and abutting partitions, positioning the long legs closest to the shaft, using powder actuated fasteners or other approved method. Secure each piece with the appropriate fasteners spaced a maximum 610 mm O.C.

.3 Attach J-track to the floor with fasteners spaced at 610 mm O.C.

.4 Install Shaftliner panels vertically. The leading edge of the first panel must be attached to the long leg of the vertical J-track with 41 mm Type S screws spaced 610 mm O.C. Secure the top and bottom edges using the same fasteners and spacing.

.5 Friction-fit C-H stud into the top and bottom tracks and slide it snugly against the Shaftliner panel. Make sure the edge of the board is in full contact with the centre web of the stud and covered by all the tabs.

.6 Place the next Shaftliner panel between the tabs and flange on the opposite side of the C-H stud and secure it to the top and bottom track with 41 mm Type S screws spaced 610 mm O.C.

.7 Install subsequent Shaftliner panels and C-H studs in the same manner. Check periodically to ensure they are plumb.

.8 At the end of a partition run, cut the last Shaftliner panel slightly narrower and shorter than the opening to facilitate installation.

.9 For walls exceeding 3.7 m in height, Shaftliner panel end joints shall fall alternately in the upper and lower 1/3 of the partition. Use a C-H stud placed horizontally between panels to secure each joint.

.10 Frame all cut openings in the shaft side with J-track, providing adequate structural support for openings over 1219 mm.

.11 Anchor elevator door frames to shaftwall enclosures; however, they must remain independently supported by the building frame.

3.9 CORNER, CASING BEADS AND TRIM

.1 Corner reinforcing bead: Install along all external angles, erect plumb, level and with a minimum of joints. Secure with screws at 225 mm o.c. apply filler over flanges flush with nose of the bead and extending at least 75 mm onto surface of board each side of corner. When filler dries, apply a thin coat of topping cement and blend onto adjoining surfaces.

.2 Casing bead: Install where wallboard butts against a surface having no trim concealing the juncture and where shown on drawings. Erect casing beads plumb or level, with minimum joints, and secure with screws at 300 mm o.c. apply filler over flange flush with bead and extending at least 75 mm onto surface of board. When dry, apply a thin coat of topping cement and blend onto adjoining surfaces.

.3 Recess channels and trim: Install recess channels and special metal trim where shown. Secure to substrate. Provide casing beads full height on wallboard edges at recess channels and metal trim.

3.10 JOINT TAPING AND FINISHING

.1 Install reinforcing tape and a minimum of 3 coats of joint compound over gypsum board joints, metal trim and accessories, and screw fasteners in accordance with the gypsum board manufacturer's instructions.

.2 Fill gaps between ,and any imperfections in, gypsum boards with joint compound, allow to dry, and sand smooth ready for painting.

.3 Install finished gypsum board Work smooth, seamless, plumb, true, flush, and with square, plumb, and neat corners.

.4 Finish gypsum board in accordance with ASTM C840 to the following grades:

1. Level 0: No taping, finishing, or accessories required. Use above suspended ceilings and within other concealed spaces, unless the assembly is fire rated, sound rated, sound or smoke controlled, or unless the space serves as an air plenum.
2. Level 1: At joints and interior angles embed tape in joint compound. Leave surface free of excess joint compound. Tool marks and ridges are acceptable. Use above suspended ceilings and within other concealed spaces if the gypsum board assembly is fire rated, sound rated, sound or smoke controlled, or the space serves as an air plenum.
3. Level 2: At joints and interior angles embed tape in joint compound with one separate coat of joint compound applied over joints, angles, fastener heads, and accessories. Use for water resistant gypsum board indicated for use as a substrate for ceramic tile.
4. Level 3: At joints and interior angles embed tape in joint compound with two separate coats of joint compound applied over all joints, angles, fastener heads, and accessories. Apply joint compound smooth and free of tool marks and ridges. Use where heavy grade wall coverings are the final decoration.
5. Level 4: At joints and interior angles embed tape in joint compound with three separate coats of joint compound applied over all joints, angles, fastener heads, and accessories. Apply joint compound smooth and free of tool marks and ridges. Use for all locations except those indicated for other finish levels.
6. Level 5: At joints and interior angles embed tape in joint compound with three separate coats of joint compound applied over all joints, angles, fastener heads, and accessories. Apply a thin skim coat of joint compound, or a material manufactured especially for this purpose, to the entire surface. Leave surface smooth and free of tool marks and ridges. Use where semi-gloss or gloss finish coatings are the final decoration.

3.11 ACCESS DOORS

.1 Install access doors, supplied as part of other parts of the Work, in accordance with manufacturer's written instructions.

3.12 SITE TOLERANCES

.1 Install metal support systems to ensure that, within a tolerance of +3 mm and -1.5 mm for plaster thickness, finish surfaces will be flat within 3 mm under a 3 m straightedge, and with no variation greater than 1.5 mm in any running 300 mm, and that surface planes shall be within 3 mm of dimensioned location.

3.13 REPAIR

1. Make good cut-outs for services and other work, fill in defective joints, holes and other depressions with joint compound.

2. Make good defective work, and ensure that surfaces are smooth, evenly textured and within specified tolerances to receive finish treatments.

END OF SECTION

1 General

1.1 **SECTION INCLUDES**

.1 Labour, Products, equipment and services necessary for tile Work in accordance with the Contract Documents.

1.2 **REFERENCES**

.1 ANSI A108/A118/A136.1, Installation of Ceramic Tile.

.2 ANSI A137.1, Specifications for Ceramic Tile.

.3 ASTM C144, Specification for Aggregate for Masonry Mortar.

.4 CAN/CSA A3000, Cementitious Materials Compendium.

.5 CAN/CGSB 25.20, Surface Sealer for Floors .

.6 TTMAC Specification Guide 09 30 00 Tile Installation Manual.

.7 TTMAC, Maintenance Guide.

1.3 **SUBMITTALS**

.1 Product data:
- .1 Submit copies of manufacturer's Product data in accordance with the Conditions of the Contract indicating:
  - .1 Performance criteria, compliance with appropriate reference standard, characteristics, limitations and warranties.
  - .2 Product transportation, storage, handling and installation requirements.

.2 Shop drawings:
- .1 Submit shop drawings in accordance with the Conditions of the Contract indicating:
  - .1 Tile layout, patterns, and colour arrangement.
  - .2 Perimeter conditions, junctions with dissimilar materials.
  - .3 Setting details.

.3 Samples:
- .1 Submit following sample panels in accordance with the Conditions of the Contract.
  - .1 Each colour, texture, size, and pattern of tile.
  - .2 Adhere tile samples to 400 x 400 x 12.5 mm thick cement board complete with selected grout colour in joints.

.4 Certificates: Submit manufacturer's certificates stating that materials supplied are in accordance with this specification.

.5 Closeout submittals: Submit recommended maintenance instructions and listing of recommended maintenance Products for incorporation into Operations and Maintenance Manuals in accordance with the Conditions of the Contract.

1.4 **QUALITY ASSURANCE**

.1 Perform Work of this Section by a company that is a member in good standing of the Terrazzo Tile and Marble Association of Canada with proven, acceptable experience on installations of similar complexity and scope.

1.5 **DELIVERY, STORAGE AND HANDLING**

.1 Deliver materials in adequate crates or containers with manufacturer's name and product description clearly marked.

.2 Handle and store tiles in a manner to avoid chipping, breakage or the instruction of foreign matter. Take precautions to protect the mortar and grout admixtures from freezing or from excessive heat.

1.6 **SITE CONDITIONS**

.1 Do not install Work of this Section outside of the following environmental ranges without the Consultant's and Product manufacturer's written acceptance:
.1 Ambient air and surface temperature: 15^0C to 45^0C.
.2 Precipitation: None.

.2 Install temporary protection and facilities to maintain the Product manufacturer's, and specified, environmental requirements for 7 Days before, during, and 7 Days after installation.

1.7 **MAINTENANCE**

.1 Submit extra tile amounting to 3% of gross area covered, allowing proportionately for each pattern and type specified and which are part of the same Production run as installed Products. Store maintenance Products as directed by the Consultant.

2 Products

2.1 **MATERIALS**

.1 General: All materials under Work of this Section, including but not limited to, sealants, adhesives, and sealers are to have low VOC content limits.

.2 Tile:
.1 To ANSI A137.1.
.2 Supply coves, caps, inside and outside corners and bullnose tile as required.
.3 Where unfinished tile edge is exposed, supply cap to Consultant's selection.
.4 Tile types to be selected by Consultant.

.3 Thresholds: Match floor tile, full width of door openings, at junction of ceramic tile and carpet and resilient floor materials.

2.2 ACCESSORIES

.1 Cement: CAN/CSA A3000, Type GU.

.2 Sand: ASTM C144.

.3 Water: Potable and free of minerals and other contaminants which are detrimental to mortar and grout mixes.

.4 Polymer additive: Keralastic by Mapei Inc or approved alternative by Flextile Ltd., Kiesel or Laticrete International.

.5 Pre-mixed thin-set mortar: ANSI A108/A118/A136.1:
- .1 'Kerabond with Keralastic Latex Additive' by Mapei Inc. or approved alternative by Flextile Ltd., Kiesel or Laticrete International unless otherwise recommended by grout manufacturer to suit tile size or application.
- .2 White coloured mortar shall be provided at appropriate tile types including, but not limited to; glass tile, light coloured marble, green marble and light coloured granite.

.6 Thick bed sloped topping: Factory mixed blend of portland cement and aggregates with latex admix. 'Ardex X32 Microtec' by Ardex, '226 thick bed mortar with 3701 admix' by Laticrete, 'Topcem with Planicrete AC Admixture' by Mapei Inc., or approved alternative by Custom Building Products.

.7 Primer: To meet specified requirements of adhesive manufacturer.

.8 Cleaner: In accordance with TTMAC's requirements and as recommended by tile manufacturer.

.9 Waterproof Membrane: Waterproof Membrane System made from black, cold-applied, self-curing, liquid rubber polymer and an integral reinforcing fabric.'92040 Waterproof and Anti-Fracture' by Custom Building Products, '9235 Waterproofing' by Laticrete International Inc. or 'Maplelastic Aqua Defence with Fiberglass' by Mapei Inc.

.10 Grout:
- .1 Floors, walls, and bases: 'Servoperl Royal' by Kiesel or approved alternative by Flextile Ltd.,or Laticrete International, or Mapei Inc.
- .2 Grout colour: To be selected by Consultant.

.11 Epoxy Grout:
- .1 ANSI A108/A118/A136.1, Non-sag additive for work on vertical surfaces, Epoxy grout material shall be non-toxic, low odour, water cleanable and stain resistant. 'Kerapoxy' by Mapei Inc., 'Spectralock' by Laticrete International or approved alternative by Flextile Ltd. or Kiesel.
- .2 Grout colour: To be selected by Consultant.

.12 Sealer: CAN/CGSB-25.20, penetrating, type as recommended by tile manufacturer.

.13 Tile sealant: In accordance with Section 07 92 00.

2.3 **MIXES**

.1 Levelling bed mix:
- .1 1 part Portland cement.
- .2 4 parts sand.
- .3 1 part water (including polymer additive), adjusted for water content of sand.
- .4 1/10 part polymer additive.

3 Execution

3.1 **EXAMINATION**

.1 Verify condition and dimensions of previously installed Work upon which this Section depends. Report defects to Consultant. Commencement of Work means acceptance of existing conditions.

3.2 **SURFACE PREPARATION**

.1 Clean and dry surfaces thoroughly. Remove oil, wax, grease, dust, dirt, paint, tar, primers, form release agents, curing compound, and other foreign material from substrate surfaces which may prevent or reduce adhesion.

.2 Neutralize any trace of strong acids or alkali from the substrate.

3.3 **CONTROL JOINTS**

.1 Provide control, expansion and isolation joints in accordance with TTMAC specification 301MJ and as indicated on drawings. Install in locations indicated on drawings and specified herein.

.2 Continue control, construction, and cold joints in the structural substrate up through the tile finish, and align with mortar joints where possible. Review joint locations on Site with the Consultant.

.3 Install joint widths to match grout joint widths, except where a minimum width is indicated.

.4 Install control joints in the following typical locations:
- .1 Aligned over changes in type of substrate.
- .2 At the restraining perimeters such as walls and columns.
- .3 Interior areas (not subject to sunlight): 6 mm minimum width, at 7320 mm o.c. maximum.
- .4 Interior areas (subject to sunlight): 6 mm minimum width, at 3660 mm o.c maximum.
- .5 As indicated on the Contract Drawings.

.5 Seal control joints in accordance with Section 07 92 00.

3.4 LEVELLING BED

.1 Install a levelling bed on uneven substrate surfaces, level and plumb substrates in accordance with the following tolerances:
- .1 Vertical surfaces: 3 mm in 2.4 m maximum .
- .2 Horizontal surfaces: 6 mm in 3 m from finished levels of the surface, or better.

.2 Clean structural substrate control joints and blow-clean with compressed air. Grout fill control joints flush to slab with levelling bed.

.3 Provide slopes to drains in washrooms and as indicated on drawings.

3.5 WATERPROOFING MEMBRANE

.1 Apply with a trowel on prepared substrate to a total dry film thickness of 1.143 mm in accordance with manufacturer's printed directions. Carry up walls to 50 mm high.

3.6 GENERAL INSTALLATION REQUIREMENTS

.1 Install tiles in accordance with manufacturer's instructions and TTMAC Specification Guide 09300 Tile Installation Manual. Manufacturer's installation instructions govern over TTMAC Installation Manual.

.2 Lay out Work to produce a symmetrical pattern with minimum amount of cutting. Ensure cut tile at room perimeter and at joints is not less than ½ full size.

.3 Install trim to be placed under tile in locations indicated on Drawings.

.4 Set tiles in place and rap or beat with a beating block as necessary to ensure a proper bond and to level surface. Align tile for uniform joints and allow to set until firm. Clean excess mortar from surface of tile with a wet cloth or sponge while mortar is fresh.

.5 Ensure following minimum mortar contact coverage to back of tiles. Contact must be evenly distributed to give full support of the tile.
- .1 90% for interior applications.
- .2 100% for large format tile.

.6 Adjust joints between units uniform, plumb, straight, even, and true, with adjacent tile flush. Align grout joints in both directions unless indicated otherwise.

.7 Align floor, base and wall grout joints.

.8 Install tile accessory fittings for a complete and fully coordinated tile assembly.

.9 Do not place tile, trim, and accessories over control, expansion, or isolation joints. Stop materials in either side on joints and provide control, expansion and isolation joints as specified.

.10 Cut and fit tile neatly around piping, fittings, joints, projections and around recesses items e.g. washroom accessories. Where surface mounted equipment and accessories are installed on tile surfaces, extend tile over surfaces. Cut edges smooth, even, and free from chipping; chipped and broken edges are not acceptable.

.11 Do not proceed with grouting until minimum 48 hours after tile has set, to prevent displacement of tiles.

.12 Apply grout in accordance with grout manufacturer's directions to produce watertight, filled joints without voids, cracks and excess grout. Thoroughly compact and tool floor grout. Finish grout flush to edge thickness of tile and remove excess grout with soft burlap or sponge moistened with clean water.

3.7 CLEANING

.1 Clean off excess grout with soft burlap or sponge moistened with clean water.

.2 Polish floor and wall tile after grout has cured in accordance with TTMAC recommendations in the Maintenance Guide; do not use acid for cleaning.

.3 Apply 2 coats of sealer to unglazed floor tile in accordance with sealer manufacturer's printed directions.

.4 Re-point joints after cleaning as required to eliminate imperfections, then re-clean as necessary. Avoid scratching tile surfaces.

3.8 JOINT BACKING AND TILE SEALANT

.1 Install joint backing under sealant as necessary.

.2 Install tile sealant around piping and fittings extending through tiled surfaces.

.3 Seal tile control joints.

.4 Seal internal tile to tile junctions. Tool to a smooth, flush surface, free from air bubbles and contamination.

3.9 PROTECTION

.1 Prevent traffic over tiled areas, and protect tiled assemblies from weather, freezing, and water immersion, for 72 hours minimum, after final installation.

.2 Prevent direct impact, vibration and heavy hammering on adjacent and opposite walls for 24 hours minimum, after final installation.

.3 Cover work temporarily with building paper properly lapped and taped at joints until work has been approved by Consultant.

END OF SECTION

1 General

1.1 **SECTION INCLUDES**

.1 Labour, Products, equipment and services necessary for detectable/tactile tiles work in accordance with the Contract Documents.

1.2 **REFERENCES**

.1 ISO 23599, Assistive Products for Blind and Vision-Impaired Persons - Tactile Walking Surface Indicators.

1.3 **DESIGN REQUIREMENTS**

.1 Design detectable tile system conforming to ISO 23599.

1.4 **SUBMITTALS**

.1 Product data:
- .1 Submit copies of manufacturer's Product data in accordance with the Conditions of the Contract indicating:
  - .1 Performance criteria, compliance with appropriate reference standard, characteristics, limitations and warranties.
  - .2 Product transportation, storage, handling and installation requirements.

.2 Shop drawings:
- .1 Submit shop drawings in accordance with the Conditions of the Contract indicating:
  - .1 Perimeter conditions, junctions with dissimilar materials.
  - .2 Setting details.

.3 Samples: Submit two 300 x 300 mm samples of each type of detectable/tactile warning surfaces in accordance with the Conditions of the Contract.

.4 Closeout submittals: Submit recommended maintenance instructions and listing of recommended maintenance Products for incorporation into Operations and Maintenance Manuals in accordance with the Conditions of the Contract.

1.5 **DELIVERY, STORAGE AND HANDLING**

.1 Deliver materials in adequate crates or containers with manufacturer's name and product description clearly marked.

.2 Handle and store tiles in a manner to avoid chipping or breakage. Take precautions to protect the adhesives from freezing or from excessive heat.

1.6 **SITE CONDITIONS**

.1 Do not install work of this Section outside of the following environmental ranges without the Consultant's and Product manufacturer's written acceptance:
.1 Ambient air and surface temperature: Minimum 40^0F.
.2 Precipitation: None.

.2 Install temporary protection and facilities to maintain the Product manufacturer's, and specified, environmental requirements for 7 Days before, during, and 7 Days after installation.

1.7 **MAINTENANCE**

.1 Submit extra tile amounting to 3% of gross area covered, allowing proportionately for each pattern and type specified and which are part of the same Production run as installed Products. Store maintenance Products as directed by the Consultant.

2 Products

2.1 **MATERIALS**

.1 All materials under work of this Section, including but not limited to, sealants and adhesives are to have low VOC content limits.

.2 Vitrified Polymer Composite (VPC) Tile: 5 mm thick epoxy polymer tiles with ultra violet stabilized coating employing aluminum oxide particles in truncated domes providing a slip resistance of not less than 0.80 to ASTM C1028. Tile shall incorporate an in-line pattern of truncated domes measuring nominal 5 mm high x 23 mm base diameter x 11 mm top diameter, spaced 60 mm o.c. diagonally and 42 mm side by side; "VPC Surface Applied Armor-Tile" as manufactured by Engineered Plastics Inc. or approved alternative in colour to be selected.
.1 Adhesive: Bonding adhesive 'Armor-Bond' by Engineered Plastics Inc. or approved alternative.
.2 Perimeter caulking sealant: 'Armor-Seal' by Engineered Plastics Inc. or approved alternative.

.3 Fasteners: Corrosion resistant inserts with heavy duty steel bolts and washers as recommended by tile Manufacturer.

3 Execution

3.1 **EXAMINATION**

.1 Verify condition and dimensions of previously installed Work upon which this Section depends. Report defects to Consultant. Commencement of work of this Section means acceptance of existing conditions.

3.2 PREPARATION

.1 Prepare substrate using steel aggregate blast method and vacuum substrate free of debris and dust.

.2 Fill minor cracks and voids and prime surfaces in accordance with manufacturer's recommendations.

.3 Project adjacent surfaces from damage resulting from this work. Mask and/or cover adjacent surfaces, fixtures, and equipment as necessary.

.4 Clean, prime and seal surfaces as recommended by detectable tile manufacturer.

3.3 SURFACE APPLIED INSTALLATION

.1 Apply adhesive to backside of tile, following perimeter and internal cross pattern established by tile manufacturer. Ensure sufficient adhesive has been placed on prescribed areas to have full coverage across width of adhesive locator and shall be applied to within 6 mm continuously around perimeter edge of tile.

.2 Set tile true and square to areas as detailed on drawings.

.3 Working from centre of tile outwards, proceed to drill and install all fasteners in tile's moulded recesses.

.4 Drill hole while standing with both feet applying pressure around moulded recess in tile, drill through tile without hammer option until tile has been penetrated, then with hammer option to drill into concrete. Maintain foot pressure on both sides of hole while drilling to prevent concrete dust from accumulating between tile and concrete.

.5 Immediately after drilling each hole, mechanically fasten tile to concrete substrate while still applying foot pressure. Ensure fastener has been placed to full depth in dome, straight, and flush to the top of dome and drive pin of fastener with mallet.

.6 Apply perimeter caulking sealant in accordance with sealant manufacturer's recommendations and Section 07 92 00.

3.4 CLEANING AND PROTECTION

.1 Clean tiles in accordance with manufacturer's written instructions.

.2 Prevent traffic over new installed detectable tiles, and protect from weather, freezing, and water immersion, for 24 hours minimum, after final installation.

.3 Cover work temporarily with plywood until work has been approved by Consultant.

END OF SECTION

1 General

1.1 **SECTION INCLUDES**

.1 Design, labour, Products, equipment and services necessary for acoustical ceilings Work in accordance with the Contract Documents.

1.2 **REFERENCES**

.1 ASTM A653/A653M, Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvanealed) by the Hot-Dip Process.

.2 ASTM C635, Specification for the Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings.

.3 ASTM C636, Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels.

.4 ASTM C645, Specification for Non-Load Bearing (Axial) Steel Studs, Runners (Tracks), and Rigid Furring Channels for Screw Application of Gypsum Board.

.5 ASTM E1264, Classification for Acoustical Ceiling Products.

1.3 **DESIGN REQUIREMENTS**

.1 Design ceiling suspension systems in accordance with ASTM C636 and manufacturer's printed directions.

.2 Design tile ceiling system for adequate support of electrical fixtures as required by the current bulletin of the Electrical Safety Authority. Acoustic panel system is not designed to carry the weight of electrical equipment.

.3 Design hanger anchor and entire suspension system static loading not to exceed 25% of their ultimate capacity including lighting fixture dead loads.

.4 Design tile suspension system to support weight of mechanical and electrical items such as air handling boots and lighting fixtures, and with adequate support to allow rotation/relocation of light fixtures. Acoustic panel system is not designed to carry the weight of mechanical and electrical equipment.

.5 Design subframing as necessary to accommodate, to avoid conflicts and interferences where ducts or equipment prevent regular spacing of hangers.

1.4 **SUBMITTALS**

.1 Shop drawings:
  .1 Submit shop drawings in accordance with the Conditions of the Contract indicating:
    .1 Suspension system layout including hangers and supports for acoustic tile system.
    .2 Acoustic panel system including suspension system, hangers, supports and panel sizes and locations.

.3 Conditions at abutting, intersecting, and penetrating construction.
.4 Dimensioned locations of lighting fixtures, diffusers, sprinkler heads and other items that pierce the ceiling plane.

.2 Samples:
.1 Submit following samples in accordance with the Conditions of the Contract:
.1 One full-size sample of each type of tile panels to be used.
.2 One of each type of suspension system members.

.3 Certificates: Submit written certification stating that suspended ceiling system is designed for adequate support of electrical fixtures as required by the current bulletin of the Electrical Safety Authority.

1.5 QUALITY ASSURANCE

.1 Mock-up:
.1 Construct one 10 m^2 mock-up for each type of ceiling system incorporating typical light fixture and other typical mechanical and electrical fixtures.
.2 Test the adequacy of the suspension system to support the fixtures without deflection of ceiling or failure of hanging wire anchorage. Supply copy of Test Results to Consultant.
.3 Change materials and installation methods if tests indicate proposed system is inadequate and re-test as necessary until system approved.
.4 Give early notice to Consultant and Mechanical and Electrical Trades and co-operate with them in selecting suitable location for sample ceiling and timing of installation and test.
.5 Do not commence general installation work until sample ceiling approved, then install ceiling to conform with approved samples.
.6 Mock-up may form part of final Work, if acceptable to Consultant. Remove and dispose of mock-ups which do not form part of Work.

1.6 SITE CONDITIONS

.1 Do not install the Work of this Section until:
.1 Mechanical and electrical Work above the ceiling is complete.
.2 Relative humidity is below 80 %.
.3 Ventilation is adequate to remove excess moisture.
.4 Areas are closed and protected against weather, and maintained at no less than 10°C.

.2 Install temporary protection and facilities to maintain Product manufacturer's, and above specification, environmental requirements 24 h before, during, and after installation.

1.7 MAINTENANCE

.1 Submit extra acoustic ceilings amounting to 2% of gross ceiling area, allowing proportionately for each pattern and type specified to nearest full carton. Submit Products which are part of same production run as installed Products. Store maintenance Products as directed by Consultant.

1.8 **DELIVERY, STORAGE AND HANDLING**

.1 Transport, handle and store material in manner to prevent warp, twist, damage to panel edges and surfaces in accordance with Manufacturer's recommendations.

.2 Any warped and/or damaged panels and trim shall be rejected and be replaced by new, straight, undamaged and acceptable material at no cost to Owner.

.3 Bent, twisted or otherwise damaged Tee grid suspension components shall not be used under any circumstances. Replace such damaged items with new undamaged material at no additional cost to Owner.

.4 Store material in warm, dry place away from water and the elements. Protect against undue loading stresses and shock.

.5 All packaged material shall be delivered in original manufacturers wrappers and containers with labels and seals intact. All cartons shall bear U.L. label.

2 Products

2.1 **MATERIALS**

.1 Wherever possible, acoustical ceiling tiles, steel suspension system and framing used in work of this Section are to contain recycled content.

.2 Galvanized steel sheet: ASTM A653/A653-M, Z275; cold rolled, galvanized steel sheet.

.3 Main carrying channels: ASTM C645; Channels formed from galvanized steel sheet, 38 x 19 mm cold rolled.

.4 Subframing: ASTM C645; Channels formed from galvanized steel sheet, dimensions and spans as required.

.5 Hangers: 2.6 mm minimum diameter, galvanized steel wire.

.6 Tie wire: 1.6 mm minimum diameter, soft annealed galvanized steel wire.

.7 Concrete anchors: tie wire sleeve anchors, 'Redi-Drive Anchors' by ITW Red Head or approved alternative.

.8 Wall mouldings and accessories, including but not limited to, corner caps, edge mouldings, panel hold over clip, metal closures, and trim. Finish and colour: same as main tees.

.1 Perimeter trim: Aluminum extrusions edge trim; 'Compässo Slim' by CGC Inc. or 'Axiom' by Armstrong World Industries or approved alternative by Chicago Metallic.

.9 Exposed main, cross tees, and relocatable cross tees: ASTM C635, 38 mm high steel, bulb tee design double steel web, rectangular single spans without exceeding a deflection of 1/360 of the span. Splices to be integral and reversible; cross tee interlocking into main tee. Colour and finish: Manufacturer's standard white.

.1 Acceptable manufacturers of Suspension Grid:

.1 CGC Inc.

.2 Armstrong World Industries.

.3 Chicago Metallic.

.10 Acoustic tiles **(ACT-1)**: ASTM E1264, to be selected by Consultant.

.11 Wall mouldings: To match acoustical ceiling suspension system.

3 Execution

3.1 **EXAMINATION**

.1 Verify condition and dimensions of previously installed Work upon which this Section depends. Report defects to Consultant. Commencement of Work means acceptance of existing conditions.

3.2 **SUSPENSION SYSTEM**

.1 Coordinate locations and openings of mechanical and electrical services support, and penetration through the acoustical ceilings. Coordinate field conditions, clearances, measurements, and mechanical and electrical services testing and commissioning, above the acoustical ceilings.

.2 Install hanger wires plumb and securely anchored to the building structural framing, independent of walls, pipes, ducts, and metal deck; install additional framing and hangers to bridge interference items.

.3 Install acoustical ceiling systems in accordance with manufacturer's written instructions, reviewed shop drawings, and ASTM C636, listed in order of precedence.

.4 Install hanger wires at 1200 mm maximum centres along carrying channels, not less than 25 mm, and not more than 150 mm from channel ends.

.5 Install additional hangers at lighting fixture and air distribution ductwork locations. Do not attach hanger wires to mechanical or electrical equipment. Do not support mechanical and electrical fixtures and fitting on ceiling without the ceiling manufacturer's written acceptance.

.6 Install acoustical ceiling suspension system to a tolerance of 1:1200 of span and 0.4 mm maximum between adjacent metal members. Tolerances are not cumulative. Refer to Electrical Contract Drawings for fixture layout.

.7 Do not bend or twist hangers as a means of levelling. Form double loops tightly and lock to prevent vertical movement or rotation within the loop.

.8 Install edge moulding at intersection of ceiling and vertical surfaces.

.9 Centre acoustical ceiling suspension systems on room axis; install equal border pieces. Install hangers onto the ends of main tee runners at not more than 150 mm from ends of runners, adjacent and perpendicular to walls.

.10 Support the suspension system independently of walls, columns, ducts, pipes and conduits.

.11 Install main runners in maximum available lengths. Layout joints in suspension members to avoid the perimeters of recessed fixtures. Lock grid members to form a rigid assembly. Install additional tee, suspension system framing around recessed fixtures, diffusers, grilles and other items for a complete assembly.

3.3 ACOUSTIC LAY-IN TILES

.1 Install acoustic tile in grid system openings supported by bottom flanges of members. Provide special shapes and sizes to provide a complete installation by cutting tile to fit into openings. Fit tile moderately tight between upright legs of members.

.2 Carefully cut and trim acoustic tiles to accommodate items piercing the finished ceiling plane.

.3 Remove and replace acoustic tiles with broken edges, or damaged, marked, discoloured, soiled, or stained faces.

3.4 ADJUSTMENTS AND CLEANING

.1 Clean soiled or discoloured surfaces of exposed work on completion of work.

.2 Replace components which are visibly damaged, marred or uncleanable.

END OF SECTION

1 General

1.1 **SECTION INCLUDES**

.1 Labour, Products, equipment and services necessary for resilient flooring Work and accessories in accordance with the Contract Documents.

1.2 **REFERENCES**

.1 ASTM F710, Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring.

.2 ASTM F1861, Specification for Resilient Wall Base.

.3 ASTM F1869, Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Cloride.

.4 ASTM F 2170, Standard Test Method for Determining Relative Humidity in Concrete Slabs Using in-situ Probes.

1.3 **SUBMITTALS**

.1 Product data:
- .1 Submit copies of manufacturer's Product data in accordance with the Conditions of the Contract indicating:
  - .1 Performance criteria, compliance with appropriate reference standard, characteristics, limitations.
  - .2 Product transportation, storage, handling and installation requirements.

.2 Samples:
- .1 Submit following samples in accordance with the Conditions of the Contract:
  - .1 Two 250 x 200 mm samples of each type of resilient material and colour.
  - .2 Two 250 mm long samples of resilient base.
  - .3 Two 250 mm long samples of each accessory and colour.

.3 Closeout submittals: Submit maintenance and cleaning data for incorporation into Operations and Maintenance Manuals in accordance with the Conditions of the Contract.

1.4 **SITE CONDITIONS**

.1 Maintain air temperature and structural base temperature at flooring installation area above 20°C for 48 hr before, during and 48 hr after installation.

.2 Store materials for 2 days prior to installation in area of Work to achieve temperature stability.

.3 Do not lay flooring in conditions of high humidity or where exposed to cold drafts. In hot weather, protect from direct sunlight.

.4 Provide adequate ventilation during installation.

1.5 **MAINTENANCE**

.1 Submit extra 5% or to nearest full carton of each colour, pattern and type of flooring material required for maintenance use. Identify each carton. Store where directed.

2 Products

2.1 **MATERIALS**

.1 All materials under Work of this Section, including but not limited to, primers, adhesives, sealers, and waxes are to have low VOC content limits.

.2 Vinyl Composition Tile **(VCT-1)**: Refer to Room Finish & Colour Schedule for types and colours.

.3 Luxury Vinyl Tile **(LVT)**: Refer to Room Finish & Colour Schedule for types and colours.

.4 Static Dissipative Vinyl Tile **(SDT1)**: Refer to Room Finish & Colour Schedule for types and colours.

.5 Rubber tile and treads **(RT-1)**: Refer to Room Finish & Colour Schedule for types and colours.

.6 Resilient Sheet and Rubberized Sports Flooring **(RSF)**: Refer to Room Finish & Colour Schedule for types and colours.

.7 Rubber base **(RB)**: Refer to Room Finish & Colour Schedule for types and colours.

.8 Reducing edge strips, transition strips, thresholds, etc.: Nitrile rubber plasticized vinyl, 80-95 Shore A Durometer, adhesive recommended by flooring manufacturer.
.1 'Finishing Accessories' by Tarkett or approved alternative by Roppe.

.9 Primers and adhesives: Low VOC, waterproof, for specific material on applicable substrate, above, at or below grade; 'Ultrabond ECO 711' by Mapei or approved alternative by Henry or Roberts.

.10 Concrete skim coat compound: High-performance, rapid-setting cement based skim coating compound. 'Ultra SkimCoat' by Mapei or approved alternative by Ardex or Laticrete, for filling minor voids and leveling existing substrate.

.11 Sealer and wax: As recommended by flooring manufacturer.

3 Execution

3.1 **EXAMINATION**

.1 Verify condition and dimensions of previously installed Work upon which this Section depends. Report defects to Consultant. Commencement of Work means acceptance of existing conditions.

.2 Ensure concrete floors meet the minimum requirements of the flooring manufacturer. Do not proceed with placement of the adhesive and resilient flooring until surfaces and conditions comply with the manufacturers requirements indicated in each of the manufacturers' instructions and good work practices. Adhesive and Resilient Flooring Manufacturers to provide their acceptance in writing to Contractor, Consultant, and Owner that the conditions are acceptable for installation.

.3 Ensure that sub-floors have been provided as specified without holes, protrusions, cracks, depressions or other major defects.

.4 Ensure that control joints have been filled and levelled.

.5 Defective Work resulting from application to unsatisfactory surfaces will be considered the responsibility of those performing the Work of this Section.

3.2 **SUBFLOOR TREATMENT**

.1 Flooring shall be installed over subfloors conforming to ASTM F710 for concrete.

.2 Remove sub-floor ridges and bumps. Fill low spots, cracks, joints, holes and other defects with sub-floor filler.

.3 Apply sub-floor filler to low spots and cracks to achieve floor level to a tolerance of 1:1000, allow to cure.

.4 Sub-floor shall be feathered up to meet adjacent floor finishes to ensure a smooth, flush transition.

.5 Meet ASTM F710 Standard for Concrete or other monolithic floors.

.6 Clean and remove all deleterious materials from surfaces to receive this Work in accordance with the adhesive manufacturer's recommendations.

.7 Prime concrete to flooring manufacturer's printed instructions.

3.3 **TILE APPLICATION**

.1 Install resilient tile flooring in accordance with manufacturer's written instructions.

.2 Install flooring wall to wall before installation of floor-set cabinets, casework, furniture, equipment, etc. Extend flooring into toe spaces, door recesses, closets and similar openings.

.3 Apply adhesive uniformly using recommended trowel in accordance with flooring manufacturer's instructions. Do not spread more adhesive that can be covered by flooring before initial set takes place.

.4 Make tile joints flush, uniform, in moderate contact, in straight lines and as inconspicuous as possible. Lay tile patterns of adjacent tiles parallel to each other. In general, grain pattern and continuous joints will run in one direction of room, staggered joints will run in opposite direction. Verify with Consultant on site which way grain pattern and joints will run in each room.

.5 Install flooring to square grid pattern with all joints aligned.

.6 As installation progresses, and after installation, roll flooring in 2 directions with minimum 45 kg minimum roller to ensure full adhesion.

.7 Remove adhesive seepage at seams or surface while adhesive is still wet, in accordance with manufacturer's recommendation.

.8 Cut tile and fit neatly around fixed objects.

.9 Install feature strips and floor markings where indicated. Fit joints tightly.

.10 Terminate flooring at centerline of door in openings where adjacent floor finish or colour is dissimilar.

.11 Install reducing edge strips at unprotected or exposed edges where flooring terminates and at edges where there are two finishes of different thicknesses.

3.4 RUBBERIZED SPORTS FLOORING APPLICATION

.1 Apply adhesive uniformly using recommended trowel in accordance with flooring manufacturers instructions. Do not spread more adhesive that can be covered by flooring before initial set takes place.

.2 Unroll flooring into freshly applied adhesive ensuring that all seams are in contact without compression.

.3 Cut flooring neatly around fixed objects.

.4 Terminate flooring at centreline of door in openings where adjacent floor finish or colour is dissimilar.

.5 Roll flooring in both directions when complete.

.6 Install reducing edge strips at unprotected or exposed edges where flooring terminates or where there are two finishes of different thicknesses.

3.5 RESILIENT BASE APPLICATION

.1 Install resilient base in accordance with manufacturer's written instructions.

.2 Lay out base to keep number of joints at minimum.

.3 Prior to installing base, fill cracks and irregularities with a filler recommended by base manufacturer.

.4 Set base in adhesive using a 3 kg hand roller, against wall and floor surfaces.

.5 Install straight and level to variation of 1:1000.

.6 Scribe and fit to door frames and other obstructions.

.7 Cope internal corners.

3.6 RUBBER TILES, STAIR TREADS, AND STAIR NOSING

.1 Prepare adhesive and install materials in accordance with manufacturer's written instructions.

.2 Pre-cut and fit treads prior to spreading adhesive. Fill back side of tread nose with a caulking bead; brush on adhesive on understeps and back of treads, as well as back of risers, and on receiving substrate. Allow to become tacky to touch before installing. Treads shall be fully bonded to substrate, with tread nosing butted tight against stair tread nosing. Roll with hand roller after installation.

.3 Trowel adhesive evenly on substrate any lay tile with tight joints. Work from off the tile. If necessary to work on the tile, avoid shifting by using a kneeling board and by cutting tile to butt tightly at wall junctions.

.4 Roll tile both directions with 68 kg sectional roller when adhesive is tacky to touch. Use hand roller in areas inaccessible with large roller.

.5 Remove adhesive seepage at seams or surface while adhesive is still wet, in accordance with manufacturer's recommendations.

3.7 ACCESSORIES AND WHEELED TRANSITION APPLICATION

.1 Install accepted adaptors between different flooring materials in accordance with manufacturer's instructions.

.2 Ensure that adaptors have been clipped into place properly to provide a smooth, gradual transition between floors of different height.

.3 Install accessories in accordance with manufacturer's written instructions.

3.8 CLEANING AND WAXING

.1 Damp mop entire floor area, remove dust and construction marks prior to sealing.

.2 Apply two coats of Enviro Solutions Barricade Floor Sealer #82 and two coats of Swish Green and Clean Floor Finish wax, in accordance with manufacturers' instructions.

.3 Baseboards are not to be waxed. When applying the floor wax there must be clearance of plus or minus 25 mm, within reasonable tolerance, from the baseboard and wall.

.4 Finished floors to be free from streaks and embedded dirt particles

3.9 **PROTECTION OF FINISHED WORK**

.1 Protect floors from time of final set of adhesive until final cleaning inspection.

.2 Prohibit traffic on floor for 48 hours after installation.

.3 Cover waxed and polished surfaces with fibre reinforced, clean, non-staining kraft paper. Secure in position with gummed tape to prevent drifting. Remove covering when directed by Consultant.

END OF SECTION

1 General

1.1 **SECTION INCLUDES**

.1 Labour, Products, equipment and services necessary for epoxy flooring work in accordance with the Contract Drawings.

1.2 **SUBMITTALS**

.1 Product data: Submit manufacturer's Product data in accordance with the Conditions of the Contract indicating:
- .1 Two copies of manufacturer's Product data on characteristics, performance criteria, and limitations.
- .2 Preparation, installation requirements and techniques, Product storage, and handling criteria.

.2 Samples: Submit duplicate samples of each type and colour of epoxy flooring mounted on 250 x 200 mm hardboard in accordance with the Conditions of the Contract.

.3 Reports: Submit manufacturer's acceptance of substrate prior to installation in writing. Submit verification of moisture content of floor prior to installation.

.4 Close-out submittals: Submit maintenance data for incorporation into Operations and Maintenance manuals in accordance with the Conditions of the Contract.

1.3 **QUALITY ASSURANCE**

.1 Perform work of this Section by a company that has a minimum of five years proven experience in installations of a similar size and nature and that is approved by manufacturer. Submit to Consultant, applicator's current certificate of approval by the material manufacturer as proof of compliance.

.2 Mock-up:
- .1 Construct one 3 m^2 mock-up of each type and colour of epoxy flooring in location acceptable to Consultant.
- .2 Arrange for Consultant's review and acceptance, allow 48 hours after acceptance before proceeding with work.
- .3 Mock-up may remain as part of Work if accepted by Consultant. Remove and dispose of mock-ups which do not form part of Work.
- .4 Upon acceptance, mock-up shall serve as a minimum standard of quality for the balance of the work of this Section.

.3 Pre-installation meetings: Arrange with manufacturer's representative and Consultant to inspect substrates, and to review installation procedures 48 hours in advance of installation.

1.4 **SITE CONDITIONS**

.1 Do not install the work of this Section outside of the following environmental ranges without Product manufacturer's written acceptance:
- .1 Ambient air and surface temperature: 15^0C to 30^0C.

.2 Relative Humidity: In accordance with manufacturers' requirements.
.3 When no dust is being raised.
.4 In well-ventilated and broom clean areas.

.2 Do not apply epoxy flooring over materials that contain over 4% moisture.

.3 Install temporary protection and facilities to maintain the Product manufacturer's, and the above specification, environmental requirements for 24 hours before, during, and 24 h after installation.

.4 Post do not enter and appropriate warning signs at conspicuous locations.

1.5 **DELIVERY, STORAGE, AND HANDLING**

.1 Package, seal and label each epoxy flooring material to show manufacturer's and product name, and colour.

.2 Store materials at site in an area specifically set aside for purpose that is locked, ventilated, and maintained at a minimum temperature of 16°C.

.3 Ensure that health and fire regulations are complied with in storage area, and during handling and application.

2 Products

2.1 **MATERIALS**

.1 General:
.1 All materials under work of this Section, including but not limited to, primers and epoxy flooring are to have low VOC content limits.
.2 Each material used in the application of each flooring system shall be as recommended or manufactured by the supplier of the flooring system.

2. Epoxy flooring and base: Trowelled system, silica sand filled 100% epoxy binder, minimum 6 mm thick, with one coat of 100% solids chemical free resistant epoxy top coat. Colours and finishes to later selection by Consultant from manufacturer's full colour range; Refer to Colour and Material Schedule for epoxy flooring and base type.

.3 Primer: As recommended by manufacturer.

3 Execution

3.1 **EXAMINATION**

.1 Verify condition of previously installed Work upon which this Section depends. Report defects to Consultant. Commencement of work of this Section means acceptance of existing conditions.

.2 Verify that concrete floor has cured 28 days minimum and that substrate is acceptable to epoxy manufacturer.

.3 Test surfaces for moisture content to ensure that they are suitable for application.

3.2 **PREPARATION**

.1 Prepare substrate using steel aggregate blast method and vacuum substrate free of debris and dust.

.2 Fill minor cracks and voids and prime surfaces in accordance with manufacturer's recommendations.

.3 Project adjacent surfaces from damage resulting from this work. Mask and/or cover adjacent surfaces, fixtures, and equipment as necessary.

.4 Fill open control joints, and other cracks and voids with material compatible with epoxy materials.

.5 Clean prime and seal surfaces as recommended by epoxy manufacturer.

3.3 **APPLICATION**

.1 Apply epoxy flooring in accordance with manufacturer's printed instructions. Epoxy manufacturer shall supervise application.

.2 Stop epoxy in a straight line on each side of control joints; fill space over expansion joint with a self-levelling, non-sag polyurethane sealant.

.3 Apply epoxy with care to ensure that no laps, voids, or other marks or irregularities are visible, and with an appearance of uniform colour, sheen and texture, all within limitations of materials and areas concerned.

.4 Match colours and textures of approved samples.

.5 Make clean true junctions with no visible overlap between adjoining applications of epoxy.

.6 Chase edge of adjacent floor systems so that epoxy finishes flush with adjacent floor systems.

3.4 **SITE TOLERANCES**

.1 Finish surfaces shall be level, or straight where sloped to drains, within a tolerance of 1.5 mm in 3 m, and shall not vary more than 0.8 mm in any running 300 mm.

3.5 **REPAIR**

.1 Touch-up and refinish minor defective work. Refinish entire coated surface areas where finish is damaged or otherwise unacceptable.

3.6 **CLEANING**

.1 Remove promptly as work progresses spilled or spattered materials from surfaces of work performed under other Sections. Clean floors on completion of work. Do not mar surfaces while removing.

.2 Leave storage and mixing areas in same condition as equivalent spaces in project.

3.7 **PROTECTION**

.1 Erect barriers to prevent the entry and presence of personnel not performing work of this Section during application of epoxy flooring, and for 48 hours following completion of application.

END OF SECTION

1 General

1.1 **SECTION INCLUDES**

.1 Labour, Products, equipment and services necessary for concrete floor sealer work in accordance with the Contract Drawings.

1.2 **SUBMITTALS**

.1 Product data: Submit manufacturer's Product data in accordance with the Conditions of the Contract indicating:
- .1 Two copies of manufacturer's Product data on characteristics, performance criteria, and limitations.
- .2 Preparation, installation requirements and techniques, Product storage, and handling criteria.

.2 Samples: Submit samples in accordance with the Conditions of the Contract indicating coating and final concrete finish.

.3 Reports: Submit manufacturer's acceptance of substrate prior to installation in writing. Submit verification of moisture content of floor prior to installation.

.4 Close-out submittals: Submit maintenance data for incorporation into Operations and Maintenance manuals in accordance with the Conditions of the Contract.

1.3 **QUALITY ASSURANCE**

.1 Perform work of this Section by a company that has a minimum of five years proven experience in installations of a similar size and nature and that is approved by manufacturer. Submit to Consultant, applicator's current certificate of approval by the material manufacturer as proof of compliance.

.2 Mock-up:
- .1 Construct one 2 m^2 mock-up of floor sealer in location acceptable to Consultant.
- .2 Arrange for Consultant's review and acceptance, allow 48 hours after acceptance before proceeding with Work.
- .3 Mock-up may remain as part of Work if accepted by Consultant. If sealer application is unacceptable to Consultant, rework sealer in accordance with manufacturer's recommendations to provide a sealed concrete surface acceptable to Consultant.
- .4 Upon acceptance, mock-up shall serve as a minimum standard of quality for the balance of the work of this Section.

.3 Pre-installation meetings: Arrange with manufacturer's representative and Consultant to inspect substrates, and to review mock-up and installation procedures 48 hours in advance of installation.

1.4 **SITE CONDITIONS**

.1 Do not install the work of this Section outside of environmental ranges as recommended by the manufacturer without Product manufacturer's written acceptance and as follows:
- .1 Relative Humidity: In accordance with manufacturers' requirements.
- .2 When no dust is being raised.
- .3 In well-ventilated and broom clean areas.

.2 Install temporary protection and facilities to maintain the Product manufacturer's, and the above specification, environmental requirements for 24 hours before, during, and 24 h after installation.

.3 Post do not enter and appropriate warning signs at conspicuous locations.

1.5 **DELIVERY, STORAGE, AND HANDLING**

.1 Store materials at site in an area specifically set aside for purpose that is locked, ventilated, and maintained at a minimum temperature of 16°C.

.2 Ensure that health and fire regulations are complied with in storage area, and during handling and application.

2 Products

2.1 **MATERIALS**

.1 All materials under work of this Section, including but not limited to, sealers and coatings are to have low VOC content limits.

2. Each material used in the application of each flooring system shall be as recommended or manufactured by the supplier of the flooring system.

.3 Concrete floor sealer: Alkali-silicate, water-soluble, inorganic concrete hardener and dustproofer; 'MasterKure HD 200WB' by Master Builders Solutions or 'Sikafloor 3S' by Sika Canada Inc.

3 Execution

3.1 **EXAMINATION**

.1 Verify condition of previously installed Work upon which this Section depends. Report defects to Consultant. Commencement of work of this Section means acceptance of existing conditions.

.2 Test surfaces for moisture content to ensure that they are suitable for application.

3.2 PREPARATION

.1 Prepare substrate in accordance with manufacturer's written instructions. Diamond grind and vacuum substrate free of debris and dust.

.2 Project adjacent surfaces from damage resulting from work of this Section. Mask and/or cover adjacent surfaces, fixtures, and equipment as necessary.

.3 Clean surfaces to be sealed as recommended by sealer manufacturer.

3.3 APPLICATION

.1 Apply concrete floor sealer in accordance with manufacturer's written instructions. Sealer manufacturer shall supervise application.

.2 Spray apply concrete sealer to entire surface and keep from drying for 30 minutes as recommended by manufacturer.

.3 Sprinkle surface with water as sealer begins to penetrate (after 30 minutes).

.4 Flush surface with water and drying begins to remove excess material. Allow to harden for 24 hours.

.5 Lightly buff floor with a commercial floor buffer and non-aggressive pad to bring up required sheen.

.6 Apply second coat of concrete sealer following same procedures as first layer.

3.4 CLEANING

.1 Remove promptly as work progresses spilled or spattered materials from surfaces of work performed under other Sections. Clean floors on completion of work. Do not mar surfaces while removing.

3.5 PROTECTION

.1 Erect barriers to prevent the entry and presence of personnel not performing work of this Section during application of floor sealer, and for 48 hours following completion of application.

END OF SECTION

1 General

1.1 **SECTION INCLUDES**

.1 Labour, Products, equipment and services necessary for tile carpet work in accordance with the Contract Documents.

1.2 **REFERENCES**

.1 Canadian Carpet Institute (CCI), Contract Carpet Manual, No. 001.

1.3 **SUBMITTALS**

.1 Product data:
- .1 Submit two copies of manufacturer's Product data for each product specified in accordance with the Conditions of the Contract indicating:
  - .1 Performance criteria, characteristics, and limitations.
  - .2 Product transportation, storage, handling and installation requirements.

.2 Shop drawings: Submit shop drawings indicating carpeted floor areas, carpet selection, pile direction, location and direction of seams, cross joints, and other details required by Consultant to clarify work in accordance with the Conditions of the Contract.

.3 Samples: Submit duplicate 300 mm square pieces of each type carpet specified, 150 mm lengths of moulding in accordance with the Conditions of the Contract.

.4 Certification:
- .1 Submit certification that tile carpet has been tested and passed the Indoor Air Quality (IAQ) Carpet Testing Program requirements of the Canadian Carpet Institute.
- .2 Four weeks after Notification of Award, Submit certification from carpet manufacturer that carpet has been ordered.
- .3 Submit program parameters for recycling.

.5 Closeout submittals: Submit maintenance and cleaning data for incorporation into Operations and Maintenance Manuals in accordance with the Conditions of the Contract.

1.4 **SITE CONDITIONS**

.1 Do not install work of this Section when the ambient air and surface temperature is below 18^0C or above 40^0C without Consultant's and Product manufacturer's written acceptance.

.2 Supply and install temporary protection and facilities to maintain Product manufacturer's, and above specified environmental requirements for 24 hours before, during, and 24 hours after installation.

1.5 **MAINTENANCE**

.1 Submit extra 3% each colour, pattern and type of flooring material required for maintenance use. Extra materials to be from same production run as installed materials and clearly labelled. Provide in one continuous full width roll. Store where directed.

.2 Upon completion of the work of this Section, bundle and wrap all large remnant pieces of carpet tile remaining and store where directed by Consultant.

2 Products

2.1 **MATERIALS**

.1 General: All materials under work of this Section, including but not limited to, adhesives are to have low VOC content limits.

.2 Carpet tile **(CPT)**: Refer to Room Finish & Colour Schedule for carpet tile types.

.3 Seaming tape: Types recommended by carpet tile manufacturer for purpose intended.

.4 Adhesive: Non-release type: recommended by carpet tile manufacturer for direct glue down installation, low odour, free of volatile hydrocarbons such as toluene and mineral spirits.

.5 Reducing edge strips, thresholds: Nitrile rubber plasticized vinyl, 80-95 Shore A Durometer, adhesive as recommended by manufacturer.

.6 Carpet protection: Non-staining heavy duty kraft paper.

.7 Base: In accordance with Section 09 65 16.

.8 Concrete skim coat compound: High-performance, rapid-setting cement based skim coating compound. 'Ultra SkimCoat' by Mapei or approved alternative by Ardex or Laticrete for filling minor voids and leveling existing substrate.

3 Execution

3.1 **EXAMINATION**

.1 Verify condition and dimensions of previously installed Work upon which this Section depends. Report defects to Consultant. Commencement of work of this Section means acceptance of existing conditions.

3.2 **PREPARATION**

.1 Verify substrate surfaces are solid, free from surface water, dust, oil, grease, scaling or laitance, projections and other foreign matter detrimental to performance.

.2 Repair depressions and cracks with latex base compound or water putty crack filler. Sweep and vacuum surfaces before laying carpet.

.3 Pre-condition carpeting following manufacturer's printed instructions.

3.3 CARPET TILE INSTALLATION

.1 Install floor carpet in accordance with pattern layout and reviewed shop drawings, manufacturer's printed instructions and in accordance with Contract Carpet Manual, Standard for Installation of Textile Floor covering Materials No. 001.

.2 Cut and install carpet to fit tightly and neatly around perimeter of carpeted areas, around permanent fixtures and around projections through the floor.

.3 Adhesive method:
- .1 Apply adhesive and install carpeting in accordance with manufacturer's written instructions by direct glue-down method.
- .2 Spread full bed of adhesive evenly over substrate surfaces and install carpet tile over adhesive. Roll carpet with approved type roller to remove air pockets, ripples and other defects.

.4 Butt all carpet tiles to tight contact to make all joints as inconspicuous as possible.

.5 Finish installation to present smooth wearing surface free from mis-alignment, lifting, burring and other faults.

.6 Use material from same dye lot. Ensure colour, pattern and texture match within any one visual area. Maintain constant pile direction.

.7 Continue carpeting through passageways and extend carpet into recesses, such as closets, and under movable casework, equipment and other movable items.

.8 Terminate carpeting at centerline of door, in closed position, in openings where adjacent floor finish or colour is dissimilar.

.9 Install base in accordance with Section 09 65 16.

.10 Transitions and nosings: Refer to Colour and Material Schedule.

3.4 CLEANING AND PROTECTION

.1 Vacuum carpets clean immediately after completion of installation. Protect traffic areas.

.2 Prohibit traffic on carpet until adhesive is cured.

END OF SECTION

1 General

1.1 **SECTION INCLUDES**

.1 Design, Labour, Products, equipment and services necessary for acoustical panels work in accordance with the Contract Documents.

1.2 **REFERENCES**

.1 ASTM A653, Standard Specification for General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot Dip Process.

1.3 **SUBMITTALS**

.1 Product data:
- .1 Submit duplicate copies of manufacturer's Product data in accordance with the Conditions of the Contract indicating:
  - .1 Performance criteria, compliance with appropriate reference standard(s), characteristics, limitations, and trouble-shooting protocol.
  - .2 Product transportation, storage, handling and installation requirements.

.2 Shop Drawings:
- .1 Submit Shop Drawings in accordance with the Conditions of the Contract indicating:
  - .1 Elevations, sections, details, materials, dimensions, and finishes.

.3 Samples:
- .1 Submit following samples in accordance with the Conditions of the Contract.
  - .1 Two 300 x 300 mm samples of each acoustical panel unit required, showing full range of exposed texture to be expected in completed work and one 300 x 300 mm sample for each finish and/or colour.

.4 Closeout submittals:
- .1 Submit following for panels incorporation into Operations and Maintenance Manuals in accordance with the Conditions of the Contract:
  - .1 Performance criteria and maintenance data.

1.4 **QUALITY ASSURANCE**

.1 Installers qualifications: Perform work of this Section by a company that has a minimum of five years proven experience in the installation of acoustical panel units of a similar size and nature and that is approved by manufacturer. Submit to Consultant, applicator's current certificate of approval by the material manufacturer as proof of compliance.

.2 Mock-up:
- .1 Construct one 3 m^2 mock-up of acoustical panels in location acceptable to Consultant.
- .2 Arrange for Consultant's review and acceptance, allow 48 hours after acceptance before proceeding with work.

.3 Mock-up may remain as part of Work if accepted by Consultant. Remove and dispose of mock-ups which do not form part of Work.

.4 Upon acceptance, mock-up shall serve as a minimum standard of quality for the balance of the work of this Section.

1.5 **DELIVERY, STORAGE, AND HANDLING**

.1 Prevent soiling, physical damage or wetting.

.2 Store cartons open at each end to stabilize moisture content and temperature.

1.6 **SITE CONDITIONS**

.1 Do not install work of this Section outside of following environmental ranges without Consultant's and Product manufacturer's written acceptance:

.1 Ambient air and surface temperature: 13^0C to 21^0C.

.2 Precipitation: None.

.3 Relative Humidity: 65 to 75%

.2 Do not install acoustical panels until building is closed in and HVAC system is operational.

.3 Supply and install temporary protection and facilities to maintain Product manufacturer's, and above specified environmental requirements for 24 hours before, during, and 24 hours after installation.

1.7 **MAINTENANCE**

.1 Submit extra 3% of gross area covered, for each pattern and type specified. Submit Products from same production run as installed products. Store maintenance Products as directed by Consultant.

2 Products

2.1 **MATERIALS**

.1 General:

.1 All materials under work of this Section, including but not limited to, adhesives and touch-up paints are to have low VOC content limits.

.2 All dimensional lumber used to be FSC certified.

.3 Material to be sourced regionally from within 800 km of jobsite wherever possible.

.2 Acoustical wall panel (AWP): Refer to Room Finish and Colour Schedule for wall panels.

.3 Acoustical suspended panel (ACP): Refer to Room Finish and Colour Schedule for ceiling panels.

.4 C-channels and furring strips: Break formed or roll formed, of minimum 1.52 mm core thickness steel, coated to ASTM A653/A653M, Z275 coating designation, profiled to accept thickness of panels specified and wall panel with structural attachment to building frame.

.5 Fasteners: Concealed, stainless steel Type 304.

2.2 **FABRICATION**

.1 Verify dimensions of existing work before commencing fabrications and report discrepancies to Consultant.

.2 Fabricate work in accordance with Contract Drawings and reviewed shop drawings. Fabricate, fit and assemble work in shop where possible. Where shop fabrication is not possible, make trial assembly in shop.

.3 Fabricate work free from defects impairing function, appearance, strength and durability.

3 Execution

3.1 **EXAMINATION**

.1 Verify condition and dimensions of previously installed Work upon which this Section depends. Report defects to Consultant. Commencement of work of this Section means acceptance of existing conditions.

3.2 **INSTALLATION**

.1 Install panels, support and anchoring system, fasteners, trim and related items to lines and elevations indicated and in strict accordance with reviewed shop/erection drawings and manufacturer's printed instructions. Carefully co-ordinate work with other Sections.

.2 C-channels and furring: Install support system true and plumb in order to provide proper support for acoustical panels.

.3 Install Panels to Shop Drawings and manufacturer's printed instructions. Damaged panels, waviness, warp or distortion of finished work will not be accepted.

.4 Cover field cut edges by means of trim or other moldings.

3.3 **CLEANING**

.1 Clean exposed surfaces of acoustical panel, trim, moldings and suspension members to comply with manufacturer's instructions for cleaning.

.2 Touch up any minor finish damage.

.3 Remove and replace work which cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

3.4 PROTECTION

.1 Protect installed work from damage due to subsequent construction activity, including temperature and humidity limitations and dust control, so that the work will be without damage and deterioration at the time of acceptance by the Owner.

END OF SECTION

1 General

1.1 **SECTION INCLUDES**

.1 Labour, Products, equipment and services necessary for painting Work in accordance with the Contract Documents.

1.2 **REFERENCES**

.1 Master Painters Institute (MPI), Painting Specification Manual.

.2 SSPC Steel Structures Painting Council, Standards.

1.3 **SUBMITTALS**

.1 Product data:
- .1 Submit copies of manufacturer's Product data in accordance with the Conditions of the Contract indicating:
  - .1 Performance criteria, compliance with appropriate reference standard, characteristics, limitations.
  - .2 Product transportation, storage, handling and installation requirements.
- .2 Submit listing of manufacturer's Product types, Product codes, and Product names, number of coats, and dry film thicknesses, corresponding to each Painting Schedule code; submit listing minimum of 8 weeks before materials are required.
- .3 If requested, submit a list of all painting materials to the Consultant and the Paint Inspection Agency for review prior to ordering materials. If requested, provide an invoice list of all paint materials ordered for project work to Paint Inspection Agency indicating manufacturer, types and quantities for verification and compliance with specification and design requirements.

.2 Samples:
- .1 Submit following samples in accordance with the Conditions of the Contract.
  - .1 Three 300 x 150 mm draw downs of each colour minimum 4 weeks before paints are required.
  - .2 Identify each sample with Contract number and title, colour reference, sheen, date, and name of applicator.

.3 Certificates:
- .1 Submit certification from paint manufacturer, on company letterhead, indicating each product proposed for use is Manufacture's premium grade, first line Product.
- .2 Submit certified documentation to confirm each airless spray painter has minimum of 5 years experience on applications of similar complexity and scope.
- .3 Submit certified documentation to confirm each worker has Provincial Tradesman Qualification certificate of proficiency.

.4 Reports:
- .1 Submit written field inspection and test report results after each inspection.
- .2 Submit Field Quality Control test result reports for alkali content, substrate moisture, and dry film thickness.
- .3 Submit electronic moisture meter manufacturer's specifications including tolerances. Submit record of latest meter calibration to meet manufacturer's recommendations.

1.4 QUALITY ASSURANCE

.1 Finishing Work: Perform work to MPI requirements for premium grade.

.2 Supervision: Have Work supervised by a full-time qualified foreperson who has 10 years minimum experience on Contracts of similar complexity and scope.

.3 Mock-up:
- .1 Construct three 10 m^2 mock-ups of different Paint Schedule code systems, selected by Consultant, in locations acceptable to Consultant to demonstrate installation workmanship, colour, and hiding power of Products.
- .2 Obtain Consultant's acceptance in writing before proceeding with the Work of this Section.
- .3 Mock-ups may remain as part of the Work if acceptable to Consultant and will serve as a standard for similar code systems.
- .4 Repaint over mock-ups which do not form part of the Work.

.4 All painting and decorating work shall be inspected by a Paint Inspection Agency (inspector) acceptable to the specifying authority and the local MPI Accredited Quality Assurance Association. The painting contractor shall notify the Paint Inspection Agency a minimum of one week prior to commencement of work and provide a copy of the project painting specification, plans and elevation drawings (including pertinent details) as well as a Finish Schedule.

.5 All surfaces requiring painting shall be inspected by the Paint Inspection Agency who shall notify the Consultant and General Contractor in writing of any defects or problems, prior to commencing painting work, or after the prime coat shows defects in the substrate.

.6 The painting contractor shall receive written confirmation of the specific surface preparation procedures and primers used for all fabricated steel items from the fabricator / supplier to ascertain appropriate and manufacturer compatible finish coat materials to be used before painting any such work.

1.5 REGULATORY REQUIREMENTS

.1 Notify the Paint Inspection Agency on award of contract and make application for assignment of an Inspector using appropriate forms supplied by the Agency as well as provide a copy of the project painting specification, drawings, color schedule and list of proposed materials for review purposes prior to commencement of work.

.2 Fully cooperate at all times with the requirements of the Paint Inspection Agency in the performance of their duties, including providing access and assistance as required to complete inspection work.

1.6 DELIVERY, STORAGE, AND HANDLING

.1 Install correct, safe temporary storage for paint, thinner, solvents, and other volatile, corrosive, hazardous, and explosive materials in accordance with requirements of authorities having jurisdiction.

.2 Post hazard warning signage in areas of storage and mixing. Install and maintain sufficient CO_2 fire extinguishers of minimum 9 kg capacity, accessible in each storage mixing and storage areas.

.3 Maintain storage enclosures at minimum 10°C ambient temperature and to manufacturer's instructions.

1.7 SITE CONDITIONS

.1 Apply coatings under the following conditions:
- .1 Exterior coatings (except Latex): 5° C minimum.
- .2 Exterior latex coatings: 10°C minimum.
- .3 24 hours minimum after rain, frost, condensation, or dew.
- .4 When no condensation is possible (unless specifically formulated against condensation).
- .5 Interior coatings: 7°C minimum.
- .6 Relative humidity: 85% maximum.
- .7 Not in direct exposure to sun light.

.2 Maintain temperature conditions indicated above for 24 hours before, during and 24 hours after painting.

.3 Install clean plywood sheets to protect floors and walls in storage and mixing areas, from paint drips, spatters, and spills.

.4 Apply sufficient masking, clean drop cloths, and protective coverings for full protection of Work not being painted including, but not limited to, the following:
- .1 Light fixtures, fire and smoke detectors.
- .2 Sprinkler heads.
- .3 Prepainted diffusers and registers.
- .4 Prepainted equipment.
- .5 Fire rating labels and equipment specification plates.
- .6 Finished surfaces.

1.8 EXTENDED WARRANTY

.1 Furnish either the local MPI Accredited Quality Assurance Association's two (2) year warranty, or, alternatively, a 100% two (2) year Maintenance Bond - both in accordance with MPI Painting Manual requirements. The Maintenance Bond shall warrant that all painting work has been performed in accordance with MPI Painting Manual requirements.

.2 All painting and decorating work shall be in accordance with MPI Painting Manual requirements and shall be inspected by the local MPI Accredited Quality Assurance Association's Paint Inspection Agency (inspector), whether using either the MPI Accredited Quality Assurance Association's warranty, or the Maintenance Bond option. The cost for such inspections, and for either the local MPI Accredited Quality Assurance Association's Guarantee, or the Maintenance Bond, shall be included in the Base Bid Price.

1.9 **ENVIRONMENTAL PERFORMANCE REQUIREMENTS**

1. Provide paint products meeting MPI "Green Performance Standard GPS-1-05".

1.10 **MAINTENANCE**

1. Deliver to Owner's place of storage on completion of work, sealed containers of each finish painting material applied, and in each colour. Label each container as for original, including mixing formula. Provide the following:
   .1 1 L of extra materials when less than 50 L are used for Project;
   .2 3.78 L of extra stock when 50 to 200 L are used;
   .3 7.57 L of extra stock when over 200 L are used.

2 Products

2.1 **MATERIALS**

.1 Paint:
   .1 All materials under Work of this Section, including but not limited to, primers, stains, and paints are to have low VOC content limits.
   .2 Products in accordance with the MPI Painting Specification Manual, Exterior and Interior Systems;
      .1 Manufacture's premium grade, first line Products is to be use.
      .2 Uniform dispersion of pigment in a homogeneous mixture.
      .3 Ready-mixed and tinted whenever possible.
   .3 Products within each MPI paint system code: From single manufacturer.
   .4 Acceptable manufacturers:
      .1 Benjamin Moore.
      .2 Dulux Paints/PPG.
      .3 Para Painting & Coatings.
      .4 Sherwin Williams.

2.2 **COLOUR SCHEDULE**

.1 Consultant will select choice of colours and gloss when compiling a Colour Schedule after award of Contract; allow for colour selection beyond paint manufacturer's standard colour range.

.2 Refer to Colour Schedule for selected colour references.

.3 Conform to gloss reflectance definitions listed in MPI Specification Manual.

2.3 PAINTING AND FINISHING SCHEDULE

.1 Refer to Table 1, MPI Painting and Finishing Schedule coded systems, comply with MPI Painting Specification Manual.

Table 1: Painting and Finishing Schedule

EXTERIOR SUBSTRATES	Typical substrates (Including but not limited to)	MPI Manual Ref.	MPI Finish System Code	Sheen	Topcoat
Galvanized steel	HM doors & frames	EXT 5.3	EXT 5.3B	-	Alkyd
INTERIOR SUBSTRATES	Typical substrates (Including but not limited to)	MPI Manual Ref.	MPI Finish System Code	Sheen	Topcoat
Structural Steel and metal deck		INT 5.1	INT 5.1C	Flat	Latex Dryfall
Concrete block masonry		INT 4.2	INT 4.2A	Semi-gloss	Latex
Galvanized metal	HM doors & door frames	INT 5.3	INT 5.3B	Semi-Gloss	WB light industrial coating
Wood paneling & casework	Partitions, panels, millwork	INT 6.4	INT 6.4C	Satin	Semi-transparent stain
Wood paneling & casework	Partitions, panels, millwork	INT 6.4	INT 6.4E	Satin	Poly-urethane
Gypsum board,	Drywall, walls	INT 9.2	INT 9.2A	Satin	Latex
Gypsum board,	Wet areas	INT 9.2	INT 9.2F	Semi-Gloss	Epoxy-modified latex
Gypsum board,	Ceilings	INT 9.2	INT 9.2A	Flat	Latex

3 Execution

3.1 **EXAMINATION**

.1 Verify condition of previously installed Work upon which this Section depends. Report defects to Consultant. Commencement of Work means acceptance of existing conditions.

3.2 **PREPARATION**

.1 General:
- .1 Clean substrate surfaces free from, dust, grease, soiling, or extraneous matter, which are detrimental to finish.
- .2 Patch, repair, and smoothen minor substrate defects and deficiencies e.g. machine, tool and sand paper marks, shallow gouges, marks, and nibs.
- .3 Clean, sweep, and vacuum floors and surfaces to be painted, debris and dust-free prior to painting.
- .4 Refer to MPI Painting Specification Manual for surface preparation requirements of substrates not listed here.

.2 Where finish hardware has been installed remove, store, re-install finish hardware, to accommodate painting. Do not clean hardware with solvent that will remove permanent lacquer finishes.

.3 Alkali Content tests and neutralization:
- .1 Test for ph level using litmus paper on dampened substrate.
- .2 Neutralize surfaces over 8.5 ph with 4% solution of Zinc Sulphate for solvent based systems and tetrapotassium pyrophosphate for latex based systems, to below 8.0 ph, and allow to dry.
- .3 Brush-off any residual Zinc Sulphate crystals.
- .4 Coordinate paint system primer / sealer to be alkali-resistant.

.4 Substrate moisture tests:
- .1 Test for moisture content over entire surface to be painted, minimum one test/ 2 m^2 in field areas and one test/600 mm along inside corners including at ceiling to wall juncture.
- .2 If any test registers above 10% allow entire substrate surfaces, within the plane, to dry further before paint system application. Install temporary drying fans if necessary.
- .3 Re-test employing same criteria.

.5 Mildew removal: Scrub with solution of trisodium phosphate and sodium hypochlorite (Javex) bleach, rinse with water, and allow to dry completely.

.6 Masonry (Concrete, block):
- .1 Allow 28 days cure before painting.
- .2 Coordinate repair of protrusion-chipping and grinding, and honeycomb filling with responsible trades.
- .3 Remove dirt, loose mortar, scale, powder, efflorescence, and other foreign matter.

.4 Remove form oil and grease with trisodium phosphate, rinse, and allow to dry thoroughly.
.5 Remove rust stains with solution of sodium metasilicate after thorough wetting; allow to dry thoroughly.

.7 Galvanized steel sheet:
.1 Z275 (Satin & Spangled Sheet): SSPC SP7 brush blast.
.2 ZF075 (Wiped Coat): Remove contamination, wash with Xylene solvent.
.3 Touch-up damaged galvanized areas with organic zinc rich primer.

.8 Galvanized iron and steel: Prepare galvanized and ungalvanized metal surfaces as follows:
.1 Unpassivated, unweathered and weathered: Remove contamination, wash with Xylene or Toluol solvent, allow to dry thoroughly. Make paint system primer/sealer an etching type primer.
.2 Manufacturer pre-treated (including passivated): SSPC SP7.
.3 Touch-up damaged galvanized areas with organic zinc rich primer.

.9 Structural steel and miscellaneous metal fabrications:
.1 Coordinate the following with the responsible trades:
.1 Rust, mars, mill scale, and weld-burn touch-ups.
.2 Oil, grease, weld flux and other residue removal.
.2 Prime paint items, not otherwise indicated to be primed as part of another Section.
.3 Touch-up damaged galvanized areas with organic zinc rich primer.

.10 Wood and Millwork:
.1 Wood surfaces to be clean and dry with a moisture content of less than 15%.
.2 Remove foreign matter prior to prime coat; spot coat knots, pitch streaks and sappy sections with sealer.
.3 Fill nail holes and fine cracks after primer has dried.
.4 Backprime interior and exterior woodwork.

.11 Factory primed surfaces:
.1 Touch up damaged areas.
.2 Clean as required for top coat.

.12 Gypsum board:
.1 Apply primer/sealer paint to reveal defects and deficiencies and to equalize absorption areas.
.2 Coordinate repairs and touch-ups with the responsible trade.
.3 Re-prime repairs.

.13 Coordinate with other trades to prevent:
.1 Damage, and inadvertent activation of fire and smoke detectors.
.2 Odour and dust distribution by permanent HVAC systems including fouling of ducts and filters.

.14 Field-mix Products in accordance with manufacturer's written instructions.

3.3 APPLICATION

.1 Apply painting systems in accordance with the MPI Painting Specification Manual. Apply each Product to manufacturer's recommended dry film thickness.

.2 Painting systems listed are required minima, apply additional coats if necessary to obtain substrate hiding acceptable to the Consultant.

.3 Tint intermediate coats lighter than final top coats for identification of each succeeding coat and to facilitate inspections. Include only manufacturer's recommended reducing and tinting accessories. Do not add adulterants.

.4 Primer to be specialized primer coating system as required by manufacturer for selected colour. Standard primer being tinted shall be tinted to a maximum of 1.5% by volume.

.5 Sand lightly between coats to achieve a tooth or anchor for subsequent coats.

.6 Unless otherwise approved by the painting inspection agency, apply a minimum of four coats of paint where deep or bright colours are used to achieve satisfactory results.

.7 Apply paint uniformly in thickness, colour, texture, and gloss, as determined by the Consultant under adequate illumination and viewed at a distance of 1500 mm. Apply finishes free of defects in materials and application which, in the opinion of the Consultant, affect appearance and performance. Defects include, but are not limited to:
- .1 Improper cleaning and preparation of surfaces.
- .2 Entrapped dust, dirt, rust.
- .3 Alligatoring, blisters, peeling.
- .4 Scratches, blemishes.
- .5 Uneven coverage, misses, drips, runs, and poor cutting in.

.8 Do not apply coatings on substrates which are not sufficiently dry. Unless indicated otherwise, allow each painting system coat to cure dry and hard before following coats are applied.

.9 Repaint entire areas of damaged or incompletely covered surfaces, to the nearest inside or outside corner; patching will not be permitted.

.10 Miscellaneous painting requirements:
- .1 Paint projecting ledges, and tops, bottoms and sides of doors both above and below sight lines to match adjacent surfaces.
- .2 Paint door frames, access doors and frames, door grilles, prime coated butts, and prime coated door closers to match surface in which they occur.
- .3 Finish closets and alcoves as specified for adjoining rooms.
- .4 Paint light coves white whether a light lense is installed or not, unless otherwise indicated.
- .5 Paint interior columns to match walls of room.
- .6 Allow for:
  - .1 2 wall colours per room, one ceiling colour per room.
  - .2 Different door colours in each functionally different area.
  - .3 Different colours on both sides of same door.

.11 Mechanical, electrical and other painting coordination:
- .1 Paint mechanical services in accordance with Mechanical Identification Division 21, 22 and 23.
- .2 Coordinate painting of pipes, ducts, and coverings with the Work of Division 21, 22 and 23 to precede pipe colour banding, flow arrows, and other pipe identification labeling installation.
- .3 Paint exposed conduit, pipes, hangers, ductwork, grilles, gratings, louvres, access panels, fire hose cabinets, registers, convector and radiator covers, enclosures, and other mechanical and electrical equipment including services concealed inside cupboard and cabinet Work; apply colour and sheen to match adjacent surfaces, except as noted otherwise.
- .4 Paint portions of surfaces such as duct interiors, piping, ductwork, hangers, insulation, walls, and similar items, visible through grilles, louvres, convector covers etc., matte black in colour.
- .5 Remove the following to accommodate painting, carefully store, clean, then re-install on completion of each area and when dry:
  - .1 Switch and receptacle plates, fittings and fastenings, grilles, gratings, louvres, access panels, convector covers, and enclosures .

3.4 FIELD QUALITY CONTROL

.1 Dry film thickness tests:
- .1 Test for film thickness over entire surface to be painted, minimum one test/2 m^2 in field areas and one test/600 mm along inside corners including at ceiling to wall juncture.
- .2 If any test registers below specified thickness, re-apply paint to entire surface to nearest inside and outside corners.
- .3 If test registers more than 50% above specified thickness, consult with paint manufacturer, determine if problem exists, offer solutions to Consultant, and repair as directed.
- .4 Re-test employing same criteria after repair.

3.5 CLEANING

.1 Remove spilled, splashed, and spattered paint promptly as Work proceeds and on completion of Work. Clean surfaces soiled by paint spillage and paint spatters. Repair or replace damaged Work, as directed by Consultant.

3.6 PROTECTION

.1 Post Wet Paint signs during drying and restrict or prevent traffic where necessary.

.2 Post sign, after Consultant's inspection and acceptance of each room, reading: PAINTING COMPLETE - NO ADMITTANCE WITHOUT CONTRACTOR'S PERMISSION.

END OF SECTION

1 General

1.1 **SECTION INCLUDES**

.1 Design, labour, Products, equipment and services necessary for demountable partition work in accordance with the Contract Documents.

1.2 **REFERENCES**

.1 AAMA 611, Voluntary Standards for Anodized Architectural Aluminum.

.2 AAMA CW-10, Care and Handling of Architectural Aluminum from Shop to Site.

.3 ANSI, H35.1M Alloy and Temper Designation Systems for Aluminum (Metric).

.4 ASTM A653/A653M, Specification for Steel Sheet, Zinc-coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvanealed) by the Hot-Dip Process.

.5 ASTM B209M, Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

.6 ASTM B221M, Specification for Aluminum-Alloy Extruded Bars, Rods, Wires, Shapes and Tubes.

.7 ASTM C1396, Specification for Gypsum Board.

.8 ASTM C645, Specification for Non-Load Bearing (Axial) Steel Studs, Runners (Tracks), and Rigid Furring Channels for Screw Application of Gypsum Board.

.9 ASTM E90, Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.

.10 ASTM F738M, Specification for Stainless Steel Metric Bolts, Screws, and Studs.

1.3 **DESIGN REQUIREMENTS**

.1 Demountable partition system to be 89 mm wide, with flush joints, system components, door frames, wood doors, glazed openings, and all trim components.

.2 Design partition system to provide an STC of 35 when tested in accordance with ASTM E90.

.3 Design partition system to allow for all panels to be point accessible without affecting adjoining panels.

1.4 **SUBMITTALS**

.1 Product data:
- .1 Submit copies of manufacturer's Product data in accordance with the Conditions of the Contract indicating:
  - .1 Performance criteria, compliance with appropriate reference standard, characteristics, and limitations.

.2 Product transportation, storage, handling and installation requirements.

.2 Shop drawings:
.1 Submit shop drawings in accordance with the Conditions of the Contract indicating:
.1 Location, construction, adjacent construction, elevations, sections, panel sizes, interior structure and/or reinforcement, door and glazing modules, frame details, trim, connection to ceiling grid system, details, anchorages, dimensions, thickness, joints, and finishes.

.3 Samples:
.1 Submit following samples in accordance with the Conditions of the Contract.
.1 Two 300 x 300 mm samples of finishes applied to gypsum board.
.2 One 300 mm long sample of door frames, glazing framing and trim.
.3 One of each component used in the partition system i.e. ceiling fixing device and other component parts.

1.5 QUALITY ASSURANCE

.1 Installers qualifications: Perform work of this Section by a company that has a minimum of five years proven experience in the installation of demountable partition systems of a similar size and nature and that is approved by manufacturer. Submit to Consultant, applicator's current certificate of approval by the material manufacturer as proof of compliance.

.2 Mock-up:
.1 Construct a mock-up of at least 4 panels in location acceptable to Consultant.
.2 Arrange for Consultant's review and acceptance, allow 48 hours after acceptance before proceeding with work.
.3 Mock-up may remain as part of Work if accepted by Consultant. Remove and dispose of mock-ups which do not form part of Work.
.4 Upon acceptance, mock-up shall serve as a minimum standard of quality for the balance of the work of this Section.

1.6 SITE CONDITIONS

.1 Do not begin work of this Section until:
.1 Floor and ceiling finishes are complete.
.2 Substrate and ambient temperature is above 15^0C.
.3 Relative humidity is below 80 %.

.2 Install temporary protection and facilities to maintain Product manufacturer's, and above specification, environmental requirements 48 h before, during, and 48 h after installation.

1.7 DELIVERY, STORAGE, AND HANDLING

.1 Handle aluminum in accordance with AAMA CW-10.

.2 Protect aluminum surfaces with strippable coating. Do not use adhesive papers or sprayed coatings which bond when exposed to sunlight or weather. Do not remove before final cleaning of building.

2 Products

2.1 **ACCEPTABLE PRODUCT(S) AND MANUFACTURER(S)**

.1 'Elite Glazing Wall System' by PC350 or approved alternative.

2.2 **MATERIALS**

.1 Galvanized steel sheet: ASTM A653/A653-M, Z275; cold rolled, galvanized steel sheet.

.2 Aluminum extrusions: ASTM B221 and ANSI H35.1 AA6063 alloy, T5 temper.

.3 Aluminum sheet: ASTM B209 and ANSI H35.1 AA1100 aluminum alloy, H14 temper, minimum 3.0 mm thick.

.4 Top track: ASTM C645; cold rolled channels, formed from galvanized steel sheet, designed to accept snap-on trim from either side of wall.

.5 Bottom track: ASTM C645; roll formed from galvanized steel sheet, with 38 mm high legs.

.6 Steel studs and runners: ASTM C645; 'U' shape, roll formed from galvanized steel sheet, 0.6 mm thick minimum, pre-punched openings for system elements, configured to meet panel system requirements, depth as indicated on Contract Drawings.

.7 Cross locking Channels: ASTM C645; 3350 mm long, roll formed from galvanized steel channels.

.8 Sliding doors: Standard profile extruded aluminum frame with 6 mm thick glazing, hardware to provide smooth, gentle soft close glide and come with braking mechanism and seal, in size shown on drawings. Door pull handle to be selected by Consultant.

.9 Glazing frames: Extruded aluminum, complete with snap-on glazing stops and neoprene gaskets for setting glass.

.10 Glazing: In accordance with Section 08 80 00.

.11 Finish hardware: In accordance with Section 08 70 00.

.12 Trim: Aluminum, colour to match frames.

.13 Fasteners: ASTM F738M; Stainless Steel Type 304.

2.3 **FINISHES**

.1 Aluminum finish: Clear anodized to AAMA 611 per Aluminum Association Designation System for Aluminum Finishes AA-M12C22A41.

3 Execution

3.1 **EXAMINATION**

.1 Verify condition and dimensions of previously installed Work upon which this Section depends. Report defects to Consultant. Commencement of work of this Section means acceptance of existing conditions.

3.2 **INSTALLATION**

.1 Install demountable partition system in accordance with reviewed Shop Drawings and manufacturer's written instructions.

.2 Install partition system on top of floor finish and accurately fitting to suspended ceiling.

.3 Erect partitions plumb, square, straight, rigid, and with horizontal lines level. Accurately fit and fasten to abutting surfaces.

.4 Provide reinforcement and bracing wherever necessary to assure lateral stability.

.5 Coordinate with mechanical and electrical trades for all services required to be built into partition system.

.6 Fasten runners to floors, ceiling and abutting vertical surfaces at 600 mm o.c. At ceilings, use fasteners that rigidly support partition without damaging or defacing ceiling panels or grid members. At carpets, use fasteners that rigidly support partition without damaging or defacing carpet.

.7 Fasten floor track to substrate at both sides of door frames.

.8 Install continuous light/sound seal at junction between partition system and ceilings, floors, and adjacent abutting surfaces.

.9 Install studs vertically in floor and ceiling track at 600 mm. Install three cross channels per stud.

.10 Install panel clips and hang panels on framework taking care to seat all panel clips on cross channels.

.11 Glaze partition system in accordance with Section 08 80 00.

.12 Install finish hardware in accordance with Section 08 70 00.

.13 Install ceiling trims, base moulding, corners, and other trim to provide a complete system.

.14 The complete installation shall be free of exposed screws or other fasteners, with surfaces free of tool marks, scratches or any other marred surface detrimental to appearance.

3.3 **CLEANING**

.1 Upon completion of work of this section, remove strippable coatings, clean surfaces, and adjust doors for proper operation.

END OF SECTION

1 General

1.1 **SECTION INCLUDES**

.1 Labour, Products, equipment and services for washroom accessories Work in accordance with the Contract Documents.

1.2 **REFERENCES**

.1 ASTM A167, Specification for Stainless Steel and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.

.2 ASTM A312, Specification for Seamless and Welded Austenitic Stainless Steel Pipes.

.3 ASTM A653/A653M, Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvanealed) by the Hot-Dip Process.

.4 CAN/CSA B651-M, Barrier Free Design.

1.3 **SUBMITTALS**

.1 Product data: Submit Product data to requirements of the Conditions of the Contract indicating each washroom accessory describing size, finish, details of function, attachment methods, hardware and locks, description of rough-in frame, and building-in details of anchors for grab bars.

1.4 **DELIVERY, STORAGE AND HANDLING**

.1 Deliver materials in sealed cartons and containers with manufacturer's name and product description clearly marked.

1.5 **EXTENDED WARRANTY**

.1 Submit a warranty for washroom accessories Work in accordance with the General Conditions, except that the warranty period is extended to 10 years.
- .1 Against cracked or scratched mirrors, spoiling or deterioration of silvering or backing, loosening of fastenings or adhesive
- .2 Coverage: complete replacement including effected adjacent Work.

2 Products

2.1 **MATERIALS**

.1 Stainless steel:
- .1 Sheet metal: ASTM A167, Type 304.
- .2 Tubing: ASTM A312, Type 304.

.2 Sheet steel: ASTM A653M, Z275; Cold rolled, commercial quality, surface preparation and pretreatment as required for applied finish.

.3 Fasteners, screws and bolts: ASTM A167, Type 304 stainless steel, tamper-proof.

2.2 ACCESSORIES

.1 The following Products are by Bobrick Washroom Equipment of Canada Ltd. except where noted. Quantity and location of accessories as shown on Contract Drawings. Equivalent Products from ASI/Watrous and Bradley are acceptable.

.2 Supplied by School Board and installed by Contractor:
- .1 Toilet paper dispenser, single and double types where required;
- .2 Paper towel dispenser;
- .3 Soap dispenser;
- .4 Hand sanitizer dispenser;
- .5 Feminine hygiene dispenser;
- .6 Garbage cans.

.3 Hand Dryer (HD):
- .1 #B-748-Eclipse Model by Bobrick; surface mounted, automatic hand dryer by Bobrick or approved alternative, one-piece, deep-drawn, steel cover, motor shall be 1/10 hp with sealed ball bearings and automatic thermal overload, automatic sensor with shut off after 1-1/2 min if covered by inanimate object, after removed unit will automatically reset.
- .2 Hand dryer unit to have 115V AC, 20 Amp, 2300 Watts and 50/60 Hz.
- .3 Finish: Chrome-plated cover.

.4 Mirror (M): 6 mm thick, mirror quality tempered glass with type 304 stainless steel frame in satin finish. Corners to be heliarc welded, ground and polished smooth.
- .1 Welded frame mirror: #B-290 Series, 457 mm x 914 mm.

.5 Grab Bars: 38 mm diameter, 1.2 mm thick, concealed mounting with snap flange, complete with escutcheons, type 304 stainless steel with a satin finish and peened grip in the following configurations:
- .1 GB1: 762 mm long horizontal and vertical legged "L" shaped grab; Series 6806.99-L30x30 by Bobrick Washroom Equipment of Canada or approved alternative.
- .2 GB2: 610 mm long straight grab bar; Series B-6806.99 by Bobrick Washroom Equipment of Canada or approved alternative.

.6 Coat hook (CH):
- .1 B-983; 30 mm projection from back plate.
- .2 Finish: Type 304 stainless steel, satin finish.

.7 Sanitary napkin disposal (SND):
- .1 #B-254 by Bobrick or #0473-1A by ASI Group Canada; Surface mounted, top hung upper door with multi-staked piano hinge, surface mounted stainless steel wall box and waste receptacle, full length stainless steel hinge. Receptacle capacity: 5.7 L.
- .2 Finish: All exposed edges Type 304 stainless steel with satin finish.

.8 Stainless steel shelf:
- .1 #B-295 x 16; shelf fabricated from 1.2 mm thick stainless steel with 25 mm return edge and front edge hemmed for safety.
- .2 Shelf complete with brackets fabricated from 1.6 mm thick stainless steel.
- .3 Size: 127 mm wide x 400 mm length.
- .4 Finish: Type 304 stainless steel, satin finish.

3 Execution

3.1 **INSTALLATION**

.1 Verify and coordinate templates, inserts, and rough-in frames and verify exact location of washroom accessories for installation.

.2 Verify there is adequate supports and/or blocking in gypsum wall assemblies prior to installation of washroom accessories.

.3 Provide fastening and mounting kits for washroom accessories.

.4 Locate washroom accessories where indicated on Drawings and where directed by Consultant.

.5 Install washroom accessory fixtures, accessories, and items in accordance with manufacturer's instructions and CAN/CSA B651-M. Provide exposed tamper-proof screws of stainless steel to match units.

.6 Install washroom accessories plumb, level, and securely and rigidly anchored to substrate surfaces and framing. Adjust accessories for proper operation and verify mechanisms function smoothly.

.7 Install grab bars to withstand minimum load of 1.3 kN applied vertically or horizontally. Provide necessary reinforcements as required.

.8 Clean and polish exposed surfaces and fill accessories with necessary supplies prior to acceptance by Consultant.

END OF SECTION

1 General

1.1 **SECTION INCLUDES**

.1 Labour, Products, equipment and services necessary for lockers work in accordance with the Contract Documents.

1.2 **REFERENCES**

.1 ASTM A240, Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications

.2 CAN/CGSB-44.40, Steel Clothing Locker.

1.3 **SUBMITTALS**

.1 Product data:
- .1 Submit duplicate copies of manufacturer's Product data in accordance with the Conditions of the Contract indicating:
  - .1 Performance criteria, compliance with appropriate reference standard(s), characteristics, and limitations.
  - .2 Product transportation, storage, handling and installation requirements.

.2 Shop drawings: Submit shop drawings in accordance with the Conditions of the Contract indicating type and class of lockers, elevations, sections, dimensions, gauges, tops, bases, hooks, shelves, trim, numbering, doors, handles, anchorage and hardware, and finishes.

.3 Samples:
- .1 Submit following samples in accordance with the Conditions of the Contract.
  - .1 Two 50 x 50 Samples of colour and finish on actual base metal.

.4 Closeout submittals: Submit maintenance and cleaning instruction for incorporation into Operations and Maintenance Manuals in accordance with the Conditions of the Contract.

2 Products

2.1 **MANUFACTURED UNITS**

.1 Lockers: CAN/CGSB-44.40, half height, Type 1, Class 2, 300 mm wide x 3750 mm deep x 1525 mm high; 'Emperor' by Hadrian Manufacturing Inc., or approved alternative.

.2 Locker Construction:
- .1 Body: Minimum 0.61 mm thick steel sheet with flanged backs and rib stiffeners on sides.
- .2 Frames: Minimum 1.6 mm thick steel sheet, box channel shape, with 2 rubber door silencers on lock side of frame at approximately 38 mm from top and bottom of each door.

.3 Assembly: Knock down construction, pop-rivetted, exposed fasteners on fronts of locker doors and frames are not allowed.
.4 Top: Sloped.
.5 Bottom base: Metal base constructed of same material as body, 100mm high.
.6 Doors: Flush type construction, one-piece double-wall envelope construction, minimum 0.91 mm steel thickness, door are to be hinged on the right and swing from left to right.
.7 Door pulls: Nickel-plated steel, single point, recessed lock pocket with friction latch padlock locking system, padlock by owner.
.8 Hinges: two (2)-1.2 mm hinges welded to frame and fastened to door.
.9 Options: To CAN/CGSB-44.40, minimum 0.76 mm thick steel sheet, manufacturer's standard, trim, closures, hat shelf, and 1 double prong nickel plated coat hook.
.10 Numbering: Each door to have number plate with non-removable numerals, one number designation for each locker.
.11 Ventilation: lockers shall have provision for ventilation through face and back.
.12 Finish: High performance baked on epoxy powder coating. Colour: To be selected by Consultant. Allow for a minimum of 4 different colours.

3 Execution

3.1 **EXAMINATION**

.1 Verify condition and dimensions of previously installed Work upon which this Section depends. Report defects to Consultant. Commencement of work of this Section means acceptance of existing conditions.

3.2 **INSTALLATION**

.1 Assemble and Install lockers in accordance with reviewed shop drawings and manufacturer's written instructions.

.2 Securely fasten lockers to bases and grounds and nailing strips and to each other when in locker banks.

.3 Install trim and closures where indicated and where obstructions occur.

.4 Install locker numbers.

.5 Upon completion, test doors and adjust for ease of operation.

3.3 **CLEANING**

.1 Touch up scratches and abrasions to match original finish. Clean and polish lockers prior to final acceptance by Consultant.

END OF SECTION

1 General

1.1 **SECTION INCLUDES**

.1 Labour, Products, equipment and services necessary for miscellaneous specialties Work in accordance with the Contract Documents.

1.2 **SUBMITTALS**

.1 Product data:
- .1 Submit duplicate copies of manufacturer's Product data for each Product specified in accordance with the Conditions of the Contract indicating:
  - .1 Performance criteria, compliance with appropriate reference standard(s), characteristics, and limitations.
  - .2 Product transportation, storage, handling and installation requirements.

.2 Shop drawings: Submit shop drawings in accordance with the Conditions of the Contract indicating elevations, sections, details, dimensions, materials, gauges, and finishes.

.3 Closeout submittals: Submit cleaning and maintenance instructions for miscellaneous specialties for incorporation into Operations and Maintenance Manuals in accordance with the Conditions of the Contract.

1.3 **DELIVERY, STORAGE, AND HANDLING**

.1 Package or crate, and brace products to prevent distortion in shipment and handling. Label packages and crates, and protect finish surfaces by sturdy wrappings.

2 Products

2.1 **MANUFACTURED UNITS**

.1 Janitor's shelf with mop and broom holders and hooks:
- .1 #B-239 x 34 by Bobrick Washroom Equipment of Canada or approved alternative.
- .2 330 mm H by 205 mm deep. Shelf constructed of minimum 1.2 mm stainless steel, mop and broom holders to have spring loaded rubber cam to grip handles up to 30 mm in diameter, and stainless steel hooks positioned below shelf.
- .3 Finish: Type 304 stainless steel with satin finish.

.2 Corner guards: 75 mm x 75 mm x 90^0, vinyl snap on cover, continuous 1.8 mm aluminum retainer fabricated from 6063 aluminum alloy, system shall come complete with steel angle, fasteners and all accessories to provide a complete installation; 'SM-10/20' by C/S Group or approved alternative.

.3 Wall Protection: Acrovyn type wall cladding, 1.0 mm thick, height as shown on Drawings. Cladding shall be applied to wall with odourless adhesive. Provide colour matched wall covering accessory trim pieces: outside edge cap, joint cover, inside corner and outside corner, to suit application. Colours to later selection by Consultant.
- .1 Acroyvn Wall Covering by Construction Specialties Ltd.
- .2 Pawling Pro-Tek Wall Covering by McGill Architectural Products.

.3 Kydex Wallcovering by Kleerdex Company.

.4 Tackboard: "Tackboards" by ASI Visual Display Products or approved alternative consisting of 6 mm natural cork laminated under heat and pressure to 6 mm hardboard, clear aluminum frame; wall mounted with concealed wall hanger.

.5 Whiteboard:
- .1 Porcelain on steel laminated to 8 mm impregnated core with zinc coated backing sheet, with recessed tray and clear anodized aluminum perimeter trim with squared corners.
- .2 Colour and finish: Low gloss finish in white, 'Porcelain Surface' by ASI Visual Display Products or approved alternative.
- .3 Sizes and layout: As shown on Contract Drawings.

.6 Student Coat Racks: Wall mounted boot racks, tube shelf, 600 mm long mounting bracket, rods and end cap trims. 'STL1001' by ASI Visual Display Products or approved alternative.

3 Execution

3.1 **EXAMINATION**

.1 Verify condition and dimensions of previously installed Work upon which this Section depends. Report defects to Consultant. Commencement of Work means acceptance of existing conditions.

3.2 **PREPARATION**

.1 Verify substrate surfaces are solid, free from surface water, dust, oil, grease, projections and other foreign matter detrimental to performance.

.2 Items to be built-in: Provide information and templates required for installation of work of this Section, and assist or supervise, or both, the setting of anchorage devices, and construction of other work incorporated with products specified in this Section in order that they function as intended.

.3 Verify there is adequate supports and/or blocking in gypsum wall assemblies prior to installation of wall protection, janitor's shelf and corner guards.

3.3 **INSTALLATION**

.1 Install miscellaneous specialties level and securely and rigidly anchored to substrate in accordance with authorities having jurisdiction, reviewed shop drawings, and manufacturer's written instructions.

.2 After installation, adjust miscellaneous specialties in accordance with manufacturer's written instructions.

3.4 **CLEANING**

.1 Clean and polish exposed surfaces prior to acceptance by Consultant.

END OF SECTION

1 General

1.1 **SECTION INCLUDES**

.1 Labour, Products, equipment and services necessary for gymnasium equipment work in accordance with the Contract Documents.

1.2 **SUBMITTALS**

.1 Product data:
- .1 Submit duplicate copies of manufacturer's Product data for each Product specified in accordance with the Conditions of the Contract indicating:
  - .1 Performance criteria, compliance with appropriate reference standard(s), characteristics, and limitations.
  - .2 Product transportation, storage, handling and installation requirements.

.2 Shop drawings:
- .1 Submit shop drawings in accordance with the Conditions of the Contract indicating elevations, sections, details, dimensions, materials, gauges, and finishes.

.3 Extended warranty: Submit extended warranty signed and registered by the manufacturer providing the warranty in the name of the Owner for the timeframe and coverage specified in this Section.

.4 Closeout submittals: Submit cleaning and maintenance instructions for gymnasium equipment for incorporation into Operations and Maintenance Manuals in accordance with the Conditions of the Contract.

1.3 **DELIVERY, STORAGE, AND HANDLING**

.1 Package or crate, and brace products to prevent distortion in shipment and handling. Label packages and crates, and protect finish surfaces by sturdy wrappings.

1.4 **EXTENDED WARRANTY**

.1 Submit an extended warranty for basketball backboards in accordance with General Conditions, except that warranty period is extended to 12 years from date of Substantial Performance.
- .1 Warrant against defects and breakage from use.

2 Products

2.1 **MANUFACTURED UNITS**

.1 Gymnasium divider curtain:
- .1 Curtain to be fire and smoke rated vinyl coated polyester fabric in colour as indicated on Room Finish and Colour Schedule. Seams shall be electronically welded with a full contact weld. Upper portion of curtain shall be a vinyl coated polyester mesh.

.2 Drive system: Overhead drive system shall consist of one continuous 60 mm diameter drive tube with electric drive unit located in the centre.

.3 Electric drive unit: Shall be electrically operated by means electric winch, instant reversible torque motor, limit switches, and flush mounted UP/DOWN/STOP constant contact single 3-position switch, sealed gear case with precision ball bearings.

.4 Hoisting mechanism:

.1 Drive tube shall be supported by roller assemblies fastened to building super structure at no more than 3050 mm on centre.

.2 Cable lift drums shall be mounted on the drive tube at no more than 3050 mm on centre.

.3 A continuous 25 mm curtain support tube shall be suspended from the roller assemblies. Curtain support tube is to be fed through the top seam in the divider curtain and is to be adjustable in order to obtain a level straight top-line and the proper clearance from the floor.

.4 Lift lines shall be galvanized aircraft cable. Lift lines to be fastened to cable lift drums at the top.

.5 Each lift line shall be securely fastened at the bottom ballast-tube and travel upwards through the curtain brailing grommets to the corresponding cable lift drums.

.6 Cross cables 3 mm placed at 750 mm centres holds together walls of curtain.

.7 Bottom lifting tube is a continuous 76 mm x 3 mm wall round steel tube. As the cables lift the tube, they lift the cross cables causing the walls of the curtain to hang in folds.

.5 Acceptable product and manufacturer: Model F3500 Centre Drive Divider Curtain by Forum athletics or approved alternative.

.2 Retractable stage:

.1 Retractable stage shall be 3658 x 6096 mm sitting 610 mm above floor and shall fold into a pocket to become completely recessed. Stage shall be modular aluminum substructure complete with 16 mm plywood subfloor. Provide one set of moveable stairs with handrails on both sides.

.2 Electric motor shall be as follows:

.1 Spring loaded key switch and three limit switches.

.2 Safety device: Provide Auto-Loc safety to bring stage to a immedaite stop activated by inertia (quick jerk) and centrifugal froce (faster than normal speed).

.3 208 volt, 3 phase, 3/4 HP instant reverse motor with magnetic starter and overload protection.

.3 Wheels: 125 mm x 38 mm non-marking urethane wheels and non-marking adjustable rubber bumpers.

.4 When stage is in position the stage shall automatically lock without the use of floor locks and the rolling frame shall be in positive engagement and alignment.

.5 Front of stage shall be provided with white maple, premium grade skirt. Vertical shroud shall be paint grade plywood, primed and painted complete with support framing and hardwood corner trim. Provide removable panel at motor for access.

.6 Acceptable Systems: 'Madsen RS-2' by Sheridan Seating and Gymnasium Equipment or 'RS-1' by Gymnasium & Health Equipment Ltd.

3 Execution

3.1 **EXAMINATION**

.1 Verify condition and dimensions of previously installed Work upon which this Section depends. Report defects to Consultant. Commencement of work of this Section means acceptance of existing conditions.

3.2 **PREPARATION**

.1 Verify substrate surfaces are solid, free from surface water, dust, oil, grease, projections and other foreign matter detrimental to performance.

.2 Items to be built-in: Provide information and templates required for installation of work of this Section, and assist or supervise, or both, the setting of anchorage devices, and construction of other work incorporated with products specified in this Section in order that they function as intended.

.3 Verify there is adequate supports and/or blocking in wall assemblies prior to installation of gymnasium equipment.

3.3 **INSTALLATION**

.1 Install gymnasium equipment level and securely and rigidly anchored to substrate in accordance with authorities having jurisdiction, reviewed shop drawings, and manufacturer's written instructions.

.2 After installation, adjust gymnasium equipment in accordance with manufacturer's written instructions.

3.4 **CLEANING**

.1 Clean and polish exposed surfaces prior to acceptance by Consultant.

END OF SECTION

1 General

1.1 **SECTION INCLUDES**

.1 Labour, Products, equipment and services necessary for manually operated window coverings Work in accordance with the Contract Documents.

1.2 **REFERENCES**

.1 CAN/ULC-S109, Flame Tests of Flame-resistant Fabrics and Films.

1.3 **SUBMITTALS**

.1 Product data:
- .1 Submit duplicate copies of manufacturer's Product data in accordance with the Conditions of the Contract indicating:
  - .1 Performance criteria, compliance with appropriate reference standard(s), characteristics, limitations, and finishes.
  - .2 Product transportation, storage, handling and installation requirements.

.2 Shop drawings:
- .1 Submit shop drawings in accordance with the Conditions of the Contract indicating:
  - .1 Elevations, sections and details of opening size, clearances, handling of operating components, anchorage, dimensions, gauges, materials, and finishes.

.3 Samples:
- .1 Submit following samples in accordance with the Conditions of the Contract.
  - .1 Two 300 x 300 mm samples of fabric type.

.4 Closeout submittals:
- .1 Submit following for each Product for incorporation into Operations and Maintenance Manuals in accordance with the Conditions of the Contract:
  - .1 Functional description detailing operation and control of components.
  - .2 Performance criteria and maintenance data.
  - .3 Operating instructions and precautions.
  - .4 Safety precautions.

1.4 **EXTENDED WARRANTY**

.1 Manufacturer shall provide warranty that all components are free of manufacturing defects for two years from date of installation. This warranty is void if the product has been improperly installed or subjected to improper care.

2 Products

2.1 ACCEPTABLE PRODUCTS AND MANUFACTURERS

.1 Manual Roller Shade:
- .1 Factory assembled, manual chain operated, roller type fabric shades with "snapin" mounting, end brackets, shade tube, aluminum fascia, hembar and fabric as indicated on drawings and as specified herein.
- .2 Acceptable manufacturers:
  - .1 Elite Pro Shading Systems.
  - .2 Light Harvesting Shading Solutions Inc.
  - .3 Urban Edge Shading.

2.2 SHADING FABRIC (3% OPENNESS)

.1 Yarn: Vinyl coated polyester, 0.46 mm thick, basket weave design.

Openness factor	3 %
Weight (g/sq.m)	21(oz./sq.yd.)
Warp ends per 25.4 mm (1") approx.	42
Fill ends per 25.4 mm (1") approx.	31
Grab tensile strength	Warp - 1180 N
	Fill - 667 N
Stretch (% at 12.2 kg.wt.)	Warp - 2%
	Fill - 3%
Set %	Warp - 1.5%
	Fill - 1.5%
Abrasion resistance	
(500 Taber cycles)	- Yarn rupture none
Wear	- trace
U.V. Deterioration(200 Sun Fade hours)	- Fade none
Tensile retention	- 96%

.2 Flame Retardance: Fabric shall be certified by an independent laboratory to pass CAN/ULC-S109.

.3 Fabric colour (RS): Refer to Room Finish and Colour Schedule for shade fabric type and colours. Shade fabric on any one floor shall be from the same dye lot.

.4 Fabric shall be sealed under heat and pressure to retain weave pattern, with additional heat seal at sides, to prevent fraying and to eliminate rough edges.

2.3 BLACKOUT FABRIC

.1 Yarn: Vinyl coated polyester, 4 ply (1 ply woven fibreglass, 3 ply PVC film)

Weight (g/sq.m)	12 (oz./sq.yd.)
Tougue tear (lbs)	Warp - 12
	Fill - 8
Breaking Strength	- Warp 240
	- Fill 179
Tear Strength	- Warp 1,360
	- Fill 720

Tensile Strength	- Warp 246
	- Fill 207
Flame Test	- NFPA 701 small scale

.2 Fabric colour: Refer to Room Finish and Colour Schedule.

2.4 FABRICATION

.1 Extruded Aluminum Shade Tube: 1.52 mm thick, 38 mm diameter with three internal, continuous fins 4.82 mm high for strength and drive capabilities when attached to the nylon sprocket. The fins shall be spaced 120 degrees apart.

.2 Fascia: 1.7 mm thick, extruded aluminum cover both sides (front and back), complete with three continuous screw flutes which accept end brackets to form unitized unit (totally assembled), clear anodized finish. To cover front of shade and return at back of shade concealing roller and hardware, notched for chain clearance.

.3 Drive Assemblies:
- .1 Factory set, spring clutch type drive assembly to suit size and travel of fabric shades, complete with built-in shock absorber system to prevent chain breakage under normal conditions, and balancing spring or lift assist mechanism.
- .2 Capable of being field adjusted from exterior of shade without having to disassemble shades.

.4 Exterior Hembar: Extruded aluminum in clear anodized finish with plastic end finials.

.5 Drive Chain:
- .1 No. 10 "bright" finished series 300 stainless steel bead type chain forming continuous loops and capable of withstanding 400 N pull test.
- .2 Provide drive chains with upper and lower stops to prevent overwinding or underwinding.

.6 Dynamic Hembar: At sill locations, in lieu of bottom channel, provide aluminum Dynamic Hembar with same finish as side channels. Upon contact with sill, it shall provide a light seal even if the sill is slightly out of level.

.7 End Bracket: Two piece moulded ABS construction with a nylon drive sprocket. Incorporate snap-in clip on each end bracket to engage snap-in mounting hardware. Bracket colour shall coordinate with the fascia colour.

.8 Colour: Exposed surfaces (excluding fabric) shall be colour selected by Consultant, and not necessarily from manufacturer's full colour range. Metal components shall be pretreated and finished with an acceptable baked enamel finish.

.9 Fasteners: Non-corrosive metal screws for attachment to windows or curtain wall framing, concealed in completed installation.

.10 Mounting System: Snap-in brackets which allow the shade to be removed without disassembling the shade unit.

.11 Shade and mounting system to be designed to allow air between shade and glass.

.12 Fabric shall hang flat, without buckling or distortion. Trimmed edges shall hang straight without curling or raveling.

.13 Unguided vertical shades shall not drift sideways more than 3 mm in total run.

.14 Provide stops at highest and lowest shade positions to prevent over winding and unrolling.

.15 Design and fabricate shades so that there is a maximum 12 mm gap both sides of fabric.

.16 Blackout side and bottom channels: Extruded aluminum channels 38 mm x 28 mm to reduce light infiltration around sides of shade. Channels shall include 11 mm 'Fuzz' on both sides to further minimize infiltration.

.17 Shades shall be Fully Factory Assembled Units of unitized construction consisting of end brackets, shade tube, extruded aluminum fascia, Hembar and specified fabric.

3 Execution

3.1 **EXAMINATION**

.1 Verify condition and dimensions of previously installed Work upon which this Section depends. Report defects to Consultant. Commencement of Work means acceptance of existing conditions.

3.2 **INSTALLATION**

.1 Install shade in accordance with accepted shop drawings and manufacturer's written instructions.

.2 Install shades in locations shown using specified fasteners, plumb, true, square, straight, and level in proper planes, complete with all fascias/soffits, trims and accessories.

3.3 **ADJUSTMENT AND CLEANING**

.1 The shade cloth fabric shall hang flat, without buckling or distortion. The edge, when trimmed, shall hang straight without ravelling. An unguided roller shade cloth shall roll true and straight, without shifting sideways more than 3 mm in either direction due to warp distortion, or weave design.

.2 Adjust, correct and lubricate fabric shade as required, to provide smooth and efficient operation without binding.

.3 Clean shade surfaces and remove all finger marks and smudges from fascia, soffits, and trim surfaces. Remove all protective films.

.4 Leave fabric shade in raised position and in first-class condition upon completion of the Work of this Section.

END OF SECTION

1 General

1.1 **SECTION INCLUDES**

.1 Design, labour, Products, equipment, tools, supervision, and services necessary for the manufacture, delivery, installation, testing, maintenance, and adjusting of a holeless hydraulic elevator in accordance with the Contract Documents.

1.2 **REFERENCES**

.1 ASTM A167, Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet and Strip.

.2 ASME A17.1/CSA B44, Safety Code for Elevators and Escalators.

.3 CSA B651, Accessible Design for the Built Environment.

.4 CSA C22.2 No.77, Motors with Inherent Overheating Protection.

.5 CSA C22.2 No.141-M, Unit Equipment for Emergency Lighting.

.6 Elevating Devices Act and Ontario Regulation 463/86.

1.3 **DESIGN REQUIREMENTS**

.1 Design elevator in compliance with the Elevating Devices Act and Regulation in accordance with the requirements of ASME A17.1/CSA B44 safety code and latest supplement.

.2 Design elevator equipment to fit into space provided for hoistway, pit, overhead and machine rooms shown on Contract Drawings.

.3 Design elevator with hydraulic operating and control equipment direct acting plunger(s), pump unit, oil storage tank, to-fro oil lines, muffler, gate and magnetic control valves. Deliver operating fluid directly into cylinder at necessary pressure and in sufficient quantity to lift rated load at rated speed.

.4 Design elevator to ensure that maintenance may be performed by any reputable service provider company, without the use of proprietary software, access codes, tools, information or equipment.

.5 Provide smooth acceleration and deceleration of car without perceptible steps so adjusted as not to cause passenger discomfort.

.6 Design guide rail brackets for attachment to elevator pit and shaft walls as shown on Contract Drawings.

.7 Control: Oil hydraulic with two way levelling.

.8 Seismic Design Criteria:
- .1 Design and assemble elevator equipment and components to withstand earthquake forces for Napanee contained in the Ontario Building Code.

.9 Elevator Characteristics:
- .1 Rated net capacity: 1365 kg.
- .2 Rated speed: 0.50 metre/second.
- .3 Travel Distance (nominal): As indicated on drawings.
- .4 No. of Stops: As indicated on drawings.
- .5 No. of Openings: As indicated on drawings.
- .6 Elevator dimensions: 1906 mm deep x 2640 mm wide.
- .7 Cab height: 2438 mm
- .8 Clear car entrance width: 1067 mm.
- .9 Door type: single.
- .10 Door Operation: front and rear doors, side opening in single speed.
- .11 Provide clear door opening of: As indicated on drawings.

.10 Car operation: Simplex Collective Operation; Using a microprocessor-based controller, operation shall be automatic by means of the car and hall buttons. If all calls in the system have been answered, the car shall park at the last landing served.

.11 Furnish car lighting and ventilation operation with energy saving mode as follows:
- .1 Automatically extinguish regular interior lighting and stop car fan or blower.
- .2 Disable power circuits to convenience outlets and plug receptacles on top and bottom of car.
- .3 Resume normal function of lighting and fan when power is reinstated.
- .4 Arrange circuits so that power to lighting and fan or blower is not interrupted by overload, blown fuse or other abnormal condition.

.12 Fire Fighter's Operation: In accordance with Authorities having Jurisdiction.

.13 Power Supply:
- .1 Equipment Power: 208 V, 3 phase, 60 Hz, alternating current..
- .2 Lighting: 120 V, 15 A, single phase, 60 Hz, alternating current.

1.4 SUBMITTALS

.1 Product data:
- .1 Submit duplicate copies of manufacturer's Product data for each Product specified in accordance with the Conditions of the Contract indicating:
  - .1 Performance criteria, compliance with appropriate reference standards, characteristics, limitations, and trouble-shooting protocol.
  - .2 Signal and operating fixtures, operating panels, indicators, car design and components, doors and frame details, door protective devices, microprocessor controller, and telephone.
  - .3 Product transportation, storage, handling and installation requirements.

.2 Shop drawings:
- .1 Submit shop drawings in accordance with the Conditions of the Contract. In addition to the requirements of ASME A17.1/CSA B44, shop drawings shall indicate:
  - .1 Elevations, sections and details of elevator and operating components, dimensions, gauges, finishes and relationship of operating components to adjacent construction.
  - .2 Weights of principal components.
  - .3 Complete electrical wiring diagrams including electrical schematics and sequence of operation.
  - .4 Complete engineering design data to confirm that elevators meet design criteria specified.
  - .5 Electrical power information including voltage confirmation sheet, recommended fuse ratings, sizes and types, equipment starting and running current.
  - .6 Fabrication and installation details of piston(s) and piston casing(s).
  - .7 Size and location of machine, controller and piping.
  - .8 Piping and other connections in machine room.
  - .9 Size and location of car, hoisting beam, Guides, buffers, buffer supports, pit channels, oil line connections, and other components in hoistway.
  - .10 Sizes and locations of cutouts for oil lines and wiring.
  - .11 Details of work required by other trades.
  - .12 Rail bracket spacing.
  - .13 Forces on guide rails, pit floor, and at other points of support.
  - .14 Outside diameter and wall thickness of hydraulic piping.
  - .15 Working pressure.
  - .16 Rating of drive motor.
  - .17 Top and bottom clearance and over travel of car.
  - .18 Location of disconnects, light switches and feeder extension points in machine room.
  - .19 Heat dissipation rate for elevator equipment in machine room.
  - .20 Hoistway entrances and doors showing method of operation, details of construction, and method of fastening to structural members of structure.
  - .21 Signal and operating fixtures including hall lanterns, car riding lanterns, hall buttons, car position indicator, control switches.
  - .22 Wiring diagram showing connections from each source.
  - .23 Loads on hoist beams.
  - .24 Seismic design data.

.3 Samples:
- .1 Eight weeks after Notification of Award, submit 2 samples of the following in accordance with the Conditions of the Contract.
  - .1 Elevator operating buttons, car interior, car ceiling, car door, hoistway entrance door and frame finishes.

.4 Reports:
- .1 Prior to installation of elevators, submit to the Consultant 2 approved copies of submissions made to the Technical Standards and Safety Authority (TSSA).
- .2 Provide inspection certificates upon elevator completion.

.5 Prior to installation of elevators, submit to the Consultant 2 approved copies of submissions made to the Technical Standards and Safety Authority (TSSA).

.6 Operations and Maintenance Manuals:
- .1 Submit following for each Product for incorporation into Operations and Maintenance Manuals in accordance with the Conditions of the Contract:
  - .1 Identification: Manufacturing name, type, year, serial number, number of units, capacity, and identification of related systems.
  - .2 Functional description detailing operation and control of components.
  - .3 Performance criteria and maintenance data.
  - .4 Operating instructions and precautions.
  - .5 Safety precautions.
  - .6 Component parts availability including names and addresses of spare part suppliers.
  - .7 Consumables.
  - .8 Lubrication schedule indicating lubrication points and type of lubricant recommended.
  - .9 Maintenance and troubleshooting guidelines/protocol, and recommended equipment for analysis and repair.
  - .10 Final tests and commissioning reports.
  - .11 Items to be submitted to Consultant: keys, tools, special devices, maintenance materials.
  - .12 Record drawings.
  - .13 Description of operation and control equipment.
  - .14 Lubrication chart.
  - .15 Equipment maintenance check chart.
  - .16 Equipment trouble shooting guide and instructions.
  - .17 Name, address, telephone and facsimile numbers for major component manufacturers.
- .2 Manual documents that are larger than standard size sheets shall be neatly folded and housed in large envelopes or drawing pockets. These documents shall be inserted and housed in each manual binder.

1.5 QUALITY ASSURANCE

.1 Retain a Professional Engineer, licensed in Province of Ontario, with experience in Elevator Work of comparable complexity and scope, to perform following services as part of Work of this Section:
- .1 Design of elevator.
- .2 Review, stamp, and sign shop drawings and design calculations.

1.6 MAINTENANCE SERVICE

.1 Provide complete service and maintenance of elevator system components during building contract and 12 month warranty period at no additional cost to Owner.

.2 Provide Maintenance Control Program (MCP) complying with ASME A17.1/CSA B44, and any other local authority rulings and requirements. MCP shall be turned over to the Owner upon completion and will be maintained as necessary.

.3 Maintenance to include systematic examination, adjustment of elevator equipment and repair or replace parts whenever required as per planned maintenance tasks and frequencies. Use genuine parts produced by the manufacturer of specific equipment.

.4 Perform work without removing cars during peak traffic periods.

.5 Provide emergency call back service during regular operating hours for the maintenance period.

.6 Maintenance service shall not be assigned or transferred to any agent or subcontractor without prior written consent of Consultant.

2 Products

2.1 **MATERIALS**

.1 Drawings and specifications are based on the 'Dual-Upright Hydraulic Elevator' by Delta Elevator Company and shall be base bid. If another manufacturer's equipment is used, adjust surrounding construction to suit other manufacturer's product. If requirements or characteristics of lift equipment differ from that which is specified herein, such as: power requirements, electrical conductor size from control box to lift controller, motor hp size, or other such difference; list such differences at the time of bidding in accordance with the Contract Documents. Alternatives by the following will be considered provided they are approved prior to purchase.
.1 Federal Elevator.
.2 Otis Elevators.
.3 Schindler Elevator Corporation.
.4 ThyssenKrupp Elevator.

.2 Use major elevator components from standard product line of one manufacturer unless otherwise approved by Consultant.

.3 Use components only which have performed satisfactorily together under conditions of normal use in not less than two other elevator installations of similar design and for a period of at least one year. Furnish names and addresses of Owners or managers of buildings, in which proposed combination of major components has so performed.

.4 Stainless steel sheet and plate: ASTM A167, Type 304, brushed finish. Sizes and shapes indicated.

2.2 **SOUND ISOLATION**

.1 Provide sound isolation between plunger platen and car frame.

.2 Provide sound isolation between pumping unit and controller, motor and pump and building supports.

.3 Limit noise from pumping unit to 70 dBA measured 1 m from unit enclosure.

.4 Sound isolation couplings in pipeline between pump and cylinder.

2.3 MACHINE ROOM EQUIPMENT

.1 Hydraulic machine equipment shall be located within the elevator machine rooms as detailed on Contract Drawings.

.2 Provide all required anchor bolts, beams, steel frames, templates, inserts, boxes, isolators, cabinets, lifting devices and supports as required to accommodate and secure the elevator machine room equipment.

.3 Hydraulic control and power equipment shall be properly anchored to the machine room construction with anchor bolts or other approved fastening devices.

.4 Hydraulic machine room equipment shall be sound and vibration isolated from the machine room floor, walls, ceiling and other structural elements.

2.4 HYDRAULIC POWER UNIT

.1 Elevator controller shall be mounted so that the machine and valve unit are visible from the controller.

.2 Provide a self contained pump unit and oil storage tank, mounted on vibration isolation pads. Power unit shall be of a compact design, complete with steel enclosure. Drive motor and pump shall be located underneath the storage tank.

.3 Fabricate tank unit of welded sheet steel, minimum 3 mm thick. Tank unit shall act as an oil storage vessel and not as a pressure tank. Provide tank unit with a tightly fitting steel cover plate. Cover plate may be sectional or designed as a 1 piece plate.

.4 Tank shall be sized to accommodate the necessary quantity of oil, plus a minimum reserve of 45 L, in order to drive the elevator cab to its top terminal landing.

.5 Thermostatically controlled heaters or other means: to maintain fluid viscosity within limits necessary to provide consistent, reliable operation at all times.

.6 Thermostatic protection of oil temperature in reservoir where pump or motor is submerged in reservoir.

.7 Oil level indicator: to show minimum permissible oil level.

.8 Provide drive motor as follows:
- .1 Minimum 40 starts per hour.
- .2 Do not exceed EEMAC design B locked rotor current.
- .3 Design for minimum locked rotor torque of 150% and minimum breakdown torque of 200% at normal voltage.
- .4 Data plate on motor showing motor connections.
- .5 Where reduced voltage starting is provided, switch to full voltage not more than 1.5 s after interlock circuit is established.
- .6 Limit starting current of elevator motor to not more than 4 times full load running current.
- .7 Include class B motor insulation.
- .8 Include manually reset integral overheating protection to CSA C22.2No.77.

.9 Pump unit:
- .1 Integral unit combining motor, pump, valves and reservoir in one enclosure.
- .2 Prevent lateral displacement of pumping unit.
- .3 Removable or hinged panels: to ensure quick access to equipment requiring adjustment and maintenance.
- .4 Use positive displacement screw-type pump, with multiple V-belt connection to drive motor or with direct connection between drive motor and pump through flexible coupling.

2.5 ELEVATOR CONTROLLER CABINET

.1 Provide elevator controls in an EEMAC 12 ventilated galvanized steel cabinet mounted adjacent to or attached to the power unit. All controllers shall be non-proprietary.

.2 Provide controller with hinged doors, designed to allow ready access to all internal components.

.3 Controller shall house contactors, relays, switches, timers, fuses and other control and operating devices. Clearly label all components with permanently marked tags or designations, corresponding to the electrical circuit wiring diagrams. Provide similar switch and relay units of same manufacturer.

.4 Use two main line contactors to avoid possibility of continued operation of pump if one switch should fail.

2.6 HYDRAULIC PIPING, CONNECTIONS AND OIL

.1 Provide all piping connections between the hydraulic cylinder(s), operating valves, pump unit and oil storage tank.

.2 Provide oil line with an isolation fitting in the pit.

.3 Provide oil pressure switch, in accordance with the requirements of ASME A17.1/CSA B44, where hydraulic cylinder head is located above oil valve and tank unit.

.4 Size oil pipe lines and connections to accommodate required oil flows and system operating pressures as required to meet performance requirements:
- .1 Support oil lines at all times.
- .2 Provide oil lines with at least two separate means of support between fittings.
- .3 Route oil lines so as to minimize the number of bends, offsets and elbows. Securely fasten pipeline stands and supports to the structural supports.
- .4 Where the line runs through an enclosure or wall, provide isolation fittings and sleeves so as to prevent any direct connections between the oil line or couplings and partition walls.
- .5 Where piping supports are fastened to the building structure, provide isolation inserts between the fitting seats and the oil line.

.5 Fabricate pipes and fittings from Schedule 40 steel, and be provided with heavy duty fittings, hangers and supports. Where piping is installed under floors, piping shall be wrapped in a heavy exterior coating of bitumastic, then routed through PVC liner for corrosion protection.

.6 Provide blow out proof muffler in oil line near the power unit. Design muffler to minimize hydraulic pulsations.

.7 Provide one manual shut off or gate valve in the oil pipe line by the machine room valve location. Provide a second gate valve in the pit, by the cylinder head.

.8 Provide oil line with self cleaning strainer, complete with 60 mesh element and magnetic drain plug.

.9 Hydraulic operating fluid shall have an oxidation and rust inhibited petroleum base, with anti wear and anti foaming additives.

2.7 HYDRAULIC PISTONS AND CYLINDERS

.1 Provide seamless steel piston(s), equipped with a fine polished surface finish of 0.0008 mm roughness height rating or better. Provide pistons with internally threaded couplings. At the piston base, provide mechanical stopping means to prevent it from leaving the cylinder.

.2 Hydraulic cylinder(s) shall be sized to suit piston length and diameter, allowing sufficient clearance at the base to prevent the piston from striking the cylinder bottom under normal operation.

.3 Cylinder(s) shall be fabricated from seamless steel piping, of sufficient thickness to accommodate system pressures.

.4 Provide cylinder head with packing and wipers.

.5 Provide cylinder supports and mounting steel. Firmly affix hydraulic jack unit to pit floor slab structure. Provide all necessary shims to level supporting structure.

.6 Mount holeless type jack units at either side of the car platform. These twin post units shall be isolated from the cab platform and enclosure to prevent the transmission of vibrations into the car enclosure.

.7 Jack units shall be located an equal distance from the car guide rail column, and be affixed to the cab by a structural connection mounted at the car crosshead.

.8 Jack units shall be synchronized and balanced to provide a smooth car ride, without racking under eccentric loading conditions. Hydraulic system piping to these cylinders shall be of diameter, evenly split and arranged to ensure an equal and balanced oil flow is provided to each jack unit.

.9 Set twin jack units to be aligned and plumb within 1.5 mm of each other. Ensure that both pistons are aligned and installed such that when the elevator is sitting at its top landing, neither piston will bend enough to distort the packing seals and permit loss of oil through the cylinder head.

2.8 LUBRICATION

.1 Grease fittings: which fit same gun, for lubricating bearings requiring periodic lubrication.

.2 Grease cups: automatic feed compression type.

.3 Lubrication points: visible and easily accessible.

2.9 **BUFFERS**

.1 Provide spring buffers complete with pipe stands, struts, braces and other required buffer supports.

.2 Alternative buffer means such as compressible polymer bumpers may be used provided such devices are acceptable to the governing enforcement authorities.

2.10 **CAR GUIDE RAILS**

.1 Provide steel "T" section car guide rails, complete with brackets and sliding rail clips. Size rails to accommodate a 1500 mm vertical span between adjacent guide rail supports, even when the actual distances between supports are less.

.2 Fasten rails to hoistway construction using fastening devices and members as provided by this Section.

.3 Accurately machined car guide rail joints. They shall have tongues and grooves in the ends and centre of each rail head and base, so as to form matching joints between the rail head and base.

.4 Maximum joint gap to be 1.5 mm. All rail joints to be filed smooth.

.5 Provide fitted fishplates to the back of each rail joint. Each fishplate shall contain no less than eight through bolts. Fishplates shall be accurately machined surfaces for all surfaces which contact the guide rails.

.6 Locate rail joints so fishplates will not interfere with the relative motion of the guide rail column with respect to rail clips, brackets and beams.

.7 Positioned and aligned car guide rails so they are within 3 mm plumb and parallel from top to bottom.

.8 Where rail shims are used, ensue they remain securely fastened, even though fastening bolts may become loose. Do not use shim packing for gaps exceeding 25 mm.

.9 Cut car guide rails off at the top so there is a minimum clearance of at least 50 mm between the underside of the hoistway ceiling or nearest obstacle above the rail head.

.10 Guide rails shall be cleaned, filed smooth and de-rusted before Substantial Completion of the work.

2.11 HOISTWAY SWITCHES

.1 Provide normal terminal stopping devices at each top and bottom landing level. Arrange these enclosed switches so that as the elevator approaches either landing, a roller with a noiseless tread, mounted on a movable arm, will come in contact with cams mounted on the elevator car. The activation of this device will cause the elevator to automatically come to a smooth stop at that terminal landing. The switch roller shall engage the full surface area on the car cam.

.2 Provide a final terminal stopping device at the top and bottom of the hoistway.

.3 Operate final limits by a fixed car cam which is securely attached to the elevator car's structure.

.4 Locate switches so they will only be activated in the event the elevator travels a predetermined distance above or below the corresponding terminal landing.

.5 These switches shall be independent of the normal stopping devices.

.6 Through bolt final limit switches once the car has passed TSSA final acceptance inspections.

.7 Hoistway switches shall be of a type that can operate without noise being heard from inside the elevator cab whenever the ventilation fan is OFF.

2.12 HOISTWAY ENTRANCE

.1 Hoistway doors and frames: Stainless steel; 1.5 mm thick. Fascia panels constructed same as doors.

.2 Door and frame construction: ULC rated for with applicable fire rating; test to CAN4-S104; sandwich panel construction, 32 mm thick minimum.

.3 Frames: bolted construction.

2.13 OPERATING PANEL AND BUTTONS

.1 One operating panel per car with stainless steel faceplate mounted in each car, containing buttons with integral illumination corresponding to floors served, alarm button and "DOOR OPEN", "DOOR CLOSE" buttons.

.2 Two risers with UP and DOWN buttons at both landings, each with integral illumination and faceplate.

.3 Button Illumination:
- .1 Include integral illumination of each button in each landing and car operating fixture.
- .2 Illuminate corresponding "up" or "down" button and car button whenever call is registered. Extinguish illumination when call has been answered.

.4 Signal Illumination: Illuminate signal fixtures with sufficient intensity to produce distinct and well-defined indications under ambient lighting conditions.

2.14 DOOR OPERATION

.1 Automatic door operation: at each landing by means of power operator mounted on top of car.

.2 Door protective devices: multiple infrared light beams with solid state electronics providing extensive cris-crossed continuous scan across car entrance, unaffected by dust, humidity and vibration.

.3 Door operating sequence to minimize car and hall door open and close times. Provide independently adjustable door open times.

.4 Include arrangement specifically designed to minimize delays and return of car to service, should doors be prevented from closing for predetermined time.

.5 If doors are prevented from closing for approximately 10 s because of obstruction or operation of safety devices, automatically disconnect door control device and allow doors to close more slowly and recycle until obstruction is cleared. Sound alarm.

2.15 CAR PLATFORM AND ENCLOSURE

.1 Structural steel platform frame: filled with wood or steel subflooring. Threshold plate: durable and easily maintainable.

.2 Enclosure: Wood core panels attached to steel frame.

.3 Floor, walls and ceiling: 19 mm plywood, fire retardant treated surfaces and edges. Attach with flush mechanical fasteners.

.4 Enclose car on all sides except entrance, suitable for removing or resurfacing for maintenance purposes.

.5 Panels: Three, removable, retained securely with hidden fastenings. Design for removal of panels from inside car. Face panels with plastic laminate.

.6 Floor finish: To be selected by Consultant.

.7 Ceiling: stainless steel as provided by elevator manufacturer.

.8 Include lighting providing a light intensity of 215 lx measured 0.75 m above floor. Totally enclose and conceal wiring and fixtures from view within car.

.9 Ventilate by an exhaust air handling unit through roof and through concealed perforations at base. Limit total fan noise to 55 dB on "A" scale of General Radio Sound Level meter type 1551A from reading 1000 mm above floor with fan on high speed.

.10 Operating panel and face plate: stainless steel with illuminating call buttons.

.11 Indicator panel within car panel.

.12 Pad hooks: stainless steel, permanently mounted at 2100 mm.

.13 Wall mats: one set canvas covered, padded with cotton wadding fill material and sewn.

.14 Furnish stainless steel license holders integral with return panel in each elevator car or control room to suit certificate issued by enforcing authority. Design holder with hidden or tamper proof fastening.

.15 Provide recessed mounted, hands-free, emergency telephone, with automatic dialing feature for dedicated line. Program to suit building manager's requirement. Provide vandal resistant mounting to prevent unit removal from cabinet.

2.16 FINISHING

.1 Structural metal surfaces: clean surfaces of rust, oil or grease; wipe clean with solvent; prime two coats.

.2 Machine room components: clean and degrease; prime one coat, two coats enamel.

.3 Field welds: chip and clean away oxidation and residue; wire brush weld; prime two coats.

.4 Galvanized surfaces: clean with neutralizing solvent; prime one coat.

.5 Wood surfaces not exposed to public view: one coat primer; two coats enamel.

.6 Baked enamel on steel: clean degrease metal surface, one coat of zinc oxide primer sprayed and baked; two coats of semi-gloss enamel sprayed and baked; color as later selected by Consultant.

2.17 BARRIER FREE DESIGN

.1 Comply with CAN/CSA-B651, Barrier Free Design.

.2 42 mm dia. stainless steel handrails as indicated on drawings with ends returned close to panels and removable from inside car.

.3 Sound audible soft-toned signal in car when car is passing or stopping at floor.

2.18 EMERGENCY LIGHTING

.1 Include emergency lighting in each car as follows:
- .1 Battery operated emergency lighting equipment, to CSA C22.2No.141, to provide general illumination and 10 lx minimum illumination in car at operating panels and telephone cabinet for 4 h minimum.
- .2 Key operated switch for manual testing of unit from within car.
- .3 Battery unit of sufficient strength to support 100 kg person without causing malfunction or damage.
- .4 Means to contain leakage or spillage of electrolyte.

3 Execution

3.1 **EXAMINATION**

.1 Verify that hoistway, pit and machine room are ready for equipment installation.

.2 Verify shaft and openings are of correct size and within tolerances.

.3 Confirm electrical power is available and of correct characteristics.

.4 Report defects in writing to Consultant.

.5 Verify condition and dimensions of previously installed Work upon which this Section depends. Report defects to Consultant. Commencement of Work means acceptance of existing conditions.

3.2 **INSTALLATION**

.1 Install equipment in accordance with the Contract Documents, reviewed shop drawings, and in accordance with ASME A17.1/CSA B44, local codes and regulations. Position components so as to allow for future replacement or repair work to be undertaken, without having to dismantle or relocate other machine room equipment.

.2 Connect to electrical services as provided in machine room.

.3 Provide wiring and conduit from electrical disconnects to car controller. Coordinate location of controller and electrical connection routing.

.4 Coordinate, supply and install oil line runs and electrical troughing between machine room.

.5 Establish and verify oil and troughing routing and right of way requirements from remote machine rooms to hoistways along routes as schematically indicated on Contract Drawings.

.6 Provide fastenings as required and coordinate coring and sleeve requirements to accommodate oil line and troughing sump.

.7 Provide suitable rail bracket fasteners and make secure attachments to hoistway construction.

.8 Provide inserts for placement in concrete form work or self drilling expansion shell bolt anchors that will perform to four times rated pull-out load.

.9 Set entrance frames in proper alignment with car platform. Fasten frames to available wall and floor supports.

.10 Exposed Work within car enclosure and hall landing entrances shall be fabricated in true planes. Metal and wood sections shall be installed flat, be securely fastened and aligned so as to be straight and true. They shall be free of visible imperfections. Joints shall be accurately fitted, aligned and installed in same plane.

.11 Install entrances so frames are plumb within maximum variation of 3 mm, measured between entrance landing sill and header, top to bottom.

.12 Install hoistway door sills, frames and headers in hoistway walls. Set entrances in vertical alignment with car openings and aligned with plumb hoistway lines.

.13 Mount copy of master schematic wiring diagrams in framed glass or plastic enclosure on machine room wall. If number of wiring drawings exceeds 5, then mount drawings protected with clear plastic on rack permanently attached to machine room wall.

.14 Install lubrication chart in plastic or glass frame, mounted on machine room wall.

.15 Balance car.

3.3 **WIRING**

.1 Install wiring in accordance with reviewed shop drawings. Tie wrap conductors.

.2 Provide wiring to connect all parts of the elevator equipment including interconnecting wiring running between machine room and elevator hoistway.

.3 Wiring to be stranded or solid, to suit manufacturer's specific requirements. Wiring shall be provided with flame proof and moisture resisting outer cover.

.4 Wrap spare conductors together and labeled with their ends insulated.

.5 Solder or fasten wiring connections to terminal strips or studs using approved mechanical fasteners.

.6 Provide wiring harness where multiplicity of conductors are terminated at remote panel terminal strips.

.7 Clearly identify controller components with designations corresponding to those used on electrical circuit drawings.

.8 Provide insulated bushings around wiring openings where traveling cable and other multi conductor cables are run through openings in car enclosure.

.9 Wiring connections to door detectors shall be protected from chaffing and splitting.

.10 Where liquid tight conduit is used, provide conduit supports and fastenings at intervals of not more than 1,500 mm.

.11 Use proper anti shorts in all conduit connections.

.12 Provide hoistway troughing and conduit.

.13 Run hoistway wiring within conduit or troughing.

.14 Run wiring in elevator machine room within conduit.

.15 Provide ETT type flexible traveling cable, complete with flame resistant and moisture proof outer cover. Provide traveling cables of identical size and diameter and ensure each cable's loop has a similar hanging radius.

.16 In all hoistway wiring risers, remote panel conduits and traveling cables runs provide a minimum of 10% spare conductors. Identify, tie wrap and isolate ends of all spare conductors.

3.4 FIELD TESTING

.1 During installation, Consultant may carry out periodic Site inspections to gauge progress of the work and assess monthly invoices.

.2 Provide full co-operate with Consultant to allow unrestricted access of the installation, including machine room, hoistway, pit and car platform.

.3 Perform all tests and inspections as required under ASME A17.1/CSA B44 and Elevating Devices Act.

.4 Include all costs of Provincial registration, design submission and acceptance inspection fees.

.5 Coordinate and schedule with TSSA acceptance inspections.

.6 Performance and operation or commissioning inspections shall be carried out by the Owner's designated representatives and shall be scheduled to take place before TSSA acceptance inspection.

.7 During commissioning inspections, supply sufficient test weights to demonstrate performances under full load and no load conditions.

3.5 EQUIPMENT PERFORMANCE AND ADJUSTMENT SETTINGS

.1 Adjust elevator to attain the following performance criteria:
- .1 Car movement on guide rails: smooth movement, with no perceptible lateral or oscillating movement or vibration.
- .2 Car speed variation: maximum 5% in lifting rated load.
- .3 Car speed variation: maximum 10% in UP or DOWN speed, empty to full rated load.
- .4 No noticeable shift in acceleration or deceleration rates.
- .5 Car leveling accuracy shall be maintained at +/- 6 mm, under all load conditions.
- .6 Guide rail alignment: plumb and parallel to each other within 3 mm.

.2 Adjust door opening and closing times to suit handicapped users in accordance with Consultants instructions.

.3 Adjust automatic floor levelling feature at each floor.

3.6 CLEANING

.1 Remove protective coverings from finished surfaces and components.

.2 Clean surfaces and components ready for inspection.

END OF SECTION

Algonquin & Lakeshore Catholic District School Board (ALCDSB)
JJ O'Neill Catholic Elementary School Addition
240 Marilyn Ave.
Napanee, ON

Quasar Consulting Group

Mechanical and Electrical Specifications

Divisions 20-28

Project Number: ED-22-069
Date of Issue: March 26, 2024
Issued for Permit and Tender

PROCUREMENT AND CONTRACTING REQUIREMENTS GROUP

Division 00 Procurement and Contracting Requirements

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End of Document

1 General

1.01 Submittals

.1 Submit product data sheets for all products specified in this Section.

1.02 References

.1 Fire extinguishers are to be in accordance with following Codes and Standards:

.1 National Fire Code of Canada;

.2 NFPA 10, Standard for Portable Fire Extinguishers;

.3 CAN/ULC S508, Standard for the Rating and Testing of Fire Extinguishers.

2 Products

2.01 General

.1 Fire extinguishers are to be pressurized (stored pressure) rechargeable type, in accordance with NFPA 10, and UL and/or ULC listed and labelled for the class of fires and hazard locations for which they are specified.

.2 Each extinguisher is to be complete with:

.1 manufacturer's identification label indicating extinguisher model number, rating, and operating instructions;

.2 anodized aluminum or chrome plated forged brass valve with positive squeeze grip on-off operation and a pull-pin safety lock;

.3 discharge hose with nozzle or horn and hose securing clip;

.4 for wall mounting extinguishers, a wall mounting bracket.

2.02 3A10B:C Rated Dry Chemical Extinguishers

.1 Multi-purpose 3A10B:C dry chemical extinguishers are to be 100 mm (4") dia., 2.27 kg (5 lb.), each complete with a steel cylinder with a safety red baked enamel finish and a waterproof stainless steel pressure gauge.

2.03 Fire Extinguisher Cabinets

.1 Surface Mounted: Rectangular break-glass type enclosures sized to suit the extinguishers to be housed, constructed of 18 gauge corrosion resistant steel with a baked white enamel finish, front glass panel, break-glass mechanism, and keyed alike cylinder lock.

.2 Recessed: Rectangular cabinets sized to suit the extinguishers to be housed, with an 18 gauge corrosion resistant white enamelled steel tub, #14 gauge cleaned and prime coat painted steel door and adjustable trim assembly with rounded corners, semi-concealed piano hinge, safety glass panel, and flush stainless steel door latch.

3 Execution

3.01 Installation of Fire Extinguisher Cabinets

.1 Provide wall cabinets for fire extinguishers where required.

.2 Unless otherwise shown or specified, locate cabinets so centerline is approximately 1.2 m (4') above finished floor.

.3 Confirm exact locations prior to installation.

End of Section

1 General

1.01 Section Includes

.1 This Section specifies products, criteria and characteristics, and methods and execution that are common to one or more Sections of Mechanical Divisions. It is intended as a supplement to each Section and is to be read accordingly.

1.02 References

.1 Division 00 and Division 01 apply to and are a part of each Mechanical Division:

.1 Division 21 – Fire Suppression;

.2 Division 22 – Plumbing;

.3 Division 23 – Heating, Ventilating, and Air Conditioning;

.4 Division 25 – Integrated Automation.

1.03 Submittals

.1 Submit shop drawings/product data sheets for:

.1 pressure gauges and thermometers;

.2 electric motors (submit with equipment they are associated with).

.2 Submit weight loads for selected equipment (upon request).

.3 Submit copy of architectural reflected ceiling plan drawings and elevation drawings to indicate proposed access door locations.

.4 Submit a list of equipment identification nameplates indicating proposed wording and sizes.

.5 Submit a list of pipe and duct identification colour coding and wording.

.6 Submit a proposed valve tag chart and a list of proposed valve tag numbering and identification wording.

.7 Submit drawings indicating size and location of required sleeves, recesses and formed openings in poured or precast concrete work.

.8 Submit any other submittals specified in this Section or other Sections of Mechanical Divisions.

1.04 Maintenance Material Submittals

.1 As specified in Part 2 of this Section, submit a spare belt set, tagged and identified, for each belt driven piece of equipment.

2 Products

2.01 Firestopping and Smoke Seal Materials

.1 Firestopping and smoke seal system materials for mechanical penetrations through fire rated construction are specified in Section 20 05 17 - Sleeves and Sleeve Seals for Mechanical Piping and work is to be done as part of mechanical work unless otherwise specified in Division 07.

2.02 Access Doors

.1 Provide all access doors required for Mechanical work unless otherwise specified in Division 08. Coordinate consistency of look and finish of access doors on project with each Division of Work. Coordinate exact requirements with General Trades Contractor.

.2 Access doors to be rust resistant steel door panels, with concealed hinges and positive locking and self-opening screwdriver operated lock. Wall type frame to be suitable for wall installation and have integral keys for plaster walls. Doors in tile wall to be stainless steel and in ceilings to be suitable for plaster covering with only frame joint showing. Other doors to be prime painted steel.

.3 Size access doors to suit the concealed work for which they are supplied, and wherever possible they are to be of standard size for all applications, but in any case they are to be minimum 300 mm x 300 mm (12" x 12") for hand entry and 600 mm x 600 mm (24" x 24") for body entry.

.4 Lay-in type tiles, properly marked, may serve as access panels. Coordinate marking of ceiling tiles with the Consultant. Panels in glazed tile walls to be 12 gauge, 304 alloy stainless steel, No. 4 finish, with recessed frame secured with stainless steel counter-sunk flush head screws.

.5 Panels in plaster surfaces to have dish-shaped door and welded metal lath, ready to take plaster. Provide a plastic grommet for door key access.

.6 Other access doors to be welded 12 gauge steel, flush type with concealed hinges, lock and anchor straps, complete with factory prime coat. Submit to Consultant for review, details of non-standard door construction details.

.7 Access doors in fire rated ceilings, walls, partitions, structures, etc., to be ULC listed and labelled and of a rating to maintain fire separation integrity.

.8 Where access doors are located in surfaces where special finishes are required, they are to be of a recessed door type capable of accepting finish in which they are to be installed so as to maintain final building surface appearance throughout.

.9 Manufacturers:

.1 Le Hage.

.2 SMS.

.3 Pedlar.

.4 Acudor.

2.03 Flexible Piping Connectors

.1 Double wall stainless steel flexible connectors for piping connections to vibration isolated equipment, each selected by manufacturer to suit the application. Shop drawings or product data sheets must indicate construction and performance requirements that suit the application.

.2 Manufacturers:

.1 Hyspan Precision Products Inc.;

.2 Senior Flexonics Ltd.;

.3 The Metraflex Co.

3 Execution

3.01 General Piping and Ductwork Installation Requirements

.1 Unless otherwise specified, locate and arrange horizontal pipes and ducts above or at ceiling on floors, arranged so that under consideration of all other work in area, maximum ceiling height and/or usable space is maintained. If required to maintain ceiling heights, reroute and/or resize ductwork, with Consultant's approval.

.2 Unless otherwise specified, install work concealed in finished spaces, and concealed to degree possible in partially finished and unfinished spaces. Refer to and examine Architectural drawings and room finish schedules to determine finished, partially finished, and unfinished areas. Walls which are painted are considered finished.

.3 Install pipes and ducts parallel to building lines and to each other.

.4 Neatly group and arrange exposed work.

.5 Locate work to permit easy access for service or maintenance as required and/or applicable. Locate valves, dampers and any other equipment which will or may need maintenance or repairs and which are to be installed in accessible construction so as to be easily accessible from access doors. Where valves, dampers and similar piping or ductwork accessories occur in vertical services in shafts, pipe spaces or partitions, locate accessories at floor level.

.6 Make connections between pipes of different materials using adapters suitable for application. Provide cast brass dielectric type adapters/unions at connections between ferrous and copper pipe.

.7 Comply with equipment and material manufacturer's installation instructions unless otherwise specified herein or on drawings, and unless such instructions contradict governing codes and regulations.

.8 Carefully clean ducts, pipe and fittings prior to installation. Temporarily cap or plug ends of pipe, ducts and equipment which are open and exposed during construction.

.9 Install piping and ductwork which are to be insulated so that they have sufficient clearance to permit insulation and finish to be applied continuously and unbroken around pipe or duct, except for ductwork at fire barriers, in which case insulation will be terminated at each side of the duct fire damper.

.10 Inspect surfaces and structure prepared by other trades before performing work. Verify surfaces or structure to receive work has no defects or discrepancies which could result in poor application or cause latent defects in installation and workmanship. Report defects in writing. Installation of work will constitute acceptance of such surfaces as being satisfactory.

.11 Any ferrous piping that exhibits in excess of 5% surface rust, either inside or outside or both, is to be wire brush cleaned to bare metal and coated with suitable primer. Steel pipe, fittings and accessories are to be free of corrosion and dirt when work is complete or prior to being concealed from view. Where dirt is evident, clean piping prior to being concealed.

.12 For factory applied finishes, repaint or refinish surfaces damaged during shipment and installation. Quality of repair work is to match original finish. This requirement also applies to galvanized finishes.

.13 Where mechanical work is located in high humidity areas where ferrous metal products will be subject to corrosion and protection for such products is not specified, provide finishes on products to protect against corrosion or provide products which will not corrode in the environment, i.e. aluminium ductwork, copper or stainless steel pipe, etc.

.14 Provide screwed unions or flanges in piping connections to equipment and in regular intervals in long (in excess of 12 m (40')) piping runs to permit removal of sections of piping.

.15 Unless otherwise specified and except where space limitations do not permit, piping elbows are to be long radius. Eccentric reducers are to be installed with straight side at top of piping.

3.02 Pipe Joint Requirements

.1 Do not make pipe joints in walls or slabs.

.2 Ream piping ends prior to making joints.

.3 Properly cut threads in screwed steel piping and coat male threads only with Teflon tape or paste, or an equivalent thread lubricant. After pipe has been screwed into fitting, valve, union, or piping accessory, not more than 2 pipe threads are to remain exposed.

.4 Site bevel steel pipe to be welded or supply mill bevelled pipe. Remove scale and oxide from bevels and leave smooth and clean. Use factory made welding tees or welding outlet fittings for piping branches off mains. Do not use shop or site fabricated fittings unless written approval has been obtained.

.5 Welded joints are to be made by CWB certified licensed journeyman welders qualified in accordance with CSA B51, Boiler Pressure Vessel and Pressure Piping Code, and who are in possession of a proper certificate of qualification for each procedure to be performed. Each weld is to be identified with the welder's identification symbol, and welds are not to be concealed until they have been inspected and approved. Electrodes are to be in accordance with CSA W48 Series, Electrodes, and requirements of CAN/CSA W117.2, Safety in Welding, Cutting and Allied Processes are to be followed.

.6 Unless otherwise specified, make flanged joints with Garlock 5500 or equivalent gasket materials to suit the application, and bolts and nuts. Bolts are not to be longer than length necessary to screw nut up flush to the end of bolt. Bolts used for flanged connections in piping with a working pressure of 690 kPa (100 psi) and greater are to be ASTM A-193 Grade B-7, with heavy hexagon nuts to ASTM A-194 CL-2H. Provide suitable washers between each bolt head and flange and between each nut and flange.

.7 A random check of bolted flanged connections will be made to verify flanged connections are properly mated with no shear force acting on bolts. Supply labour to disconnect and reconnect selected flanged joints. If improperly mated joints are found, remove and reinstall affected piping so flanges mate properly. If improperly mated joints are found, additional joints will be checked, and you will be responsible for the repair of any other improper joints discovered.

.8 Unless otherwise specified make soldered joints in copper piping using flux suitable for and compatible with type of solder being used. Clean the outside of pipe end and inside of fitting, valve, or similar accessory prior to soldering.

.9 Install mechanical joint fittings and couplings in accordance with manufacturer's instructions.

.10 Grooves are to be rolled. Make arrangements with coupling and fitting manufacturer for shop and/or site instructions and demonstrations as required, and adhere to manufacturer's instructions with respect to pipe grooving, support, type of gasket required, anchoring and guiding the grooved piping system.

.11 If pressure crimped couplings and fittings are used, ensure gaskets are fully compatible with piping fluid, and valves and piping accessories are suitable. Use only fitting manufacturer supplied crimping equipment. Comply with manufacturer's latest published specification, instructions, and recommendations with respect to pipe, coupling, and fitting preparation and installation, and support, anchoring and guiding of the piping system.

.12 Solvent weld PVC piping in 2 parts, primer stage and cementing stage, in accordance with manufacturer's recommendations, ASTM D2855, and CSA requirements.

.13 Install PVC piping with gasketed joints in accordance with manufacturer's current published specifications, instructions and recommendations, and CSA requirements.

3.03 Duct Openings

.1 Duct openings, air inlet and outlet openings, fire damper and similar openings will be provided in new poured concrete work, masonry, drywall and other building surfaces by trade responsible for particular construction in which opening is required.

.2 Size openings for fire dampers to suit damper arrangement with folding blade out of air stream.

.3 For duct openings except where fire dampers are required, pack and seal space between duct or duct insulation and duct opening as specified above for pipe openings in non-fire rated construction.

3.04 Sleeve and Formed Opening Location Drawings

.1 Prepare and submit for review, drawings indicating size and location of required sleeves, recesses and formed openings in poured or precast concrete work.

.2 Such drawings are to be completely and accurately dimensioned and relate sleeve, recesses, and formed openings to suitable grid lines and elevation datum, and are to take into account structural items such as grade beams, column caps, and column drop slabs.

.3 Begin to prepare such drawings immediately upon notification of acceptance of bid and award of Contract.

3.05 Installation of Pipe Escutcheon Plates

.1 Provide escutcheon plates suitably secured over exposed piping passing through finished building surfaces. A finished building surface is any surface with a factory finish or that receives a site applied finish.

.2 Install plates so they are tight against building surface concerned, completely covering pipe sleeves and/or openings, except where waterproof sleeves extend above floors, in which case fit plate tightly around sleeve.

3.06 Supply of Access Doors

.1 Supply access doors to give access to mechanical work which may need maintenance or repair but which is concealed in inaccessible construction, except as otherwise specified herein or on drawings.

.2 Before commencing installation of mechanical work, coordinate with other trades and prepare on a set of reflected ceiling plans and wall elevations, complete layouts of access doors. Submit these layouts for Consultant's review and show exact sizes and locations of such access doors. Locate and arrange mechanical work to suit.

.3 Access doors will be installed by trade responsible for particular type of construction in which doors are required. Supply access doors to trade installing same at proper time.

.4 Wherever possible, access doors to be of a standard size for each application. Confirm exact dimensions and minimum size restrictions with the Consultant prior to ordering.

.5 Group piping and ductwork to ensure minimum number of access doors is required.

.6 Coordinate with Electrical Contractor and General Trades Contractor to ensure access doors on project are provided by a single manufacturer, installed as part of work of General Trades Contractor and work involving both mechanical and electrical services should, where possible, be accessible from common access door. Coordinate work to ensure common location access doors are not supplied by both Mechanical Divisions and Electrical Divisions.

3.07 Installation of Valves

.1 Generally, valve locations are indicated or specified on drawings or specified in Sections of the Specification where valves are specified, however, regardless of locations shown or specified, following requirements apply:

.1 provide shut-off valves to isolate systems, at base of vertical risers, in branch take-offs at mains and risers on floors, to isolate equipment, to permit work phasing as required, and wherever else required for proper system operation and maintenance;

.2 install shut-off valves with handles upright or horizontal, not inverted, and located for easy access;

.3 unless otherwise specified, provide a check valve in discharge piping of each pump;

.4 valve sizes are to be same as connecting pipe size;

.5 valves are to be permanently identified with size, manufacturer's name, valve model or figure number and pressure rating, and wherever possible, valves are to be product of same manufacturer;

.6 for valves in insulated piping, design of valve stem, handle and operating mechanism is to be such that insulation does not have to be cut or altered in any manner to permit valve operation.

3.08 Finish Painting of Mechanical Work

.1 Finish paint exposed mechanical work as specified and/or scheduled in accordance with requirements of Division 09.

.2 Touch-up paint damaged factory applied finishes on mechanical work products.

3.09 Pipe Leakage Testing

.1 Before piping has been insulated or concealed, and before equipment, fixtures and fittings have been connected, test piping for leakage.

.2 Tests are to be witnessed by the Consultant and/or Owner's representative, and, where required, representatives of governing authorities. Give ample notice of tests in writing and verify attendance. Have completed test report sheets dated and signed by those present to confirm proper test results.

.3 When circumstances prevent scheduled tests from taking place, give immediate and adequate notice of cancellation to all who were scheduled to attend.

.4 Gravity Drainage and Vent Piping

.1 Test piping in accordance with local governing building code.

.2 After fixtures and fittings are set and pipes are connected to building drain or drains, turn on water into pipe, fixtures, fittings and traps in order to detect any imperfect material or workmanship. Perform a smoke test if required by local governing authorities.

.5 Pumped Drainage Piping

.1 Test piping with cold water at a pressure of 1-½ times normal working pressure and maintain pressure for a minimum of 2 hours.

.6 Domestic Water Piping

.1 Test piping with cold water at a pressure of 1-½ times normal working pressure and maintain pressure for a minimum of 2 hours.

.7 Sprinkler System Piping

.1 Test system piping in accordance with requirements of NFPA No. 13, "Installation of Sprinkler Systems", and in accordance with any additional requirements of governing authorities.

.8 Heat Transfer (HVAC) System Piping

.1 Test piping with cold water at a pressure of 1035 kPa (150 psi) for a minimum of 2 hours.

.9 Natural Gas Piping

.1 Test piping in accordance with requirements of CAN/CSA B149.1 and any additional requirements of local governing authorities.

.2 After completion of the verification test, locate required tag stating results of the verification test at the point of entry of gas main into building, affixed to the pipe in a secure manner.

.3 Check piping joints and connections for leaks with a water/soap solution while piping is under pressure.

.10 Refrigerant Piping

.1 Test refrigerant piping for leakage and dehydrate in accordance with requirements of Chapter 18 of ASHRAE Handbook - Fundamentals.

.11 Following requirements apply to all testing:

.1 ensure piping has been properly flushed, cleaned and is clear of foreign matter prior to pressure testing;

.2 temporarily remove or valve off piping system specialties or equipment which may be damaged by test pressures prior to pressure testing systems, and flush piping to remove foreign matter;

.3 when testing is carried out below highest level of the particular system, increase test pressure by the hydrostatic head of 7 kPa (1 psi) for every 600 mm (24") below the high point;

.4 include for temporary piping connections required to properly complete tests;

.5 piping under test pressure is to have zero pressure drop for length of test period;

.6 tighten leaks found during tests while piping is under pressure. If this is impossible, remove and refit piping and reapply test until satisfactory results are obtained;

.7 where leaks occur in threaded joints in steel piping, no caulking of these joints will be allowed under any conditions;

.8 tests are to be done in reasonably sized sections so as to minimize number of tests required;

.9 in addition to leakage tests specified above, demonstrate proper flow throughout systems including mains, connections and equipment, as well as proper venting and drainage, and include for any necessary system adjustments to achieve proper conditions.

3.10 Interruption to and Shut-Down of Mechanical Services and Systems

.1 Coordinate shut-down and interruption to existing mechanical systems with Owner. Generally, shut-downs may be performed only between the hours of 12:00 midnight Friday until 6:00 a.m. Monday

morning, unless otherwise specified in Division 01. Include for costs of premium time to perform work during nights, weekends or other times outside of normal working hours, which may be necessary to comply with stipulations specified herein this Article. Services for operation of existing non-renovated areas of building are to be maintained.

.2 Upon award of a Contract, submit a list of anticipated shut-down times and their maximum duration.

.3 Prior to each shut-down or interruption, inform Owner and the Consultant in writing 5 working days in advance of proposed shut-down or interruption and obtain written consent to proceed. Do not shut-down or interrupt any system or service without such written consent. Shutdowns of some essential services may require additional advance notification time.

.4 Perform work associated with shut-downs and interruptions as continuous operations to minimize shut-down time and to reinstate systems as soon as possible, and, prior to any shut-down, ensure materials and labour required to complete the work for which shut-down is required are available at site.

.5 Pipe freezing shall be used to connect new piping to existing piping. Alternative methods may be proposed, if site conditions are evaluated and permit, and are approved by the Consultant.

.6 Where existing isolation valves do not hold, pipe freezing shall be used to connect new piping to existing piping.

3.11 Mechanical Service Requirements for Floating Floor Slabs

.1 Where mechanical services are required to be installed in or through a vibration isolated floating slab, install such services so as not to transmit any vibration to base slab on which floating floor slab is placed.

.2 Wherever possible, arrange mechanical work to avoid penetrating a floating floor slab.

3.12 Excavation and Backfill Work

.1 Unless otherwise specified in Division 31, provide all excavation and backfill associated with the mechanical scope of work.

.2 Before commencement of excavation for work, determine in consultation with Consultant, Owner, Municipality and utilities, presence, if any, of existing underground services at site. Engage local utilities to locate and mark out such services. Ensure trades concerned are aware of their presence.

.3 Be responsible for any damage done to underground services caused by neglect to determine and mark out location of such services prior to excavation work commences.

.4 Where Work falls under jurisdiction of local governing utility, confirm requirements and comply with utility requirements.

.5 Unless otherwise specified in Division 31, provide excavation, backfill and related work required for mechanical work. Obtain a copy of soil test report if available from the Consultant. Depth of excavations must accommodate local governing requirements and local standard practices to compensate for local frost levels of Place of the Work.

.6 Inverts and locations of existing site services may have been site surveyed and approximate location may be shown on drawings. Confirm inverts and locations are correct, prior to commencing excavation and contact Utilities to accurately locate their services. Where discrepancies are found, immediately inform Consultant, and await a direction. Grade bottom of trench excavations as required.

.7 In firm, undisturbed soil, lay pipes directly on soil, unless otherwise directed.

.8 Before backfilling, arrange for inspection of work by the Consultant. Do not backfill work unless reviewed with the Consultant. Failure to do so prior to backfilling will require re-excavating work and re-backfill at no additional cost to Owner.

.9 Unless otherwise specified, backfill trenches within building with clean sharp sand in individual layers of maximum 150 mm (6") thickness compacted to a density of 100% Standard Proctor. Hand compact first layers up to a compacted level of minimum 300 mm (12") above top of pipe. Hand or machine compact the balance up to grade.

.10 Unless otherwise specified, backfill trenches outside the building (not under roads, parking lots or traffic areas), up to a compacted level of 450 mm (18") thick above the pipe, hand compacted to a density of 95% Standard Proctor, using granular "A" gravel. Backfill the balance in 150 mm (6") layers with approved excavated material, compacted to 95% Standard Proctor density.

.11 Unless otherwise specified, backfill trenches outside building under roads, parking lots or traffic areas with crushed stone or granular "A" gravel in layers not exceeding 150 mm (6") thickness, compacted to 100% Standard Proctor density up to grade level.

.12 Provide minimum 1.37 m (4.5') of cover for underground piping subject to freezing and located outside building.

.13 Provide minimum 450 mm (18") of cover for underground piping subject to freezing and located inside building.

.14 After first lift of backfill has been compacted, mark entire path of pipe using continuous 75 mm (3") wide detectable identified marking tape equal to SMS Ltd. D-UGMT.

.15 Unless otherwise directed in Division 02 and/or Division 31, store and dispose of excavated materials as follows:

.1 during progress of contract, place material as directed in such a manner to minimize damage or disfigurement of ground and which in no way impedes progress of work;

.2 separately place surplus topsoil and subsoil as directed; leave site clean and unencumbered.

.16 Perform pumping as required to keep excavations free of water.

.17 Engage services of independent soils testing agency to test final backfill compaction density of each backfilled location. Compact backfill to satisfaction of testing agency and in accordance with Specification. Submit a copy of testing agency's report to the Consultant for review.

.18 Fill depressions to correct grade level with appropriate material, after an adequate period has passed to reveal any settlement. Use maximum possible compaction. Pay costs required to make good damages caused by settlement.

.19 Coordinate requirements for final surface toppings (concrete, asphalt, pavers, grass sod, etc.) with General Contractor.

3.13 Cutting, Patching and Core Drilling

.1 Unless otherwise provided by General Trades, perform cutting, patching, and core drilling of existing building required for installation of mechanical work. Perform cutting in a neat and true fashion, with proper tools and equipment to Consultant's approval. Patching is to exactly match existing finishes and be performed by tradesmen skilled in particular trade or application. Work is subject to review and acceptance by the Consultant.

.2 Criteria for cutting holes for additional services:

.1 cut holes through slabs only; no holes to be cut through beams;

.2 cut holes 150 mm (6") diameter or smaller only; obtain approval from Structural Consultant for larger holes;

.3 keep at least 100 mm (4") clear from beam faces;

.4 space at least 3 hole diameters on centre;

.5 for holes that are required closer than 25% of slab span from supporting beam face, use cover meter above slab to clear slab top bars;

.6 for holes that are required within 50% of slab span, use cover meter underside of slab to clear slab bottom bars;

.7 submit sleeving drawings indicating holes and their locations for Structural Consultant's review.

.3 Do not cut or drill any existing work without approval from Owner and Consultant. Be responsible for damage done to building and services caused by cutting or drilling.

.4 Where pipes pass through existing construction, core drill an opening. Size openings to leave 12 mm (½") clearance around pipes or pipe insulation.

.5 Prior to drilling or cutting an opening, determine, in consultation with Consultant and Owner, and by use of non-destructive radar scan (magnetic scan) of slab or wall, presence of any existing services and reinforcement bars concealed behind building surface to be cut and locate openings to suit. Coring is not permitted through concrete beams or girders.

.6 Where drilling is required in waterproof slabs, size opening to permit snug and tight installation of a pipe sleeve sized to leave 12 mm (½") clearance around pipe or pipe insulation. Provide a pipe sleeve, constructed of Schedule 40 galvanized steel pipe with a flange at one end and of a length to extend 100 mm (4") above slab, in opening. Secure flange to the underside of slab and caulk void between sleeve and slab opening with proper non-hardening silicone base caulking compound to produce a water-tight installation.

.7 Firestop and seal openings in fire rated construction. Do not leave openings open overnight unless approved by Owner and Consultant.

3.14 Packing and Sealing Core Drilled Pipe Openings

.1 Pack and seal void between pipe opening and pipe or pipe insulation for length of opening as follows:

.1 non-fire rated interior construction – pack with mineral wool and seal both ends of opening with non-hardening silicone base caulking compound to produce a water-tight seal;

.2 exterior walls above grade – pack with mineral wool and seal both ends of sleeves water-tight with non-hardening silicone base caulking compound unless mechanical type seals have been specified;

.3 exterior walls below grade (and any other wall where water leakage may be a problem) – seal with link type mechanical seals as specified.

3.15 Flashing for Mechanical Work Penetrating Roof

.1 Unless otherwise specified in Division 07, perform required flashing work, including counter-flashing, for mechanical work penetrating and/or set in roof.

.2 Perform flashing work in accordance with requirements of drawing details and/or requirements specified in Division 07.

3.16 Cleaning Mechanical Work

.1 Refer to cleaning requirements specified in Division 01.

.2 Clean mechanical work prior to application for Substantial Performance of the Work.

.3 Include for vacuum cleaning interior of air handling units and ductwork systems.

3.17 Connections to Other Equipment

.1 Carefully examine Contract Documents during bidding period and include for mechanical work piping and/or ductwork connections to equipment requiring such connections.

3.18 Installation of Flexible Connectors

.1 Provide flexible connectors in piping connections to seismically restrained equipment, where applicable, and wherever else shown.

.2 Provide flexible connectors in piping connections to vibration isolated equipment.

3.19 Fan Noise Levels

.1 Submit sound power levels with fan shop drawings/product data, with levels measured to AMCA 300 and calculated to AMCA 301.

3.20 Equipment and System Manufacturer's Certification

.1 When equipment/system installation is complete, but prior to start-up procedures, arrange and pay for equipment/system manufacturer's authorized representative to visit site to examine installation, and after any required corrective measures have been made, to certify in writing to the Consultant that equipment/system installation is complete and in accordance with equipment/system manufacturer's instructions.

3.21 System Startup

.1 When installation of equipment/systems is complete but prior to commissioning, perform start-up for equipment/systems as specified in mechanical work Sections in accordance with following requirements:

.1 submit a copy of each equipment/system manufacturer's start-up report sheet to the Consultant for review, and incorporate any comments made by the Consultant;

.2 under direct on-site supervision and involvement of equipment/system manufacturer's representative, start-up equipment/systems, make any required adjustments, document procedures, leave equipment/systems in proper operating condition, and submit to the Consultant complete set of start-up documentation sheets signed by manufacturer/supplier and Contractor.

End of Section

1 General

1.01 Section Includes

.1 This Section specifies requirements, criteria, methods and execution for mechanical demolition work that are common to one or more mechanical work Sections, and it is intended as a supplement to each Section and is to be read accordingly.

2 Products – Not Used

3 Execution

3.01 Disconnection and Removal of Existing Mechanical Work

.1 Where indicated on drawings, disconnect and remove existing mechanical work, including hangers, supports, insulation, etc. Disconnect at point of supply, remove obsolete connecting services and make system safe. Cut back obsolete piping behind finishes and cap water-tight unless otherwise specified.

.2 Scope and extent of demolition or revision work is only generally indicated on drawings. Estimate scope, extent and cost of work at site during bidding period site visit(s). Claims for extra costs for demolition work not shown or specified but clearly visible or ascertainable at site during bidding period site visits will not be allowed.

.3 If any re-design is required due to discrepancies between mechanical drawings and site conditions, notify the Consultant who will issue a Site Instruction. If, in the opinion of the Consultant, discrepancies between mechanical drawings and actual site conditions are of a minor nature, required modifications are to be done at no additional cost.

.4 Where existing mechanical services extend through, or are in an area to serve items which are to remain, maintain services in operation. Include for rerouting existing services concealed behind existing finishes and which become exposed during renovation work, so as to be concealed behind new or existing finishes.

.5 Unless otherwise specified, remove from site and dispose of existing materials which have been removed and are not to be relocated or reused.

3.02 Roofing Work

.1 Where roof revisions and/or replacements are part of project, include for disconnecting, lifting, or temporarily removing mechanical equipment on roof as required to permit completion of roofing work, and for re-installing equipment when roofing work is complete.

End of Section

1 General

1.01 Section Includes

.1 This Section specifies requirements that are common to Mechanical Divisions work Sections and it is a supplement to each Section and is to be read accordingly. Where requirements of this Section contradict requirements of Division 00 or Division 01, conditions of Division 00 or Division 01 to take precedence.

.2 Be responsible for advising product vendors of requirements of this Section.

1.02 Related Requirements

.1 Division 00 and Division 01 apply to and are a part of this Section.

1.03 Definitions

.1 "concealed" – means hidden from normal sight in furred spaces, shafts, ceiling spaces, walls and partitions.

.2 "exposed" – means work normally visible, including work in equipment rooms, service tunnels, and similar spaces.

.3 "finished" - means when in description of any area or part of an area or a product which receives a finish such as paint, or in case of a product may be factory finished.

.4 "provision" or "provide" (and tenses of "provide") – means supply and install complete.

.5 "install" (and tenses of "install") – means secure in position, connect complete, test, adjust, verify and certify.

.6 "supply" – means to procure, arrange for delivery to site, inspect, accept delivery and administer supply of products; distribute to areas; and include manufacturer's supply of any special materials, standard on site testing, initial start-up, programming, basic commissioning, warranties and manufacturers' assistance to Contractor.

.7 "delete" or "remove" (and tenses of "delete" or "remove") – means to disconnect, make safe, and remove obsolete materials; patch and repair/finish surfaces to match adjoining similar construction; include for associated re-programming of systems and/or change of documentation identifications to suit deletions, and properly dispose of deleted products off site unless otherwise instructed by Owner and reviewed with the Consultant.

.8 "BAS" – means building automation system; "BMS" – means building management system; "FMS" – means facility management system; and "DDC" means direct digital controls; references to "BAS", "BMS", "FMS" and "DDC" generally mean same.

.9 "governing authority" and/or "authority having jurisdiction" and/or "regulatory authority" and/or "Municipal authority" – means government departments, agencies, standards, rules and regulations that apply to and govern work and to which work must adhere.

.10 "OSHA" and "OHSA" – stands for Occupational Safety and Health Administration and Occupational Health and Safety Act, and wherever either one is used, they are to be read to mean local governing occupational health and safety regulations that apply to and govern work and to which work must adhere, regardless if Project falls within either authority's jurisdiction.

.11 "Mechanical Divisions" – refers to Division 20, Division 21, Division 22, Division 23, Division 25, and other Divisions as specifically noted, and which work as defined in Specifications and/or on drawings is responsibility of Mechanical Contractor, unless otherwise noted.

.12 "Electrical Divisions" – refers to Division 26, Division 27, Division 28, and other Divisions as specifically noted, and which work as defined in Specifications and/or on drawings is responsibility of Electrical Contractor, unless otherwise noted.

.13 "Consultant" – means person, firm or corporation identified as such in Agreement or Documents, and is licensed to practice in Place of the Work, and has been appointed by Owner to act for Owner in a professional capacity in relation to the Work.

.14 Wherever words "indicated", "shown", "noted", "listed", or similar words or phrases are used in Contract Documents they are understood, unless otherwise defined, to mean product referred to is "indicated", "shown", "listed", or "noted" on Contract Documents.

.15 Wherever words "reviewed", "satisfactory", "as directed", "submit", or similar words or phrases are used in Contract Documents they are understood, unless otherwise defined, to mean that work or product referred to is "reviewed by", "to the satisfaction of", "submitted to", etc., Consultant.

1.04 Documents

.1 Documents for bidding include but are not limited to issued Drawings, Specifications and Addenda.

.2 Specification is arranged in accordance with CSI/CSC 49 Divisions of MasterFormat.

.3 Drawings and Specifications are portions of Contract Documents and identify labour, products and services necessary for performance of work and form a basis for determining pricing. They are intended to be cooperative. Perform work that is shown, specified, or reasonably implied on the drawings but not mentioned in Specification, or vice-versa, as though fully covered by both.

.4 Review Drawings and Specifications in conjunction with documents of other Divisions and, where applicable, Code Consultant's report.

.5 Unless otherwise specifically noted in Specifications and/or on Drawings, Sections of Mechanical Divisions are not intended to delegate functions nor to delegate work and supply of materials to any specific trade, but rather to generally designate a basic unit of work, and Sections are to be read as a whole.

.6 Drawings are performance drawings, diagrammatic, and show approximate locations of equipment and connecting services. Any information regarding accurate measurement of building is to be taken on site. Do not scale Drawings, and do not use Drawings for prefabrication work.

.7 Drawings are intended to convey the scope of work and do not show architectural and structural details. Provide, at your cost, offsets, fittings, transformations and similar products required as a result of obstructions and other architectural and/or structural details but not shown on Drawings.

.8 Locations of equipment and materials shown may be altered, when reviewed by the Consultant, to meet requirements of equipment and/or materials, other equipment or systems being installed, and of building, all at no additional cost to Contract.

.9 Specification does not generally indicate specific number of items or amounts of material required. Specification is intended to provide product data and installation requirements. Refer to schedules, Drawings (layouts, riser diagrams, schematics, details) and Specification to provide correct quantities. Singular may be read as plural and vice versa.

.10 Starter/motor control centre (MCC)/variable frequency drive (VFD) schedule drawings are both mechanical and electrical, and apply to work of Mechanical Divisions and Electrical Divisions. Be responsible for reviewing starter, MCC, VFD, and motor specification requirements prior to Bid submission. Confirm and coordinate exact scope of work and responsibility of work between Mechanical Divisions and Electrical Divisions.

.11 Drawings and Specifications have been prepared solely for use by party with whom Consultant has entered into a contract and there are no representations of any kind made by the Consultant to any other party.

.12 In the case of discrepancies between the drawings and specifications, documents will govern in order specified in "General Conditions", however, when scale and date of drawings are same, or where discrepancy exists within specification, most costly arrangement will take precedence.

1.05 Metric and Imperial Measurements

.1 Generally, both metric and imperial units of measurement are given in Sections of Specification governed by this section. Measurement conversions may be generally "soft" and rounded off. Confirm exact measurements based on application. Where measurements are related to installation and onsite applications, confirm issued document measurements with applicable local code requirements, and/or as applicable, make accurate measurements onsite. Where significant discrepancies are found, immediately notify Consultant for direction.

1.06 Examination of Documents and Site

.1 Carefully examine Documents and visit site to determine and review existing site conditions that will or may affect work, and include for such conditions in Bid Price.

.2 Report to Consultant, prior to Bid Submittal, any existing site condition that will or may affect performance of work as per Documents. Failure to do so will not be grounds for additional costs.

.3 Upon finding discrepancies in, or omissions from Documents, or having doubt as to their meaning or intent, immediately notify Consultant, in writing.

1.07 Work Standards

.1 Where any code, regulation, bylaw, standard, contract form, manual, printed instruction, and installation and application instruction is quoted it means, unless otherwise specifically noted, latest published edition at time of submission of Bids adopted by and enforced by local governing authorities having jurisdiction. Include for compliance with revisions, bulletins, supplementary standards or amendments issued by local governing authorities.

.2 Where regulatory codes, standards and regulations are at variance with Drawings and Specification, more stringent requirement will apply unless otherwise directed by Owner and reviewed with the Consultant.

.3 Supplementary mandatory specification and requirements to be used in conjunction with project include but are not limited to following:

.1 Air-Conditioning, Heating and Refrigeration Institute (AHRI);

.2 Air Movement and Control Association (AMCA);

.3 American Iron and Steel Institute (AISI);

.4 American National Standards Institute (ANSI);

.5 American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc., (ASHRAE);

.6 American Society of Mechanical Engineers (ASME);

.7 American Society of Testing and Materials (ASTM);

.8 American Water Works Association (AWWA);

.9 Associated Air Balance Council (AABC);

.10 Building Industry Consulting Services, International (BICSI);

.11 Canadian Gas Association (CGA);

.12 Canadian General Standards Board (CGSB);

.13 Canadian Standards Association (CSA);

.14 Electrical and Electronic Manufacturers Association of Canada (EEMAC);

.15 Electrical Safety Authority (ESA);

.16 Electronic Industries Association (EIA);

.17 Factory Mutual Systems (FM);

.18 Illuminating Engineering Society (IES);

.19 Institute of Electrical and Electronic Engineers (IEEE);

.20 International Standards Organization (ISO);

.21 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS);

.22 National Building Code of Canada (NBC);

.23 National Electrical Manufacturers Association (NEMA);

.24 National Environmental Balancing Bureau (NEBB);

.25 National Fire Protection Association (NFPA);

.26 National Standards of Canada;

.27 NSF International;

.28 Occupational Health and Safety Act (OHSA);

.29 Ontario Building Code (OBC);

.30 Ontario Electrical Safety Code (OESC);

.31 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA);

.32 Technical Standards and Safety Authority (TSSA);

.33 Thermal Insulation Association of Canada (TIAC);

.34 Underwriters' Laboratories of Canada (ULC);

.35 Workplace Hazardous Materials Information System (WHMIS);

.36 Material Safety Data Sheets by product manufacturers;

.37 Local utility inspection permits;

.38 Codes, standards, and regulations of local governing authorities having jurisdiction;

.39 Additional codes and standards listed in Trade Sections;

.40 Owner's standards.

.4 Provide applicable requirements for barrier free access in accordance with latest edition of local governing building code.

.5 Where any governing Code, Regulation, or Standard requires preparation and submission of special details or drawings for review they are to be prepared and submitted to appropriate authorities. Be responsible for costs associated with these submittals.

.6 Unless otherwise specified, install equipment in accordance with equipment manufacturer's recommendations and instructions, and requirements of governing Codes, Standards, and Regulations. Governing Codes, Standards, and Regulations take precedence over manufacturer's instructions.

.7 Work is to be performed by journeyperson tradesmen who perform only work that their certificates permit, or by apprentice tradesmen under direct on site supervision of experienced journeyperson tradesman. Journeyperson to apprentice ratio is not to exceed ratio determined by the Board as stated in Ontario College of Trades and Apprenticeship Act or local equivalent governing body in Place of the Work.

.8 Journeyperson tradesmen are to have a copy of valid trade certificates available at site for review with the Consultant at any time.

.9 Experienced and qualified superintendent is to be on-site at times when work is being performed.

.10 Coordinate work inspection reviews and approvals with governing inspection department to ensure that construction schedule is not delayed. Be responsible for prompt notification of deficiencies to the Consultant and submission of reports and certificates to the Consultant.

.11 Properly protect equipment and materials on site from damage due to elements and work of trades, to satisfaction of Owner and reviewed with the Consultant. Equipment and materials are to be in new condition upon Substantial Performance of the Work.

.12 Mechanical piping system work, including equipment, must comply in all respects with requirements of local technical standards authorities and CSA B51, Boiler, Pressure Vessels and Pressure Piping Code. Where required, mechanical work products must bear a CRN number.

.13 Electrical items associated with mechanical equipment are to be certified and bear stamp or seal of a recognized testing agency such as CSA, UL, ULC, ETL, etc., or bear a stamp to indicate special electrical utility approval.

1.08 Permits, Certificates, Approvals, and Fees

.1 Contact and confirm with local authorities having jurisdiction including utility providers, requirements for approvals from such authorities. Obtain and pay for permits, certificates, and approvals required to complete Work.

.2 Be responsible for ensuring that authorities having jurisdiction which require on-site inspection of work, have ample notification to perform inspection, with sufficient lead time to correct deficiencies in a manner that will not impede schedule of completion of Work. If any defect, deficiency or non-compliant is found in work by inspection, be responsible for costs of such inspection, including any related expenses, making good and return to site, until work is passed by governing authorities.

.3 Obtain and submit to Consultant, approval/inspection certificates issued by governing authorities to confirm that Work as installed is in accordance with rules and regulations of local governing authorities and are acceptable.

.4 Include in each copy of operating and maintenance instruction manuals, copies of approvals and inspection certificates issued by regulatory authorities.

1.09 Requirements for Contractor Retained Engineers

.1 Professional engineers retained to perform consulting services with regard to Project work, i.e. seismic engineer, fire protection engineer or structural engineer, are to be members in good standing with local Association of Professional Engineers, and are to carry and pay for errors and omissions professional liability insurance in compliance with requirements of governing authorities in Place of the Work.

.2 Retained engineer's professional liability insurance is to protect Contractor's consultants and their respective servants, agents, and employees against any loss or damage resulting from professional services rendered by aforementioned consultants and their respective servants, agents, and employees in regards to the Work of this Contract.

.3 Unless otherwise specified in Division 00 or 01, liability insurance requirements are as follows:

.1 coverage is to be a minimum of $1,000,000.00 CDN inclusive of any one occurrence;

.2 insurance policy is not to be cancelled or changed in any way without insurer giving Owner minimum thirty days written notice;

.3 liability insurance is to be obtained from an insurer registered and licensed to underwrite such insurance in the Place of the Work;

.4 retained consultants are to ascertain that sub-consultants employed by them carry insurance in the form and limits specified above;

.5 evidence of the required liability insurance in such form as may be required is to be issued to Owner, Owner's Consultant, and Municipal Authorities as required prior to commencement of aforementioned consultant's services.

1.10 Workplace Safety

.1 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage and disposal of hazardous materials. Submit WHMIS MSDS (Material Safety Data Sheets) for products where required, and maintain one copy at site in a visible and accessible location available to personnel.

.2 Comply with requirements of Occupational Health and Safety Act and other regulations pertaining to health and safety, including worker's compensation/insurance board and fall protection regulations. When working in confined spaces, comply with requirements of Occupational Health and Safety Act - Ontario Regulation 632, "Confined Spaces" and any other applicable Ministry of Labour requirements.

.3 If at any time during course of work, hazardous materials other than those identified in Documents and pertaining to Project Scope of Work, are encountered or suspected that were not identified as being present and which specific instructions in handling of such materials were not given, cease work in area in question and immediately notify Consultant. Comply with local governing regulations with regards to working in areas suspected of containing hazardous materials. Do not resume work in affected area without approval from Owner and reviewed with the Consultant.

1.11 Planning and Layout of Work

.1 Base installation layout, design, terminations, and supply of accessories, on Contract Documents with specific coordination with reviewed shop drawings.

.2 Plan, coordinate, and establish exact locations and routing of services with affected trades prior to installation such that services clear each other as well as other obstructions. Generally, order of right of way for services to be as follows:

.1 piping requiring uniform pitch;

.2 piping 100 mm (4") dia. and larger;

.3 large ducts (main runs);

.4 cable tray and bus duct;

.5 conduit 100 mm (4") dia. and larger;

.6 piping less than 100 mm (4") dia.;

.7 smaller branch ductwork;

.8 conduit less than 100 mm (4") dia.

.3 Unless otherwise shown or specified, conceal work in finished areas, and conceal work in partially finished and/or unfinished areas to extent made possible by the area construction. Install services as high as possible to conserve headroom and/or ceiling space. Notify Consultant where headroom or ceiling space appears to be inadequate prior to installation of work.

.4 Do not use Contract Drawing measurements for prefabrication and layout of piping, sheet metal work and such other work. Locations and routing are to generally be in accordance with Contract Drawings, however, prepare layout drawings for such work. Use established bench marks for both horizontal and vertical measurements. Confirm inverts, coordinate with and make allowances for work of other trades. Accurately layout work, and be entirely responsible for work installed in accordance with layout drawings. Where any invert, grade, or size is at variance with Contract Drawings, notify Consultant prior to proceeding with work.

.5 Prepare plan and interference drawings (at a minimum drawing scale of 1:50 or ¼"=1' 0") of work for coordination with each trade Contractor. Arrange for preparation of detailed section drawings of ceiling spaces of corridors and any other congested areas. Sections are to be cross referenced with plan drawings so that trades may make use of section drawings. Section drawings to indicate lateral and elevation dimensions of major services within ceiling space. Lateral dimensions are to be from grid lines and elevations from top of floor slab. Obtain from Consultant, engineering drawings for this use. Contractors' interference drawings are to be distributed among other Trade Contractors. Submit drawings to the Consultant for review. Failure of General Contractor to prepare and coordinate overall interface drawings of trades does not relieve respective Division Contractor of responsibility to ensure that work is properly planned and coordinated.

.6 Carry out alterations in arrangement of work that has been installed without proper coordination, study, and review, even if in accordance with Contract Documents, in order to conceal work behind finishes, or to allow installation of other work, without additional cost. In addition, make necessary alterations in other work required by such alterations, without additional cost.

.7 Shut-off valves, balancing devices, air vents, equipment and similar products, particularly such products located above suspended ceilings must be located for easy access for servicing and/or removal. Products which do not meet this location requirement are to be relocated to an accessible location at no additional cost.

.8 Be responsible for making necessary changes, at no additional cost, to accommodate structural and building conditions that were missed due to lack of coordination.

1.12 Scheduling

.1 Include for any and all scheduling, coordination, and construction phasing to suit project, specified in Division 01 and/or as indicated on the drawings. Review exact phasing requirements with Consultant prior to start of Work.

.2 Phasing and scheduling of Work is required in order to maintain existing building operations. Include costs (including costs for "off hours" work) for scheduling, co-ordination, and construction phasing to suit

this project as specified in Division 01 and on drawings. Review phasing requirements with the Consultant prior to start of Work.

.3 Protect existing areas above, below and adjacent areas of Work from any debris, noise, or interruptions to existing services to satisfaction of Owner and reviewed with the Consultant. Maintain in operation existing services to these areas to allow Owner to continue use of these areas. If services that are required to be maintained run through areas of renovations, provide necessary protection to services or reroute, in coordination with Owner and Consultant. Include for required premium time work to meet these requirements.

.4 Work being performed within occupied spaces and work affecting surfaces adjacent to occupied spaces may need to be performed after regular business hours. For areas where spaces are used by Owner on a 24 hours basis or over various hours, coordinate hours of work with Owner on a regular basis to suit Owner's schedule. Execute work at times confirmed with and agreed to by Owner and reviewed with the Consultant, so as not to inconvenience Owner's occupation or in any way hinder Owner's use of building. Include for required premium timework to meet these requirements.

.5 Project partial occupancy permits may be required throughout project. Provide for each partial permit, required local governing authority certificate and any other testing/verification certificates for systems.

1.13 Coordination

.1 Review Contract Documents and coordinate work with work of each trade. Coordination requirements are to include but not be limited to following:

.1 requirements for openings, sleeves, inserts and other hardware necessary for installation of work;

.2 concrete work such as housekeeping pads, sumps, bases, etc., required for work, and including required dimensions, operating weight of equipment, location, etc.;

.3 depth and routing of excavation required for work, and requirements for bedding and backfill;

.4 wiring work required for equipment and systems but not specified to be done as part of mechanical work, including termination points, wiring type and size, and any other requirements.

.2 Ensure materials and equipment are delivered to site at proper time and in such assemblies and sizes so as to enter into building and be moved into spaces where they are to be located without difficulty.

.3 Wherever possible, coordinate equipment deliveries with manufacturers and/or suppliers so equipment is delivered to site when it is required, or so it can be stored within building, subject to available space as confirmed with Owner and reviewed with Owner, and protected from elements.

.4 Ensure proper access and service clearances are maintained around equipment, and, where applicable, access space for future equipment removal or replacement is not impeded. Comply with code requirements with regards to access space provision around equipment. Remove and replace any equipment which does not meet this requirement.

.5 Where work is to be integrated, or is to be installed in close proximity with work of other trades, coordinate work prior to and during installation.

1.14 Products

.1 Be responsible for ordering of products (equipment and materials) in a timely manner in order to meet project-scheduling timelines. Failure to order products to allow manufacturers sufficient production/delivery time to meet project-scheduling timelines is an unacceptable reason to request for other suppliers or substitutions.

.2 Provide Canadian manufactured products wherever possible or required and when quality and performance is obtainable at a competitive price. Products are to be supplied from manufacturer's

authorized Canadian representative, unless otherwise noted. Unless otherwise specified, products are to be new and are to comply with applicable respective Canadian standards. References to UL listings of products to include requirements that products are to be also Underwriters Laboratories of Canada (ULC) listed for use in Canada. Products are to meet or exceed latest ANSI/ASHRAE/IES 90.1 standards, as applicable. Do not supply any products containing asbestos materials or PCB materials.

.3 Systems and equipment of this Project are to be "State of the Art" and be most recent and up to date series/version of product that is available at time of shop drawing review process. Products that have been stored or "on shelf" for an extended period of time will not be accepted. Software is to be of latest version available and be provided with updates available at time of shop drawing review process. Systems are to be designed such that its software is backwards compatible. Future upgrades are not to require any hardware replacements or additions to utilize latest software.

.4 Products scheduled and/or specified have been selected to establish a performance and quality standard, and, in some instances, a dimensional standard. In most cases, base specified manufacturers are stated for any product specified by manufacturer's name and model number. Where manufacturers are listed, first name listed is base specified company. Bid Price may be based on products supplied by any of manufacturers' base specified or named as acceptable for particular product. If manufacturers are not stated for a particular product, base Bid Price on product supplied by base specified manufacturer.

.5 Documents have been prepared based on product available at time of Bidding. If, after award of Contract, and if successful manufacturer can no longer supply a product that meets base specifications, notify Consultant immediately. Be responsible for obtaining other manufacturers product that complies with base specified performance and criteria and meets project timelines. Proposed products are subject to review and consideration by the Consultant and are considered as substitutions subject to a credit to Contract. In addition, if such products require modifications to room spaces, mechanical systems, electrical systems, etc., include required changes. Such changes are to be submitted in detail to the Consultant for review and consideration for acceptance. There will be no increase in Contract Price for revisions. Above conditions supplement and are not to supersede any specification conditions with regards to substitutions or failure to supply product as per issued documents.

.6 Listing of a product as "acceptable" does not imply automatic acceptance by the Consultant and/or Owner. It is responsibility of Contractor to ensure that any price quotations received and submittals made are for products that meet or exceed specifications included herein.

.7 If products supplied by a manufacturer named as acceptable are used in lieu of base specified manufacturer, be responsible for ensuring that they are equivalent in performance and operating characteristics (including energy consumption if applicable) to base specified products. It is understood that any additional costs (i.e. for larger starters, larger feeders, additional spaces, etc.), and changes to associated or adjacent work resulting from provision of product supplied by a manufacturer other than base specified manufacturer, is included in Bid Price. In addition, in equipment spaces where equipment named as acceptable is used in lieu of base specified equipment and dimensions of such equipment differs from base specified equipment, prepare and submit for review accurately dimensioned layouts of rooms affected, identifying architectural and structural elements, systems and equipment to prove that equipment in room will fit properly meeting design intent. There will be no increase in Contract Price for revisions.

.8 In addition to manufacturer's products base specified or named as acceptable, other manufacturers of products may be proposed as substitutions to the Consultant for review and consideration for acceptance, listing in each case a corresponding credit for each substitution proposed. However, base Bid Price on products base specified or named as acceptable. Certify in writing to the Consultant that proposed substitution meets space, power, design, energy consumption, and other requirements of base specified or acceptable product. It is understood that there will be no increase in Contract Price by reason of any changes to associated equipment, mechanically, electrically, structurally or architecturally, required by acceptance of proposed substitution. Consultant has sole discretion in accepting any such proposed substitution of product. Indicate any proposed substitutions in areas provided on Bid Form. Do not order such products until they are accepted in writing by the Consultant.

.9 Where products are listed as "or approved equal", certify in writing that product to be used in lieu of base specified product, at least meets space, power, design, energy consumption, and other requirements of base specified product and is equivalent or better than base specified product. When requested by the Consultant, provide full design detail drawings and specifications of proposed products. Acceptance of these "or approved equal" products is at sole discretion of the Consultant. It is understood that there will be no increase in Contract Price by reason of any changes to associated equipment, mechanically, electrically, structurally or architecturally, required by acceptance of approved equal product. There must be no increase in Contract price due to Consultant's rejection of proposed equivalent product.

.10 Whenever use of product other than base specified product is being supplied, ensure corresponding certifications and product information (detailed catalogue and engineering data, fabrication information and performance characteristics) are submitted to the Consultant for review. Failure of submission of these documents to the Consultant in a timely manner to allow for review will result in base specified product to be supplied at Consultant's discretion, at no additional cost to Contract.

.11 Products supplied by a manufacturer/supplier other than a manufacturer listed as acceptable may be considered for acceptance by the Consultant if requested in writing with full product documentation submitted, a minimum of 10 working days prior to Bid closing date.

.12 Any proposed changes initiated by Contractor after award of Contract may be considered by the Consultant at the Consultant's discretion, with any additional costs for such changes if accepted by Owner and reviewed with the Consultant, and costs for review, to be borne by Contractor.

.13 Whenever use of product other than based specified products or named as acceptable is being supplied, time for process of submission of other products and Consultant's review of products will not alter contract time or delay work schedule.

1.15 Shop Drawings

.1 At start-up meeting, review with the Consultant products to be included in shop drawing submission. Prepare and submit list of products to the Consultant for review.

.2 Submit electronic copies of shop drawings unless otherwise directed by the Consultant. Coordinate exact requirements with the Consultant.

.3 Submit for review, drawings showing detail design, construction, and performance of equipment and materials as requested in Specification. Submit shop drawings to the Consultant for review prior to ordering and delivery of product to site. Include minimally for preparation and submission of following, as applicable:

.1 product literature cuts;

.2 equipment data sheets;

.3 equipment dimension drawings;

.4 system block diagrams;

.5 sequence of operation;

.6 connection wiring schematic diagrams;

.7 functionality with integrated systems.

.4 Each shop drawing or product data sheet is to be properly identified with project name and product drawing or specification reference. Shop drawing or product data sheet dimensions are to match dimension type on drawings.

.5 Where any item of equipment is required by Code or Standard or By-Law to meet a specific energy efficiency level, or any other specific requirement, ensure this requirement is clearly indicated on submission.

.6 Ensure proposed products meet each requirement of Project. Endorse each shop drawing copy "CERTIFIED TO BE IN ACCORDANCE WITH ALL REQUIREMENTS". Include company name, submittal date, and sign each copy. Shop drawings that are received and are not endorsed, dated and signed will be returned to be resubmitted.

.7 Consultant to review shop drawings and indicate review status by stamping shop drawing copies as follows:

.1 "REVIEWED" or "REVIEWED AS NOTED" (appropriately marked) – If Consultant's review of shop drawing is final, Consultant to stamp shop drawing;

.2 "RETURNED FOR CORRECTION" – If Consultant's review of shop drawing is not final, Consultant to stamp shop drawing as stated above, mark submission with comments, and return submission. Revise shop drawing in accordance with Consultant's notations and resubmit.

.8 Following is to be read in conjunction with wording on Consultant's shop drawing review stamp applied to each and every shop drawing or product data sheet submitted:

.1 "THIS REVIEW BY CONSULTANT IS FOR SOLE PURPOSE OF ASCERTAINING CONFORMANCE WITH GENERAL DESIGN CONCEPT. THIS REVIEW DOES NOT MEAN THAT CONSULTANT APPROVES DETAILED DESIGN INHERENT IN SHOP DRAWINGS, RESPONSIBILITY FOR WHICH REMAINS WITH CONTRACTOR. CONSULTANT'S REVIEW DOES NOT RELIEVE CONTRACTOR OF RESPONSIBILITY FOR ERRORS OR OMISSIONS IN SHOP DRAWINGS OR OF CONTRACTOR'S RESPONSIBILITY FOR MEETING REQUIREMENTS OF CONTRACT DOCUMENTS. BE RESPONSIBLE FOR DIMENSIONS TO BE CONFIRMED AND CORRELATED AT JOB SITE, FOR INFORMATION THAT PERTAINS SOLELY TO FABRICATION PROCESSES OR TO TECHNIQUES OF CONSTRUCTION AND INSTALLATION, AND FOR COORDINATION OF WORK OF SUB-TRADES."

.9 Submit each system and each major component as separate shop drawing submissions. Submit together, shop drawings for common devices such as devices of each system are to be submitted together.

.10 Obtain shop drawings for submission from product manufacturer's authorized representatives and supplemented with additional items specified herein.

.11 Do not order product until respective shop drawing review process has been properly reviewed with the Consultant.

.12 Where extended warranties are specified for equipment items, submit specified extended warranty with shop drawing submittal.

.13 Applicable mechanical equipment has been selected to meet energy efficiency requirements of ANSI/ASHRAE/IES 90.1, Energy Standards for Buildings, and shop drawings/product data submittals for such equipment must indicate compliance with this Standard or they will be returned for correction and re-submittal.

1.16 Equipment Loads

.1 Supply equipment loads (self-weight, operating weight, housekeeping pad, inertia pads, etc.) to the Consultant, via shop drawing submissions, prior to construction.

.2 Where given choice of specific equipment, actual weight, location and method of support of equipment may differ from those assumed by the Consultant for base design. Back-check equipment loads, location, and supports, and include necessary accommodations.

.3 Where supporting structure consists of structural steel framing, it is imperative that equipment loads, location, and method of support be confirmed prior to fabrication of structural steel. Review locations of equipment with the Consultant prior to construction.

1.17 Openings

.1 Supply opening sizes and locations to the Consultant to allow verification of their effect on design, and for inclusion on structural drawings where appropriate.

.2 No openings are permitted through completed structure without written approval from Owner and reviewed with the Consultant. Show required openings on a copy of structural drawings. Identify exact locations, elevations, and size of proposed openings and submit to the Consultant for review, well in advance of doing work.

.3 Prior to leaving site at end of each day, walk through areas of work and check for any openings, penetrations, holes, and/or voids created under scope of work of project, and ensure that any openings created under scope of work have been closed off, fire-stopped and smoke-sealed. Unless directed by Owner and reviewed with the Consultant, do not leave any openings unprotected and unfinished overnight.

1.18 Scaffolding, Hoisting and Rigging

.1 Unless otherwise specified or directed, supply, erect and operate scaffolding, rigging, hoisting equipment and associated hardware required for work, and subject to approval from Owner and reviewed with the Consultant.

.2 Immediately remove from site scaffolding, rigging and hoisting equipment when no longer required.

.3 Do not place major scaffolding/hoisting equipment loads on any portion of structure without approval from Owner and reviewed with the Consultant.

1.19 Changes in the Work

.1 Whenever Consultant proposes in writing to make a change or revision to design, arrangement, quantity or type of work from that required by Contract Documents, prepare and submit to the Consultant for review, a quotation being proposed cost for executing change or revision.

.2 Quotation is to be a detailed and itemized estimate of product, labour, and equipment costs associated with change or revision, plus overhead and profit percentages and applicable taxes and duties.

.3 Unless otherwise specified in Division 00 or Division 01, allowable maximum percentages for overhead and profit are to be 7% and 5% respectively.

.4 Unless otherwise specified in Division 00 or Division 01, following additional requirements apply to all quotations submitted:

.1 when change or revision involves deleted work as well as additional work, cost of deleted work (less overhead and profit percentages but including taxes and duties) is to be subtracted from cost of additional work before overhead and profit percentages are applied to additional work;

.2 material costs are not to exceed those published in the latest edition of Allpriser price guide, less the following discounts:

Item	Discount
Steel Pipe	50%
Copper Pipe	45%
Cast Iron Soil Pipe	45%
Stainless Steel Pipe and Fittings	45%
Welded Fittings	50%
Grooved Fittings	30%
Threaded Fittings	40%
Cast Iron Screwed Fittings	40%
Copper Fittings	45%
Cast Iron MJ Fittings	35%
Valves	25%
Insulation Materials	35%
All Other Materials	[ ]%

.3 mechanical material labour unit costs are to be in accordance with Mechanical Contractors Association of America Labor Estimating Manual, less 25%;

.4 electrical material labour unit costs are to be in accordance with National Electrical Contractors Association Manual of Labor Units at difficult level, less 25%;

.5 costs for journeyperson and apprentice labour must not exceed prevailing rates at time of execution of Contract and must reflect actual personnel performing work;

.6 cost for site superintendent must not exceed 10% of total hours of labour estimated for change or revision, and change or revision must be such that site superintendent's involvement is necessary;

.7 costs for rental tools and/or equipment are not to exceed local rental costs;

.8 overhead percentage will be deemed to cover quotation costs other than actual site labour and materials, and rentals;

.9 quotations, including those for deleted work, to include a figure for any required change to Contract time.

.5 Quotations submitted that are not in accordance with requirements specified above will be rejected and returned for re-submittal. Failure to submit a proper quotation to enable Consultant to expeditiously process quotation and issue a Change Order will not be grounds for any additional change to Contract time.

.6 Make requests for changes or revisions to work to Consultant in writing and, if Consultant agrees, will issue Notice of Change.

.7 Do not execute any change or revision until written authorization for the change or revision has been obtained from the Consultant.

1.20 Progress Payment Breakdown

.1 Prior to submittal of first progress payment draw, submit a detailed breakdown of work cost to assist Consultant in reviewing and approving progress payment claims.

.2 Payment breakdown is subject to Owner's approval and Consultant's review. Progress payments will not be processed until an approved breakdown is in place. Breakdown is to include one-time claim items such as mobilization and demobilization, insurance, bonds (if applicable), shop drawings and product data sheets, commissioning including testing, adjusting and balancing, system testing and verification, and project closeout submittals.

.3 Indicate equipment, material and labour costs for site services (if applicable) and indicate work of each trade in same manner as indicated on progress draw.

1.21 Notice for Required Field Reviews

.1 Whenever there is a requirement for the Consultant to perform a field review prior to concealment of any work, to inspect/re-inspect work for deficiencies prior to Substantial Performance of the Work, for commissioning demonstrations, and any other such field review, give minimum 5 working days' notice in writing to the Consultant.

.2 If Consultant is unable to attend a field review when requested, arrange an alternative date and time.

.3 Do not conceal work until the Consultant advises that it may be concealed.

.4 When Consultant is requested to perform a field review and work is not ready to be reviewed, reimburse Consultant for time and travel expenses.

1.22 Preliminary Testing

.1 When directed by the Consultant, promptly arrange, pay for, and perform site tests on any piece of equipment or any system for such reasonable lengths of time and at such times as may be required to prove compliance with Specification and governing Codes and Regulations, prior to Substantial Performance of the Work.

.2 When, in Consultant's opinion, tests are required to be performed by a certified testing laboratory, arrange and pay for such tests.

.3 These tests are not to be construed as evidence of acceptance of work, and it is agreed and understood that no claim for delays or damage will be made for injury or breakage to any part or parts of equipment or system due to test where such injuries or breakage were caused by faulty parts and/or workmanship of any kind.

.4 When, in Consultant's opinion, tests indicate that equipment, products, etc., are defective or deficient, immediately remove such equipment and/or products from site and replace them with acceptable equipment and/or products, at no additional cost.

1.23 Provisions for Systems/Equipment Used During Construction

.1 Permanent building mechanical systems are not to be used for temporary heating or cooling purposes during construction.

1.24 Temporary Services

.1 Coordinate with Prime Contractor, requirements for temporary services including but not limited to temporary heating, cooling and water. Unless otherwise noted, provide required services in compliance with requirements of local governing building code and local governing inspection authorities.

.2 Maintain fire protection of areas which may include fire watch during temporary shutdowns of existing systems, in accordance with requirements of local governing code and local governing authorities.

1.25 Maintaining Equipment Prior to Acceptance

.1 Maintain equipment in accordance with the manufacturer's printed instructions prior to start-up, testing and commissioning.

.2 Employ a qualified millwright to check and align shafts, drives, and couplings on all base mounted split coupled motor driven equipment.

.3 Where equipment lubrication fittings are not easily accessible, extend the fittings to accessible locations using copper or aluminium tubing.

.4 All filters are to be new upon Substantial Performance of the Work. This is in addition to any spare filters specified.

1.26 Record Documentation

.1 Drawings for this project have been prepared on a CAD system using AutoCAD software of release version reviewed with the Consultant. For purpose of producing record "as built" drawings, copies of Contract Drawings can be obtained from the Consultant.

.2 As work progresses at site, clearly mark in red in a neat and legible manner on a set of bound white prints of Contract Drawings, changes and deviations from routing of services and locations of equipment shown on Contract Drawings, on a daily basis. Changes and deviations include those made by addenda, change orders, and site instructions. Use notes marked in red as required. Maintain white print red line as-built set at site for exclusive use of recording as-built conditions, keep set up-to-date at all times, and ensure set is always available for periodic review. As-built set is also to include the following:

.1 dimensioned location of inaccessible concealed work;

.2 locations of control devices with identification for each;

.3 for underground piping and ducts, record dimensions, invert elevations, offsets, fittings, cathodic protection and accessories if applicable, and locate dimensions from benchmarks to be preserved after construction is complete;

.4 for fire protection systems, record actual locations of equipment, sprinkler heads, and valves, drains, and test locations, and deviations of pipe routing and sizing from that shown on the drawings;

.5 location of piping system air vents;

.6 location of concealed services terminated for future extension and work concealed within building in inaccessible locations.

.3 Before applying for a Certificate of Substantial Performance of the Work, update a clean copy of Contract Drawing set in accordance with marked up set of "as-built" white prints including deviations from original Contract Drawings, thus forming an "as-built" drawing set. Submit "as-built" site drawing prints to the Consultant for review. Make necessary revisions to drawings as per Consultant's comments, to satisfaction of the Consultant.

.4 Use final reviewed "as-built" drawing set to provide CAD files of drawings thus forming true "as-built" set of Contract Drawings. Identify set as "Project Record Copy". Load digital copies of final reviewed by the Consultant as-built drawings onto USB type flash drive. Provide 2 complete sets of "as-built" drawings on separate USBs. Submit "as-built" sets of white prints and USBs to Consultant.

.5 Submitted drawings are to be of same quality as original Contract Drawings. CAD drawing files are to be compatible with AutoCAD software release version confirmed with the Consultant.

.6 Unless otherwise noted in Division 00 or Division 01, failure to maintain accurate record drawings will incur additional 5% holdback on progress claims until drawings are brought up to date to satisfaction of Owner and reviewed with the Consultant.

.7 For projects with phased turnover of project (refer to Division 01), review with the Consultant completeness of as-built drawings prior to turn over of an area. Interim as-built drawings to be made available to Owner's maintenance personnel.

.8 Where part of the Mechanical Scope of Work, retain and pay for services of a land surveyor registered in Place of the Work to measure, verify, and record size, location, invert elevation and pitch of buried piping services, and, when complete, transfer survey work to as-built drawings.

1.27 Operating and Maintenance Data

.1 For each item of equipment for which a shop drawing is required (except for simple equipment), supply indexed copies of equipment manufacturers' operating and maintenance (O&M) instruction data manuals. Consolidate each copy of data as a PDF file on a USB drive. Consolidated O&M manual PDF to include:

.1 front cover: project name; wording – "Mechanical Systems Operating and Maintenance Manual"; and date;

.2 introduction sheet listing Consultant, Contractor, and Subcontractor names, street addresses, telephone and fax numbers, and e-mail addresses;

.3 equipment manufacturer's authorized contact person name, telephone number and company website;

.4 Table of Contents sheet, and corresponding index tab sheets;

.5 copy of each "REVIEWED" or clean, updated "REVIEWED AS NOTED" shop drawing or product data sheet, with manufacturer's/supplier's name, telephone and fax numbers, email address, company website address, and email address for local source of parts and service; when shop drawings are returned marked "Reviewed As Noted" with revisions marked on shop drawing copies, they are to be revised by equipment supplier to incorporate comments marked on "Reviewed" shop drawings and a clean updated copy is to be included in operating and maintenance manuals;

.6 Operating data is to include:

.1 pressure test reports, and certificates issued by governing authorities;

.2 description of each system and its controls;

.3 control schematics for equipment/systems including building environmental controls;

.4 wiring and connection diagrams;

.5 if applicable, BAS architecture and all required operating data;

.6 description of operation of each system at various loads together with reset schedules and seasonal variances;

.7 operation instruction for each system and each component;

.8 description of actions to be taken in event of emergencies and/or equipment failure;

.9 valve tag schedule, and flow diagrams to indicate valve locations.

.7 Maintenance data is to include:

.1 operation and trouble-shooting instructions for each item of equipment and each system;

.2 schedules of tasks, frequency, tools required, and estimated task time;

.3 recommended maintenance practices and precautions;

.4 complete parts lists with numbers.

.8 Performance data is to include:

.1 equipment and system start-up data sheets;

.2 equipment performance verification test results, and final commissioning report;

.3 final testing, adjusting and balancing reports.

.9 copies of warranties;

.10 items requested specifically in Section Articles.

.2 Operating and maintenance instructions are to relate to job specific equipment supplied under this project and related to Owner's building. Language used in manuals is to contain simple practical operating terms and language easy for in-house maintenance staff to understand how to operate and maintain each system.

.3 Before applying for a Certificate of Substantial Performance of the Work, assemble one copy of O&M Manual and submit to the Consultant for review prior to assembling remaining copies. Incorporate Consultant's comments into final submission.

1.28 Commissioning

.1 An independent Commissioning Agent is retained by Owner to perform equipment and system commissioning work as specified in Division 01, and in Section 20 08 00 – Commissioning of Mechanical Systems. Interface, cooperate and coordinate with Owner's Commissioning Agent. Submit copies of submittals such as shop drawings/product data sheets, schedules, O&M manuals, and test reports to Commissioning Agent as required.

1.29 Warranty

.1 Unless otherwise specified in Division 00 and Division 01, warrant mechanical work to be in accordance with Contract Documents and free from defects for a period of 1 year from date of issue of a Certificate of Substantial Performance of the Work.

.2 Where equipment includes extended warranty period, e.g., 5 years, first year of warranty period is to be governed by terms and conditions of warranty in Contract Documents, and remaining years of warranty are to be direct from equipment manufacturer and/or supplier to Owner. Submit signed and dated copies of extended warranties to the Consultant.

.3 Warranty to include parts, labour, travel costs and living expenses incurred by manufacturer's authorized technician to provide factory authorized on-site service.

.4 Repair and/or replace any defects that appear in Work within warranty period without additional expense to Owner. Be responsible for costs incurred in making defective work good, including repair or replacement of building finishes, other materials, and damage to other equipment. Ordinary wear and tear and damage caused wilfully or due to carelessness of Owner's staff or agents is exempted.

.5 Do not include Owner deductible amounts in warranties.

.6 It is understood that warranties are to commence from time of Substantial Performance of the Work, regardless of what is noted within following Sections of Specification. Be responsible for providing whatever "bridging" or additional extended warranty period is required from time that material is purchased until this time.

.7 Visit building during warranty period with Owner representatives. Owner to organize these visits. At these meetings, Owner representatives are to review performance of systems. If performance is satisfactory, then no further action needs to be taken. If unsatisfactory, then correct deficiencies, as directed by Owner representatives, to satisfaction of Owner's representatives. These site visits to occur:

.1 once during 1st month of building operation;

.2 once during 3rd month of building operation;

.3 once between 4th and 10th month in a season opposite to 1st and 3rd month visits.

1.30 Closeout Submittals

.1 Prior to application for Substantial Performance of the Work, submit required items and documentation specified, including following as applicable to the project:

.1 Operating and Maintenance Manuals;

.2 as-built record drawings and associated data;

.3 extended warranties for equipment as specified;

.4 operating test certificates, i.e. Sprinkler Test Certificate;

.5 final commissioning report and TAB report;

.6 identified keys for equipment and/or panels for which keys are required, and other items required to be submitted;

.7 other data or products specified.

1.31 Instructions to Owner

.1 Refer to equipment and system operational and maintenance training requirements specified in Division 01.

.2 Train Owner's designated personnel in aspects of operation and maintenance of equipment and systems as specified. Demonstrations and training are to be performed by qualified technicians employed by equipment/system manufacturer/supplier. Supply hard copies of training materials to each attendee.

.3 Unless where specified otherwise in trade Sections, minimum requirements are for manufacturer/suppliers of each system and major equipment, to provide minimum two separate sessions each consisting of minimum 4 hours on site or in factory training (at Owner's choice), of Owner's designated personnel (for up to 6 people each session), on operation and maintenance procedures of system.

.4 For each item of equipment and for each system for which training is specified, prepare training modules as specified below. Use Operating and Maintenance Manuals during training sessions. Training modules include but are not limited to:

.1 Operational Requirements and Criteria – equipment function, stopping and starting, safeties, operating standards, operating characteristics, performance curves, and limitations;

.2 Troubleshooting – diagnostic instructions, test and inspection procedures;

.3 Documentation – equipment/system warranties, and manufacturer's/supplier's parts and service facilities, telephone numbers, email addresses, and the like;

.4 Maintenance – inspection instructions, types of cleaning agents to be used as well as cleaning methods, preventive maintenance procedures, and use of any special tools;

.5 Repairs – diagnostic instructions, disassembly, component removal and repair instructions, instructions for identifying parts and components, and review of any spare parts inventory.

.5 Before instructing Owner's designated personnel, submit to the Consultant for review preliminary copy of training manual and proposed schedule of demonstration and training dates and times. Incorporate Consultant's comments in final copy.

.6 Obtain in writing from the Consultant list of Owner's representatives to receive instructions. Submit to Consultant prior to application for Certificate of Substantial Performance of the Work, complete list of systems for which instructions were given, stating for each system:

.1 date instructions were given to Owner's staff;

.2 duration of instruction;

.3 names of persons instructed;

.4 other parties present (manufacturer's representative, consultants, etc.).

.7 Obtain signatures of Owner's staff to verify they properly understood system installation, operation and maintenance requirements, and have received operating and maintenance instruction manuals and "as-built" record drawings.

.8 Submit to Consultant copy of electronic version of training materials and include in operating and maintenance manuals submission.

1.32 Final Inspection

.1 Submit to Consultant, written request for final inspection of systems. Include written certification that:

.1 deficiencies noted during job inspections have been completed;

.2 field quality control procedures have been completed;

.3 systems have been tested and verified, balanced and adjusted, and are ready for operation;

.4 maintenance and operating data have been completed and submitted to, reviewed with the Consultant and accepted by Owner;

.5 tags and nameplates are in place and equipment identifications have been completed;

.6 clean-up is complete;

.7 spare parts and replacement parts specified have been provided and acknowledged by the Consultant;

.8 as-built and record drawings have been completed and submitted to and reviewed with the Consultant and accepted by Owner;

.9 Owner's staff has been instructed in operation and maintenance of systems;

.10 commissioning procedures have been completed.

2 Products – Not Used

3 Execution – Not Used

3.01 Cleaning

.1 During construction, keep site reasonably clear of rubbish and waste material resulting from work on a daily basis to the satisfaction of Owner and Consultant. Before applying for a Certificate of Substantial Performance of the Work, remove rubbish and debris, and be responsible for repair of any damage caused as a result of work.

.2 Clean equipment and devices installed as part of this project.

End of Section

1 General

1.01 Submittals

.1 Submit shop drawings/product data sheets for:

.1 electric motors (submit with equipment they are associated with).

.2 Submit a list of equipment identification nameplates indicating proposed wording and sizes.

2 Products

2.01 Equipment Belt Drives

.1 ANSI/RMA Standard V-belt type rated at minimum 1.5 times motor nameplate rating, and in accordance with following requirements:

.1 belts are to be reinforced cord and rubber, and multiple belts are to be matched sets;

.2 sheaves are to be cast iron or steel, secured to shafts with removable keys unless otherwise specified, standard adjustable pitch (± 10% range) for motors under 10 HP, fixed pitch type with split tapered bushing and keyway for motors 10 HP and larger, and, if required, replaced as part of mechanical work to suit system air/water quantity testing and balancing work;

.3 motor slide rail adjustment plates are to allow for centre line adjustment.

.2 Supply a spare belt set (tagged and identified) for each belt drive and hand to Owner upon Substantial Performance of the Work.

2.02 Equipment Drive Guards and Accessories

.1 For V-belt drives – removable, 4-sided, fully enclosed, galvanized sheet steel guards to OHSA standards, cleaned, factory primed and painted with yellow equipment enamel, complete with a 2-piece full length hinged front panel to permit belt maintenance or replacement without removing guard, and 40 mm (1-½") diameter tachometer openings at each shaft location.

.2 For flexible couplings – removable "U" shaped galvanized steel guards to OHSA Standards with a 2.3 mm (3/32") thick frame and expanded mesh face.

.3 For unprotected fan inlets and outlets – unless otherwise specified, removable 20 mm (¾") galvanized steel wire mesh with galvanized steel frames, all to OHSA Standards.

2.03 Electric Motors

.1 Unless otherwise specified, motors are to conform to NEMA Standard MG1, applicable IEEE Standards, and applicable CSA C22.2 Standards, and are to meet NEMA standards for maximum sound level ratings under full load. Confirm motor voltages prior to ordering.

.2 Vertically mounted and submersible motors are to be purposely designed for mounting in this attitude.

.3 Efficiency of 1-phase motors to 1 HP is to be in accordance with CAN/CSA C747. Efficiency of 3-phase motors 1 HP and larger is to be in accordance with CAN/CSA C390 or IEEE 112B.

.4 Unless otherwise specified, 1-phase motors smaller than ½ HP are to be 115 volt, continuous duty capacitor start type with an NEMA 48 or 56 frame size, solid base, heavy-gauge steel shell with solid die-cast end shields, dynamically balanced die-cast rotor, integral automatic reset thermal overload protection, Class "B" insulation, and a 1.15 service factor at 40°C (105°F) ambient temperature.

.5 Explosion-proof 1-phase motors are to be totally enclosed, fan cooled, 115 volt continuous duty capacitor start type in accordance with CSA C22.2 No. 145, as specified for standard 1-phase motors but suitable for use in Class 1 Group D hazardous locations and complete with a rolled steel shell and a 1.0 service factor at 40°C (105°F) ambient temperature.

.6 Unless otherwise specified, motors ½ HP and larger are to be totally enclosed, fan cooled, 3-phase, T-frame, squirrel cage continuous duty induction motors suitable for voltages indicated on Drawings, NEMA Design "B" for normal starting torque or Design "C" for high starting torque as required by the application, each complete with Class "B" insulation, a 1.15 service factor at 40°C ambient temperature, grease lubricated open ball bearings with grease fittings to permit re-lubrication without dismantling motor, a cast iron frame with cast iron feet where required, cast iron end bracket and precision machined bearing fit, and balanced carbon steel shaft assembly with die-cast aluminum rotor windings.

.7 Explosion-proof 3-phase motors are to be totally enclosed fan cooled motors in accordance with CSA C22.2 No. 145, generally as specified above for standard 3-phase motors but suitable for use in Class 1 Group D hazardous locations and with a 1.0 service factor at 40°C (105°F) ambient temperature.

.8 Motor(s) for 2-speed cooling tower(s) are to be as specified above but 2-speed single winding type.

.9 Motor(s) for 2-speed fan(s) are to be as above but 2-speed double winding type.

.10 Unless otherwise indicated, motors 30 HP and larger are to be complete with a heat sensing PTC thermistor in the end turn of stator winding for each phase and connected in series inside motor with 2 marked leads brought out to motor conduit box.

.11 Motors for equipment with variable frequency drives are to be generally as specified above but inverter duty type to NEMA Standard MG-1 Part 31, quantified by CSA for operation from a variable frequency drive of type specified, and complete with Class "H" insulation. Motors are to be equipped with AEGIS, or approved equal, shaft grounding ring system to protect bearings from damage by diverting harmful shaft voltages and bearing currents to ground.

.12 Motors 150 HP and larger with "wye-delta" reduced voltage starters are to be complete with six leads for connection to motor starter.

.13 Motors for equipment which is scheduled or specified with a corrosion resistant coating or constructed from corrosion resistant materials are to be factory coated with a primer and epoxy paint finish.

.14 Manufacturers:

.1 TECO-Westinghouse Motors (Canada) Inc.;

.2 Canadian General Electric;

.3 Baldor Electric Co.;

.4 U.S. Electrical Motors;

.5 Weg Electric Corp.;

.6 Marathon Electric;

.7 Toshiba Corp.;

.8 Leeson Canada.

2.04 Motor Starters and Accessories

.1 Motor starters must be capable of starting associated motors under the imposed loads. Confirm starter voltage matches motor prior to ordering.

.2 Unless otherwise specified, starters for 1-phase motors are to be 115 volt, thermal overload protected manual starting switches with a neon pilot light, a surface or recessed enclosure to suit the application, and, where automatic operation is required, a separate H-O-A switch in an enclosure to match starter enclosure.

.3 Unless otherwise specified, starters for 3-phase motors less than 50 HP are to be combination "quick-make" and "quick-break" fused disconnects and full voltage non-reversing across-the-line starters, each complete with and overload relay per phase, an enclosure to suit the application, and, a H-O-A switch, pilot lights, control transformer, auxiliary contacts, and other accessories as per motor starter schedule.

.4 Unless otherwise specified, starters for 3-phase motors 50 HP to 150 HP are to be reduced voltage, non-reversing, auto-transformer type starters complete with one overload relay per phase, an enclosure to suit the application, and, a H-O-A switch, pilot lights, control transformer, auxiliary contacts, and other accessories as per motor starter schedule.

.5 Unless otherwise specified, starters for 3-phase motors 150 HP and larger are to be reduced voltage, non-reversing, closed transition "wye-delta" starters complete with one overload relay per phase, an enclosure to suit the application, and, a H-O-A switch, pilot lights, control transformer, auxiliary contacts, and other accessories as per motor starter schedule.

.6 Starters for 2-speed double winding motors are to be generally as specified above but suitable for motor and equipped with a 45 second time delay to permit equipment to coast down to low speed before it is operated at low speed.

.7 Starters for 2-speed single winding motors are to be generally as specified above but suitable for motor and equipped with a 45 second time delay to permit equipment to coast down to low speed before it is operated at low speed.

.8 Starters for reversible motors for cooling towers are to be generally as specified above but suitable for motor and equipped with a 45 second time delay to allow fan(s) to coast down to a stop before being operated in reverse rotation.

.9 Unless otherwise specified, motor starter enclosures are to be in accordance with following NEMA ratings:

.1 enclosures located in sprinklered areas – Type 2;

.2 enclosures exposed to the elements – Type 3R, constructed of stainless steel;

.3 enclosures inside the building in wet areas – Type 3R, constructed of stainless steel;

.4 enclosures in explosion rated area – Type 7 with exact requirements to suit the area and application;

.5 enclosures except as noted above – Type 1;

.6 enclosures located in finished areas – as above but recess type with brushed stainless steel faceplate.

.10 Motor control centres are to be multi-unit, 2.28 m (9') high, NEMA Class 1, type "B", factory assembled, dead front, floor mounted, free-standing motor control centre with tin plated copper bus and an NEMA Type 1 or Type 2 enclosure as for loose starters specified above. Each motor control centre is to be complete with starters as specified above, load and control wiring terminal boards, and required facilities for line and load side power wiring connections.

.11 Disconnect switches for motor control centres are to be heavy-duty, CSA certified, front operated switches as per motor starter schedule, each complete with a handle suitable for padlocking in "off" position and arranged so that door cannot be opened with handle in "on" position and an NEMA

enclosure as specified for loose starters. Fusible units are to be complete with fuse clips to suit fuse types specified below.

.12 Fuses are to be, unless otherwise scheduled or specified, English Electric Ltd. HRC fuses, Form I Class "J" for constant running equipment and Form II Class "C" for equipment that cycles on and off.

.13 Manufacturers:

.1 Rockwell Automation Inc. - Allen-Bradley;

.2 Eaton Corp. – Cutler-Hammer;

.3 Eaton Corp. – Moeller Electric;

.4 Siemens Canada;

.5 Schneider Electric.

2.05 Sprinkler Proofing

.1 Provide drip shields for protection of surface mounted equipment enclosures from water spray and dripping of liquids. Features of shields include:

.1 factory constructed by respective equipment manufacturers;

.2 constructed from non-combustible materials (sheet steel);

.3 enamel painted to match equipment;

.4 surfaces and edges filled/sanded smooth prior to painting;

.5 supported from equipment with structural steel rods/metal framing or other method approved by Consultant;

.6 structural support finish painted to match shield.

.2 Include with equipment shop drawings, detailed dimensions of drip shields and methods of supporting.

.3 Equipment with top cable/conduit entries to include additional sealing of entries with 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 proof" standards for equipment specified as NEMA 1, 2 or 12.

.6 Obtain CSA approval where required by local governing authorities.

3 Execution

3.01 Installation of Equipment Drive Guards and Accessories

.1 Provide OHSA guards for exposed accessible rotating parts such as belt drives, couplings, fan wheels, and shaft ends on mechanical equipment.

.2 Install belt guards to allow movement of motors for adjusting belt tension.

.3 Provide a means to permit lubrication and use of test instruments with guards in place.

.4 Secure guards to equipment or equipment base but do not bridge sound or vibration isolation.

.5 Where equipment oil level gauges, oil reservoirs, grease cups, or grease gun fittings are integral with equipment but are not easily accessible for service, extend to an accessible location using aluminium or copper tubing.

3.02 Supply of Motor Starters and Accessories

.1 Unless otherwise shown or specified, supply a starter for each item of motorized equipment. Refer to Motor Starter Schedule.

.2 Where 3-phase starters are indicated in motor control centres, supply motor control centres with starters and bolt to a concrete housekeeping pad.

.3 Where package type equipment with integral starters, or equipment with starters integral in loose power and control panels supplied with equipment is fed from a motor control centre, provide a disconnect switch in motor control centre in lieu of a motor starter.

.4 Where 3-phase starters are indicated and/or scheduled to be mounted on a motor starter panel, starters will be mounted and connected, complete with panels and splitter trough, as part of electrical work. Hand starters to electrical trade at site when they are required.

.5 Where package type equipment with integral starters, or equipment with starters integral in loose power and control panels supplied with equipment is fed from a motor starter panel, a disconnect switch will be provided on motor starter panel as part of electrical work.

.6 Unless otherwise specified or shown on drawings, 1-phase motor starters will be mounted adjacent to equipment they serve and connected complete as part of electrical work. Hand starters to electrical trade at site at the proper time.

3.03 Electrical Wiring Work for Mechanical Work

.1 Unless otherwise specified or indicated, following electrical wiring work for mechanical equipment will be done as part of the electrical work:

.1 "line" side power wiring to motor starters or disconnect switches in motor control centres and starters or disconnects on motor starter panels, and "load" side wiring from starters or disconnects to equipment;

.2 "line" side power wiring to individual wall mounted starters, and "load" side wiring from starters to equipment;

.3 "line" side power wiring to pre-wired power and control panels and variable frequency drives (VFD), and "load" side power wiring from the panels and VFD's to equipment;

.4 provision of receptacles for plug-in equipment;

.5 provision of disconnect switches for motors in excess of 10 m (30') from starter location, or cannot be seen from starter location, and associated power wiring;

.6 motor starter interlocking in excess of 24 volts;

.7 wiring from motor winding thermistors in motors 30 HP and larger to motor starter contacts;

.8 120 volt power connections to electrical receptacles integral with small ceiling exhaust fans, including wiring through light switches or speed controllers;

.9 120 volt wiring connections to lighting fixture/switch combinations integral with air handling units;

.10 120 volt wiring connections to duplex receptacles integral with air handling unit control panels;

.11 120 volt wiring connections to BAS system controllers/panels and other control system or component requiring 120 volt power including, but not limited to, VAV boxes, dampers, low voltage transformers, etc.

.2 Mechanical wiring work not listed above or specified herein or on drawings to be done as part of electrical work is to be installed in conduit and is to be done as part of mechanical work in accordance with wiring requirements specified for electrical work.

End of Section

1 General

1.01 Submittals

.1 Shop Drawings/Product Data: Submit shop drawings with product data sheets for variable frequency drives (VFDs). Include:

.1 construction and performance details;

.2 wiring and control schematics;

.3 dimensions of units;

.4 calculations specific to installation showing total harmonic voltage distortion is less than 5%;

.5 certified production test results with serial numbers for harmonic mitigation performance and energy efficiency under actual variable frequency drive loading.

1.02 Closeout Submittals

.1 Certification Letter: Submit a start-up and installation certification letter from supplier of VFDs as specified in Part 3 of this Section;

.2 Parameters: Prepare list of parameters for uploading for Owner's future use as specified in Part 3 of this Section. Load on USB type flash drive and submit to the Consultant.

.3 Extended Warranty: Where extended warranty is specified to be included, include a copy of VFD extended warranty in each Operating and Maintenance Manual. Prior to Substantial Performance of Work, submit a copy of warranty to Owner.

.4 Additionally, coordinate with Prime Contractor and Electrical Contractor to ensure that shop drawings clearly identify that proposed VFDs and connected motors are 100% compatible and Mechanical Contractor to sign off on selected VFDs.

1.03 Coordination with Electrical Divisions

.1 This Section specifies VFD requirements for motors. Ensure that VFDs packaged with various system equipment, complies with specifications of this Section.

.2 VFDs are each to be approved by respective manufacturers of VFDs and connected motors, as suitable for installation on scheduled motors. VFD output current rating to match or exceed connected motor nameplate full load current rating.

.3 Coordinate and review with Electrical Divisions, responsibility requirements for supply of VFDs, harmonic filters and requirements for control and power conductors and connections.

.4 Check that motors are equipped with AEGIS or approved equal, shaft grounding ring system to protect bearings from damage in motors by diverting harmful shaft voltages and bearing currents to ground.

.5 Additionally, review and confirm responsibilities with Consultant and Prime Contractor.

1.04 Warranty

.1 VFDs to be warranted free from defective labour and materials for period of 36 months from date of Substantial Performance of the Work. Include for initial one year Contract warranty and an additional 2 year extended warranty direct to Owner. Extended warranty terms and conditions are to be identical to one year Contract warranty, and extended warranty period is to commence day Contract warranty expires.

2 Products

2.01 VFD Basic Requirements

.1 VFDs supplied on project to be products of same manufacturer and be CSA approved, ULC listed and labelled. Base specified product is ABB ACH series units that include compliance with following standards:

.1 CSA C22.2 No.14 Industrial Control Equipment;

.2 UL 508 - Industrial Control Equipment;

.3 UL 508C – Power Conversion Equipment;

.4 NEMA ICS 7 - Adjustable-Speed Drives.

.2 Basis for limiting harmonics is to be provided generally to IEEE Standard 519 - Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems, except intended for user's electrical distribution system with point of common coupling (where harmonic limits are assessed) to be set at input terminals of harmonic mitigating equipment.

.3 VFDs to include following basic requirements:

.1 regardless of HP rating are to be of same VFD model; I/O and control circuit boards as well as keypads are to be identical and interchangeable regardless of HP rating;

.2 to be capable of starting into a coasting load (forward or reverse) up to full speed and accelerate or decelerate to set point without safety tripping or component damage (flying start);

.3 6-pulse width modulated (PWM) AC to AC converter utilizing latest isolated gate bipolar transistor (IGBT) technology; PWM switching pattern to include a motor flux optimization circuit that automatically reduces applied motor voltage to the motor to optimize energy consumption and audible motor noise;

.4 carrier frequency control circuit that reduces the carrier frequency based on actual VFD temperature that allows higher carrier frequency without derating VFD or operating at high carrier frequency only at low speeds;

.5 provisions that determine motor torque and flux every 25 microseconds (40,000 times per second);

.6 completely assembled and tested by manufacturer in their facility;

.7 designed to provide at least 250,000 hours mean time before failure (MTBF) when specified preventative maintenance is performed.

.8 bypass system completely factory wired and tested;

.9 door interlocked padlockable disconnect switch that disconnects all input power from drive and all internally mounted options;

.10 control panel keyboard and display with password protection against parameter changes.

2.02 VFD Ratings

.1 VFDs to be rated to operate from 3 phase input voltage of 208 or 600 volts ± 10%, as scheduled, and frequency range from 48 to 63 Hz. In addition, a tolerated voltage window to allow system to operate from a line of +30% to -35% nominal voltage. System to incorporate circuitry that allows drive or bypass contactor to remain "sealed in" over this voltage tolerance at a minimum.

.2 VFDs to employ a full wave rectifier to prevent input line notching and operate at a minimum fundamental input power factor of 0.97 at all speeds and loads.

.3 VFDs efficiency to be 96% or better at full speed and load.

.4 Output voltage and current ratings to match adjustable frequency operating requirements of standard 3ph, 60Hz, NEMA design B inverter-duty motors in compliance with NEMA-MG1, Part 31 Standard. Overload current capacity for variable torque overload capacity to be 110% of rated current for 1 minute out of 10 minutes and 130% for 2 seconds. Output frequency to be adjustable between 0 and 500 Hz.

.5 Open loop static speed regulation to be 0.1% to 0.3% (10% of motor slip). Dynamic speed accuracy to be 4%-sec. or better open loop.

.6 When a suitable motor is used, drive provides breakaway torque equal to 200% of rated motor torque. Torque response time to be 5 ms or less.

.7 Enclosures:

.1 in climate controlled areas – minimum NEMA 12 with drip shield;

.2 in non-climate controlled areas – NEMA 3R.

2.03 Controls and Adjustment Functions

.1 Include for following:

.1 programmable critical frequency lockout ranges to prevent VFD from operating load continuously at an unstable speed;

.2 proportional integral derivative (PID) speed loop regulators with an auto tune function as well as manual adjustments; PID set point controllers to allow pressure or flow signals to be connected to VFD, using microprocessor in VFD for closed loop control; includes 250 ma of 24 VDC auxiliary power and capability of loop powering a transmitter supplied by others; two parameter sets for first PID that allow sets to be switched via a digital input, serial communications or from keypad for night setback, summer/winter set points, etc; independent, second PID loop that can utilize second analogue input and modulate analogue outputs to maintain set point of an independent process (ie. valves, dampers, etc.); set points, process variables, etc. to be accessible from serial communication network;

.3 programmable analogue inputs that accept current or voltage signals.

.4 programmable analogue outputs (0-20ma or 4-20 ma), that may be programmed to output proportional to Frequency, Motor Speed, Output Voltage, Output Current, Motor Torque, Motor Power (kW), DC Bus voltage, Active Reference, and other data;

.5 programmable digital inputs;

.6 programmable digital Form-C relay contact outputs for programmable on and off delay times and adjustable hysteresis; rated for maximum switching current 8 amps at 24 VDC and 0.4 A at 250 VAC; maximum voltage 300 VDC and 250 VAC; continuous current rating 2 amps RMS;

.7 run permissive circuit - for damper or valve control; dry contact closure that will signal damper to open (VFD motor does not operate); when damper is fully open, a normally open dry contact (end-switch) closes; closed end-switch is wired to a VFD digital input and allows motor operation; two separate safety interlock inputs, when either is opened, motor to coast to stop, and damper to close;

.8 two independently adjustable accel and decel ramps with 1 – 1800 seconds adjustable time ramps;

.9 fireman's override input - upon receipt of a contact closure from fireman's control station, VFD operates in one of two modes: operate at a programmed predetermined fixed speed or operate in a specific fireman's override PID algorithm that automatically adjusts motor speed based on override set point and feedback; mode overrides all other inputs (analogue/digital, serial communication and keypad commands), except customer defined safety run interlock, and forces motor to run in one of the two modes; "Override Mode" to be displayed on control panel; upon removal of override signal, VFD resumes normal operation.

.2 Operator Control Panel:

.1 front mounted plug-in operator control panel consisting of keypad, multi-line backlit LCD display for programming and fault diagnostics;

.2 keys (switches) for HAND, OFF, AUTO, and manual speed control INCREASE/DECREASE;

.3 menu navigation and parameter selection keys for custom programming;

.4 date and time clock - clock to have a battery backup with 10 years minimum life span; clock to be used to date and time stamp faults and record operating parameters at time of fault; if battery fails VFD l automatically reverts to hours of operation since initial power up; clock also to be programmable to control start/stop functions, constant speeds, PID parameter sets and output relays; VFD to have a digital input that allows an override to time clock (when in off mode) for a programmable time frame; four (4) separate, independent timer functions that have both weekday and weekend settings;

.5 parameter names, fault messages, warnings and other information to be displayed in complete words or standard abbreviations to allow user to understand what is being displayed without use of a manual or cross reference table, as follows:

.1 "HAND" position to start drive and modify reference frequency by use of INCREASE/DECREASE keys;

.2 "OFF" position stops drive;

.3 "AUTO" position allows drive to be started or stopped using whichever remote start/stop command configured; drive speed controlled by external speed reference input or by PID controller.

.4 applicable operating values to be capable of being displayed in engineering (user) units; operating displayed include:

.1 Output Frequency;

.2 Motor Speed (RPM, %, or Engineering units);

.3 Motor Current;

.4 Drive Temperature;

.5 DC Bus Voltage;

.6 Output Voltage.

2.04 Protective Functions

.1 For each programmed warning and fault protection function, keypad displays a message in complete words or standard abbreviations.

.2 VFDs include metal oxide varistors (MOV's) for phase to phase and phase to ground line voltage transient protection.

.3 Short circuit current rating of 100,000 amps to be provided per UL 508C without relying on line fuses.

.4 Ground fault protection, motor phase loss protection and phase unbalance protection to be provided. Single phase protection to be provided on input and output.

.5 VFDs to provide electronic motor overload protection qualified per UL 508C.

.6 Protection to be provided for AC line or DC bus overvoltage at 130% of maximum rated or undervoltage at 65% of minimum rated.

.7 Stall protection to be programmable to provide a warning or stop VFD after motor has operated above a programmable torque level for a programmed time limit.

.8 Underload protection to be programmable to provide a warning or stop VFD after motor has operated below a selected underload curve for a programmed time limit.

.9 Overtemperature protection to provide a warning if power module temperature is less than 5C° (9F°) below overtemperature trip level.

.10 Input terminal to be provided for connecting a motor thermistor (PTC type) to drive's protective monitoring circuitry. An input to also be programmable to monitor an external relay or switch contact.

.11 VFDs through 56 kW (75HP) to be protected from damage from input and output power miss-wiring. VFD to sense this condition and display an alarm on control panel.

.12 EMI / RFI filters to be provided as per standard EN 61800-3.

.13 dv/dt long lead filter (LRC) to protect power system network.

.14 Automatic reset feature to automatically reset selected faults and attempt to restart drive based on control parameters such as adjustable time delays, number of restart attempts and duration of restart attempts. Faults include following:

.1 Overcurrent;

.2 Overvoltage;

.3 Undervoltage;

.4 Analogue input signal reference loss;

.5 External fault.

.15 Additional built-in protection circuits include:

.1 Overcurrent trip limit;

.2 Undervoltage trip limit;

.3 Microprocessor fault;

.4 Keypad control panel loss;

.5 Serial communication loss;

.6 External fault interlock inputs;

.7 Adjustable output frequency and motor speed limits;

.8 Pass code parameter change protection;

.9 Keypad operator control lockout.

2.05 Electronic Bypass

.1 Electronic bypass system to be a fully operational horsepower rated manual and automatic system for full speed operation without VFD, with following components and features:

.1 factory wired and tested microprocessor controlled bypass system consisting of an output contactor and bypass contactor, service (isolation) switch and VFD input fuses; (bypass designs, which have no VFD only fuses, or that incorporate fuses common to both VFD and bypass will not be accepted);

.2 bypass enclosure door and VFD enclosure to be interlocked such that input power is turned off before either enclosure can be opened;

.3 door interlocked padlockable disconnect switch that disconnects all input power from drive and all internally mounted devices;

.4 following operators:

.1 bypass Hand-Off-Auto;

.2 drive mode selector and light;

.3 bypass mode selector and light;

.4 bypass fault reset;

.5 bypass LCD display, 2 lines for programming and status / fault / warning indications.

.5 motor protection from single phase power conditions; bypass system to detect a single phase input power condition while running in bypass, disengage motor in a controlled fashion, and give a single phase input power indication;

.6 bypass system does not depend on VFD for bypass operation; bypass to be completely functional in both Hand and Automatic modes even if VFD is removed from enclosure for repair / replacement;

.7 run permissive circuit - for damper or valve control; dry contact closure that will signal damper to open (VFD motor does not operate); when damper is fully open, a normally open dry contact (end-switch) closes; closed end-switch is wired to a VFD digital input and allows motor operation; two separate safety interlock inputs, when either is opened, motor to coast to stop, and damper to close;

.8 bypass control to monitor status of VFD and bypass contactors and indicate when there is a welded contactor contact or open contactor coil; this failed contactor operation to be indicated on Bypass LCD display as well as over serial communications protocol;

.9 bypass control to include a programmable time delay for bypass start and control panel indication that this time delay is in process; this allows VAV boxes to be driven open before motor operates at full speed in bypass mode; time delay to be field programmable from 0 - 120 seconds;

.10 bypass control to be programmable for manual or automatic transfer to bypass; user to be able to select via control panel programming which drive faults will generate an automatic transfer to bypass and which faults require a manual transfer to bypass;

.11 adjustable motor current sensing circuit for bypass and VFD mode to provide proof of flow indication; condition is indicated on control panel display, transmitted over building automation protocol and on a relay output contact closure;

.12 programmable digital inputs, and programmable Form-C relay outputs;

.13 relay outputs from bypass to be programmable for any of following indications:

.1 system started;

.2 system running;

.3 bypass override enabled;

.4 drive fault;

.5 bypass fault;

.6 bypass H-O-A position;

.7 motor proof of flow (broken belt);

.8 overload;

.9 bypass selected;

.10 bypass run;

.11 system started (damper opening);

.12 bypass alarm;

.13 over temperature.

.14 digital inputs for system accept 24VAC or 24VDC; bypass incorporates internally sourced power supply and does not require an external control power source; bypass power board to supply 250 ma of 24 VDC for use by others to power external devices;

.15 interlock terminal strip: provide a separate terminal strip for connection of freeze, fire, smoke contacts, and external start command; external safety interlocks to remain fully functional whether system is in VFD or bypass mode; remote start/stop contact to operate in VFD and bypass modes; terminal strip allows for independent connection of up to four (4) unique safety inputs;

.16 User is able to select text to be displayed on keypad when safety opens; example text display indications include "Firestat", "Freezestat", "Over pressure" and "Low pressure"; user is able to determine which of four (4) safety contacts is open over serial communications connection;

.17 Class 10, 20, or 30 (selectable) electronic motor overload protection is included as required for specific applications.

2.06 Communications

.1 VFD to be complete with communications connections of integrated RS-485 port suitable to allow for VFD to be controlled, supervised, monitored and programmed from one remote control panel or PC with VFD system Windows based application software.

.2 Communications protocol to be industry standard compatible to BAS of building. Coordinate exact requirements with Mechanical Divisions controls contractor and BAS vendor to ensure that appropriate

interface module is supplied for drive system to communicate with BAS being used in building with interface capability to include serial communication standard protocols as follows:

.1 ModBus;

.2 Johnson Controls Metasys N2;

.3 Siemens Building Technologies FLN;

.4 BACnet.

.3 Serial communication to be used for drive setup, diagnostic analysis, monitoring and control with capabilities to include, but not be limited to:

.1 run-stop control;

.2 speed set adjustment;

.3 proportional/integral/derivative PID control adjustments;

.4 current limit;

.5 accel/decel time adjustments;

.6 ability to lock and unlock control panel keypad;

.7 capability of allowing BAS to monitor feedback such as process variable feedback, output speed / frequency, current (in amps), % torque, power (kW), kilowatt hours (resettable), operating hours (resettable), and drive temperature;

.8 monitoring relays output status, and digital input status and analogue output values;

.9 transmitting diagnostic warning and fault information over communications bus to BAS or other monitoring system;

.10 remote fault reset.

.4 Serial communication and Windows based software to be used for drive setup, diagnostic analysis, monitoring and control. Software to provide real time graphical displays of drive performance. VFD software communication capabilities include, but not be limited to:

.1 system ON/OFF;

.2 system status;

.3 Suitable input for speed control;

.4 run-stop control;

.5 ability to force unit to bypass;

.6 ability to lock and unlock control panel keypad;

.7 allowing BAS to monitor feedback such as, current (in amps), kilowatt hours (resettable), operating hours (resettable), and logic board temperature;

.8 monitoring relays output status, and all digital input status;

.9 transmitting diagnostic warning and fault information over communications bus to BAS or other monitoring system;

.10 remote fault reset;

.11 keypad "Hand" or "Auto" selected, and status indications and settings transmitted over serial communications bus;

.12 monitor if motor is running under load in both VFD and bypass (proof of flow) in VFD mode over serial communications or Form-C relay output;

.13 minimum of 40 field parameters to be capable of being monitored in bypass mode.

2.07 Site Services, Training, and Maintenance Manuals

.1 Provide onsite inspection, testing, start up and verification work of VFDs and filters by manufacturer's authorized technician. Allow a minimum of 1/2 day per system. Also include for a second visit to site of one (1) day duration to train operating personnel in operation and maintenance of drives. Provide verification reports and supply soft copy of system programming parameters.

.2 Upon completion of installation, supplier of VFDs to supply minimum one hard copy of complete sets of service and maintenance manuals including wiring and connection diagrams. Include for digital copy loaded onto a USB type flash drive.

.3 Provide system training and instructions on operating and maintenance procedures. Refer to additional requirements in General Instructions section and Division 01.

.4 Include for manufacturer's authorized technician to be in attendance to assist Commissioning Agent during commissioning process.

2.08 Manufacturers

.1 Manufacturer List:

.1 ABB;

.2 Schneider Electric (Square D);

.3 Rockwell Automation;

.4 Eaton Cutler Hammer;

.5 Siemens Electric;

.6 Control Techniques.

3 Execution

3.01 Installation of Variable Frequency Drives

.1 Provide variable frequency drives for motorized equipment in accordance with drawing requirements. Coordinate requirements for conductors and connections with Electrical Divisions Contractor.

.2 Ensure that variable speed drives supplied are products of same manufacturer.

.3 Unless otherwise noted on drawings or in Part 2 of this Section, include minimally, a manual bypass with each VFD. Supply electronic bypass with VFDs specifically noted and/or scheduled on drawings.

.4 Ensure wire length between VFD and motor is less than 15 m (50') with properly sized conductors.

.5 Install VFDs in accordance with manufacturer's instructions. Ensure that VFDs installation include upstream protection, either fuses or circuit breakers in accordance with VFD manufacturer's

recommendations and local electrical code requirements. Advise Electrical Divisions Contractor of these requirements in addition to required conductors and connections. Provide required control wiring and connections.

.6 Review VFD and related connected motor installation. Provide local disconnect to VFD in accordance with local governing code requirements.

.7 Mount VFDs operating controls/display at approximately 1.5 m (5') above finished floor level, unless otherwise directed by Consultant. Provide dual back to back C-channel support system from floor to ceiling, complete with cross bracing to form a solid backing for VFD mounting at required locations.

.8 Properly support VFDs. Coordinate exact locations on site with Consultant.

.9 Where VFDs are required for custom made air handling units VFDs to be supplied, factory mounted on fan cabinets, and "load" side connected to fan motors by air handling unit manufacturer. "Line" side power wiring to these VFDs to be provided as part of Electrical Divisions work.

.10 Where VFDs are required for commercial fans, mount each VFD generally where shown but with exact location to ensure that VFD is accessible in accordance with local governing electrical code requirements. "Line" and "load" side power wiring to these VFD's to be provided as part of Electrical Divisions work.

.11 Ground and bond equipment as per local governing electrical code requirements and manufacturer's instructions.

.12 Provide engraved lamacoid nameplate identifying each piece of equipment. Review exact nomenclature with the Consultant.

.13 Be responsible for ensuring that VFDs, harmonic filters and connected motors are properly installed, connected, tested in proper working order and operation verified.

3.02 Installation of Variable Frequency Drives

.1 Provide VFDs for motorized mechanical equipment in accordance with drawing requirements and coordinated with mechanical equipment vendors and Mechanical Divisions Contractor.

.2 Ensure that VFDs supplied for project are products of same manufacturer.

.3 Unless otherwise noted on drawings or in Part 2 of this Section, include minimally, a manual bypass with each VFD. Supply electronic bypass with VFDs specifically noted and/or scheduled on drawings.

.4 Supply and install wiring and connections to VFDs and harmonic filters are to recommendations of VFD Manufacturer. Ensure wire length between VFD and motor is less than 15 m (50') with properly sized conductors. Obtain required wiring diagrams from equipment vendors. Provide required control wiring and connections.

.5 Install VFDs in accordance with manufacturer's instructions.

.6 Review VFD and related connected motor installation. Provide local disconnect (fusible switch or breaker) to VFD in accordance with local governing electrical code requirements and VFD manufacturer instructions. Confirm requirements with VFD vendor.

.7 Mount VFDs operating controls/display at approximately 1.5 m (5') above finished floor level, unless otherwise directed by the Consultant. Provide dual back to back C-channel support system from floor to ceiling, complete with cross bracing to form a solid backing for VFD mounting at required locations.

.8 Properly support VFDs. Coordinate exact locations on site with Mechanical Divisions Contractor and review with the Consultant.

.9 Coordinate installation and control of VFDs with Mechanical Division Contractor and Controls Contractor. Confirm communications protocol required for compatibility with BAS and ensure VFD system includes for proper protocol.

.10 Install harmonic mitigation filter equipment as follows:

.1 to be handled, stored and installed in accordance with manufacturer's recommended installation practices and to comply with applicable local governing codes;

.2 provide each VFD as specified in per Part 2, with a harmonic filter sized as per manufacturer's rating table to match rating of connected VFD;

.3 mount harmonic filters sized up to 110 kW (150 HP) typically to wall/ceiling construction using suitable brackets, metal C-channel framework and vibration isolators assemblies, ensuring full support of units acceptable to local governing authorities;

.4 mount harmonic filters sized greater than 110 kW (150 HP) typically to floor mounted concrete pads with suitable vibration isolators and seismic restraints in accordance with local governing building codes;

.5 ensure that adequate ventilation and space for access is provided;

.6 review exact locations with the Consultant prior to installation;

.7 provide required conductors and connections in accordance with filter manufacturer's instructions; obtain required wiring diagrams from equipment vendors;

.8 connect complete to line side supply feed and to VFD in accordance with VFD manufacturer's instructions for standalone VFDs and VFD system with bypass.

.11 Ground and bond equipment as per local governing code requirements and manufacturer's instructions. Refer also to requirements of grounding and bonding article.

.12 Provide engraved lamacoid nameplate identifying each piece of equipment. Review nomenclature with the Consultant.

.13 Be responsible for ensuring that VFDs, harmonic filters and connected motors are properly installed, connected, tested in proper working order and operation verified.

3.03 Testing, Start-Up, and Verification

.1 When installation of VFDs are complete, arrange for VFD manufacturer/supplier to:

.1 supply factory authorized technician at site for minimum of 4 hours per system to examine installation and connection of each VFD, and to perform start-up and set-up procedures in conjunction with equipment start-up and testing procedures;

.2 supply factory authorized technician at site for minimum of one 8 hour day to train Owner's personnel on VFD operating and maintenance procedures;

.3 prepare and submit letter to certify that VFDs have been properly installed, tested and adjusted, and are in proper operating condition;

.4 submit list of start-up and testing parameters for uploading for future use by Owner.

.2 Start-up data entries to include motor nameplate power, speed, voltage, frequency and current.

.3 Inspect VFDs and accessories for verification of proper operation and installation.

.4 Inspect interface wiring to BAS for verification of proper operation and installation.

.5 Verification of wire terminations to VFDs and bypass and to operational circuitry.

.6 Installation verification of VFD, bypass and motor being driven for proper operation and reliability.

.7 Verification that connections and communications to BAS or other monitoring/remote control system are of proper operation and installation and of full communications compatibility.

.8 Measurement for verification of proper operation on each of following items:

.1 Motor voltage and frequency;

.2 Verification of proper motor operation;

.3 Control input for proper building automation system interface and control calibration.

.9 Calibration check for following set points (and adjustment as necessary):

.1 minimum speed;

.2 maximum speed;

.3 acceleration and deceleration rates.

.10 Verify harmonic compliance with onsite field measurements of both voltage and current harmonic distortion at point of common coupling-input terminals of harmonic mitigating equipment with and without equipment operating. Utilize recording type Fluke 41 or equivalent harmonics analyser displaying individual and total harmonic currents and voltages.

.11 Document testing and results in a report signed by a Professional Engineer licensed in the Place of Work and authorized by system manufacturer. Include for minimum 3 hard copies and electronic copy of report to be submitted to the Consultant for review.

.12 Additionally, refer to applicable installation, testing, coordination and verification requirements in Electrical Divisions Sections.

End of Section

1 General

1.01 Sleeve and Formed Opening Location Drawings

.1 Prepare and submit for review, drawings indicating size and location of required sleeves, recesses and formed openings in poured or precast concrete work.

.2 Such drawings are to be completely and accurately dimensioned and relate sleeve, recesses, and formed openings to suitable grid lines and elevation datum, and are to take into account structural items such as grade beams, column caps, and column drop slabs.

.3 Begin to prepare such drawings immediately upon notification of acceptance of bid and award of Contract.

2 Products

2.01 Pipe Sleeves

.1 Galvanized Sheet Steel – Minimum #16 gauge galvanized steel with an integral flange at one end to secure sleeve to formwork construction.

.2 Polyethylene – Factory fabricated, flanged, high density polyethylene sleeves with reinforced nail bosses.

.3 Waterproof Galvanized Steel Pipe – Schedule 40 mild galvanized steel pipe with a welded-on square steel anchor and water stop plate at sleeve midpoint.

.4 Galvanized Steel or Cast Iron Pipe – Schedule 40 mild galvanized steel, or Class 4000 cast iron.

2.02 Firestopping and Smoke Seal Materials

.1 Asbestos-free elastomeric materials tested, listed and labelled by ULC in accordance with ULC S115 and ULC S101 for installation in ULC designated firestopping and smoke seal systems to provide a positive fire, water and smoke seal, and a fire-resistance rating (flame, hose stream and temperature) not less than fire resistance rating of surrounding fire rated construction.

.2 Materials are to be compatible with abutting dissimilar materials and finishes and complete with primers, damming and back-up materials, supports, and anchoring devices in accordance with firestopping manufacturer's recommendations and ULC tested assembly.

.3 Pipe insulation forming part of a fire and smoke seal assembly is specified in Section entitled Mechanical Insulation.

.4 Manufacturers:

.1 A/D Fire Protection Systems "FIREBARRIER";

.2 Tremco Inc. Fire Protection Systems Group "TREMSTOP";

.3 3M Canada;

.4 Hilti (Canada) Ltd. Firestop Systems;

.5 Specified Technologies Inc.

.5

2.03 Waterproofing Seal Materials

.1 Modular, mechanical seal assemblies consisting of interlocking synthetic rubber links shaped to continuously fill annular space between pipe and pipe sleeve or wall opening, assembled with stainless steel bolts and pressure plates and designed so when bolts are tightened the links expand to seal the opening watertight. Select seal assemblies to suit pipe size and sleeve size or wall opening size.

.2 Manufacturers:

.1 Thunderline Corp. (Power Plant Supply Co.) "LINK SEAL" Model S-316;

.2 The Metraflex Co. "MetraSeal" type ES.

2.04 Pipe Escutcheon Plates

.1 One-piece chrome plated brass or #4 finish type 302 stainless steel plates with matching screws for attachment to building surface, each plate sized to completely cover pipe sleeve or building surface opening, and to fit tightly around pipe or pipe insulation.

3 Execution

3.01 Installation of Pipe Sleeves

.1 Where pipes pass through concrete and/or masonry surfaces provide pipe sleeves as follows:

.1 in poured concrete slabs – unless otherwise specified, minimum 16 gauge flanged galvanized steel or, where permitted by governing authorities, factory fabricated plastic sleeves;

.2 in concrete or masonry walls – Schedule 40 galvanized steel pipe or Class 4000 cast iron pipe.

.2 Sleeves in waterproofed slabs or walls are to be lengths of Schedule 40 mild galvanized steel pipe with a waterstop plate in accordance with drawing detail. Provide waterproof sleeves in following locations:

.1 in mechanical room floor slabs, except where on grade;

.2 in slabs over mechanical, fan, electrical and telephone equipment rooms or closets;

.3 in floors equipped with waterproof membranes;

.4 in roof slab;

.5 in waterproof walls.

.3 Size sleeves, unless otherwise specified, to leave 12 mm (½") clearance around pipes, or where pipe is insulated, a 12 mm (½") clearance around pipe insulation.

.4 Pack and seal void between pipe sleeves and pipe or pipe insulation in non-fire rated construction for the length of sleeves as follows:

.1 pack sleeves in interior construction with mineral wool and seal both ends of sleeves with non-hardening silicone base caulking compound;

.2 pack sleeves in exterior walls above grade with mineral wool and seal both ends of sleeves water-tight with approved non-hardening silicone base caulking compound unless mechanical type seals have been specified;

.3 seal sleeves in exterior walls below grade (and any other wall where water leakage may be a problem) with link type mechanical seals as specified.

.5 Where sleeves are required in masonry work, accurately locate and mark sleeve location, and hand sleeves to mason for installation.

.6 Terminate piping for sleeves that will be exposed so sleeve is flush at both ends with building surface so sleeve may be completely covered by an escutcheon plate, except for sleeves in waterproof floors which are to terminate 100 mm (4") above finished floor.

.7 "Gang" type sleeving will not be permitted.

.8 Where sleeves are provided in non-fire rated construction for future piping, or where piping has been removed from existing sleeves, cap and seal both ends of sleeved opening.

3.02 Installation of Waterproof Mechanical Seals

.1 Provide watertight link type mechanical seals in exterior wall openings.

.2 Assemble and install each mechanical seal in accordance with manufacturer's instructions.

.3 After installation, periodically check each mechanical seal installation for leakage and, if necessary, tighten link seal bolts until seal is completely watertight.

End of Section

1 General

2 Products

2.01 Piping Hangers and Supports

.1 Pipe hanger and support materials, including accessories, are to be, unless otherwise specified, in accordance with Manufacturers Standardization Society (MSS) Standard Practice Manual SP-58, Pipe hangers and Supports-Materials, Design and Manufacture, and where possible, MSS designations are indicated with each product specified below. Conform to following requirements:

.1 unless otherwise specified, ferrous hanger and support products are to be electro-galvanized;

.2 hangers and supports for insulated piping are to be sized to fit around insulation and insulation jacket.

.2 Hangers and supports for horizontal suspended piping as follows:

.1 adjustable steel clevis hanger – MSS Type 1;

.2 adjustable swivel ring band hanger – MSS Type 10;

.3 adjustable roller hanger – MSS Types 41, 43, and/or 45, with MSS Type 39 steel protection saddle.

.3 Supports for horizontal pipe on vertical surfaces as follows:

.1 steel offset pipe clamp – Anvil Fig. 103 or Myatt Fig. 170;

.2 heavy-duty steel pipe clip – MSS Type 26;

.3 single steel pipe hook – Myatt Fig. 156;

.4 epoxy coated steel pipe stays are not permitted.

.4 Floor supports for vertical risers as follows:

.1 copper tubing riser clamp – MSS Type 8;

.2 heavy-duty steel riser clamp – MSS Type 8.

.5 Supports for vertical piping on vertical surfaces as follows:

.1 steel offset pipe clamp – Anvil Fig. 103 or Myatt Fig. 170;

.2 heavy-duty steel pipe bracket or soil pipe bracket – MSS Type 26;

.3 extension split pipe clamp – MSS Type 12;

.4 epoxy coated steel pipe stays are not permitted.

.6 Base support for vertical risers in excess of 6 m (20') high extending out from base mounted equipment is to consist of a base elbow support with flange.

.7 For horizontal pipe on racks, Unistrut or equal galvanized steel pipe racks with pipe securing hardware as follows:

.1 standard galvanized steel U-bolts/clamps supplied by rack manufacturer;

.2 adjustable roller chair – MSS Type 44 with MSS Type 39 steel protection saddle.

.8 Special hangers and supports for various applications as follows:

.1 vibration isolated riser supports – black steel riser clamps as specified above, complete with neoprene–steel–neoprene sandwich type vibration isolation pads between clamp and floor;

.2 for groups of pipes having same slope – MSS Type 32 welded steel brackets, Anvil Fig. 46 universal trapeze assemblies, or Unistrut or equal support assemblies, all with U-bolts, clamps, etc., to secure pipes in place;

.3 for sections of piping connected to vibration isolated equipment – hangers and supports as specified above but complete with MSS Type 48 spring cushions;

.4 for piping on existing roof – Portable Pipe Hangers (Canada) Inc. "PP" Series prefabricated portable pipe support system components to suit pipe, complete with required accessories including bases, galvanized structural steel frames, and galvanized steel pipe hangers and supports conforming to MSS SP-58;

.5 for piping on new roofs – Lexcor "Flash-Tite" or Thaler Roofing Specialties Products Inc. "MERS" Series insulated aluminum support risers with diameter, height, securement method and flashing to suit the application, channel type aluminum cross members, and galvanized steel pipe hangers and supports conforming to MSS SP-58, complete with all required accessories;

.6 for glass drain and vent piping – special padded hangers supplied by pipe supplier;

.7 for plastic piping – generally as specified above but in accordance with pipe manufacturer's recommendations;

.8 for fire protection piping – generally as above but ULC listed and/or FM approved, and in accordance with Chapter requirements of NFPA Standard applicable to piping system;

.9 for bare horizontal copper piping – generally as above but factory vinyl coated to prevent direct copper/steel contact;

.10 for bare copper vertical piping – corrosion resistant ferrous clamps with flexible rubber gasket type material (not tape) to isolate pipe from clamp;

.11 insulation protection shields to and including 40 mm (1-½") dia. – MSS Type 40 galvanized steel shields with ribs to keep shield centred on hanger.

.9 Hanger rods are to be electro-galvanized carbon steel (unless otherwise specified), round, threaded, to ASTM A36, complete with captive machine nuts with washers at hangers, sized to suit loading in accordance with Table 3 in MSS SP-58, but in any case, minimum 9.5 mm (3/8") diameter.

.10 Manufacturers:

.1 E. Myatt & Co. Inc.;

.2 Anvil International Inc.;

.3 Empire Industries Inc.;

.4 Hunt Manufacturing Ltd.;

.5 Unistrut Canada Ltd.;

.6 Nibco Inc. "Tolco";

.7 Taylor Pipe Supports.

3 Execution

3.01 Installation of Fastening and Securing Hardware

.1 Provide fastening and securing hardware required for mechanical work to maintain installations attached to structure or to finished floors, walls and ceilings in a secure and rigid manner capable of withstanding dead loads, live loads, superimposed dead loads, and any vibration of installed products.

.2 Use fasteners compatible with structural requirements, finishes and types of products to be connected. Do not use materials subject to electrolytic action or corrosion where conditions are liable to cause such action.

.3 Where floor, wall or ceiling construction is not suitable to support loads, provide additional framing or special fasteners to ensure proper securement to structure that is to support the products. Provide reinforcing or connecting supports where required to distribute loading to structural components.

.4 Obtain written consent before using explosive actuated fastening devices. If consent is obtained, comply with requirements of CAN/CSA Z166.1 and CAN/CSA Z166.2.

.5 Do not attach fasteners to steel deck without written consent from Consultant.

3.02 Installation of Pipe Hangers and Supports

.1 Provide required pipe hangers and supports.

.2 Provide any additional structural steel channels, angles, inserts, beam champs and similar accessories required for hanging or supporting pipe. Unless otherwise shown or specified, hang or support pipes from structure only.

.3 For insulated pipe, size hanger or support to suit diameter of insulated pipe and install hanger or support on outside of insulation and insulation finish.

.4 Support requirements for underground piping are as follows:

.1 support underground pipe, unless otherwise specified, on a well compacted bed of dry, natural, undisturbed earth free from rocks or protrusions of any kind, or on compacted material as specified;

.2 support underground service piping penetrating building exterior walls or foundations to prevent pipe damage if minor building settlement occurs;

.3 ensure bedding and supports for underground pipes are flat and true and allowances are made for pipe hubs, couplings, or other protrusions so no voids are left between pipe and bedding.

.5 Unless otherwise shown or specified, hang and/or support horizontal pipe above ground by means of hangers and/or supports specified in Part 2 of this Section. Unless otherwise shown or specified, hangers for suspended pipe less than or equal to 25 mm (1") dia. are to be clevis type or adjustable ring type, and hangers for suspended pipe greater than or equal to 40 mm (1-½") dia. are to be adjustable clevis type.

.6 Space hangers and supports in accordance with following:

.1 cast iron pipe – hang or support at every joint with maximum 2.4 m (8') spacing;

.2 plastic pipe – conform to pipe manufacturer's recommended support spacing;

.3 glass pipe – conform to pipe manufacturer's recommended support spacing and support requirements;

.4 copper and steel pipe – hang or support at spacing in accordance with following schedule:

Pipe dia.	Max. Spacing Steel (meters)	Max. Spacing Copper (meters)
to 25 mm (1")	2.4 m (8')	1.8 m (6')
40 mm (1-½")	2.7 m (9')	2.4 m (8')
50 mm (2")	3.0 m (10')	2.7 m (9')
65 mm (2-½")	3.6 m (12')	3.0 m (10')
75 mm (3")	3.6 m (12')	3.0 m (10')
90 mm (3-½")	3.6 m (12')	3.6 m (12')
100 mm (4")	4.2 m (14')	3.6 m (12')
250 mm (10")	6.0 m (20')	
300 mm (12")	6.7 m (22')	

.5 flexible grooved pipe/coupling joint piping – as above but with not less than one hanger or support between joints;

.7 Where pipes change direction, either horizontally or vertically, provide a hanger or support on horizontal pipe not more than 300 mm (12") from elbow, and where pipes drop from tee branches, support tees in both directions not more than 50 mm (2") on each side of tee.

.8 When pipes with same slope are grouped and a common hanger or support is used, space hanger or support to suit spacing requirement of smallest pipe in group and secure pipes in place on common hanger or support.

.9 Provide roller hangers or supports for heat transfer piping greater than or equal to 150 mm (6") diameter and conveying a material 75°C (170°F) or greater to facilitate pipe movement due to expansion and contraction, and at each hanger or support tack weld a steel protection saddle to pipe to protect piping insulation.

.10 Unless otherwise shown or specified, support vertical piping by means of supports specified in Part 2 of this Section, spaced in accordance with following:

.1 support vertical pipes at maximum 3 m (10') intervals or at every floor, whichever is lesser;

.2 for sections of vertical piping with a length less than 3 m (10'), support pipe at least once;

.3 for vertical cast iron plain end pipe (mechanical joint type), secure riser or pipe clamp around pipe under a flange integral with pipe for vertical support purposes, or provide a length of hub and spigot pipe to facilitate proper support;

.4 for vertical steel pipe risers in excess of 3 m (10'), weld shear lugs to pipe to carry load;

.5 for vibration isolated piping risers, provide rubber-steel-rubber vibration isolation pads between riser clamps and floor.

.11 Support piping on the roof as follows:

.1 on existing roof – provide support members as specified in Part 2 of this Section spaced as per schedule above and of a type to suit the application, and, for each support, carefully scrape away

roofing gravel, bed support in a heavy covering of roofing mastic, then scrape gravel back up around support and secure pipes to supports;

.2 on new roof – supply manufactured roof supports as per Part 2 of this Section to accommodate piping involved and support spacing specified above, and hand supports to roofing trade on roof for installation as part of roofing work, then secure piping in place on supports.

.12 Each hanger, support or securement for horizontal bare copper tubing is to be plastic coated to prevent direct contact between pipe and ferrous hanger. Each wall or floor clamp for vertical bare copper piping is to be isolated from pipe by means of strips of flexible rubber inserts. Use of painted ferrous hangers and supports, including those painted with copper coloured paint, is not acceptable. Site application of tape or other types of isolation is not acceptable.

.13 For insulated horizontal piping less than or equal to 40 mm (1-½") diameter, provide galvanized steel insulation protection shields between insulation and hanger or support. Install shields immediately after pipe is insulated.

.14 Do not support piping from steel deck without written consent from Consultant.

3.03 Equipment Bases and Supports

.1 Unless otherwise specified or required, set floor mounted equipment on minimum 100 mm (4") high reinforced concrete housekeeping pads 200 mm (8") clear of equipment on each side and end, or a minimum of 200 mm (8") from centreline of equipment anchor bolts to edge of the base, whichever is larger. Conform to following requirements:

.1 supply dimensioned drawings and equipment base templates, and provide anchor bolts for proper setting and securing of equipment on pads;

.2 place anchor bolts during concrete pour and be responsible for required levelling, alignment, and grouting of equipment;

.3 as a minimum, use wire mesh reinforcement, however, for pads for large heavy equipment, use reinforcement as per structural drawing details.

.2 For equipment not designed for base mounting, where required, provide welded, cleaned and prime coat painted structural steel stands or supports conforming to following requirements:

.1 provide stands and supports, except those for small equipment, designed by a structural engineer registered in jurisdiction of the work, and submit stamped and signed design drawings with calculations as shop drawings for review;

.2 flange bolt steel stands to concrete housekeeping pads;

.3 seismically restrained stands and supports in accordance with applicable requirements.

.3 Where indicated on mechanical drawings, provide welded, cleaned and prime coat painted structural steel platforms, designed by a structural engineer registered in the jurisdiction of the work, for service access to equipment. Submit stamped and signed design drawings with calculations as shop drawings for review. Conform to following requirements:

.1 platforms in accordance with OHSA requirements and adequately sized, braced, anchored, and, as required, seismically restrained;

.2 flooring equal to Fisher & Ludlow "Tru-Weld" Type 19-4, Borden type W/B (19-W-4), welded steel bar type grating;

.3 support legs constructed of welded Schedule 40 black steel pipe with welded steel cross-bracing, securely anchored and sway braced;

.4 safety guard rails, constructed from minimum 32 mm (1-¼") dia. Schedule 40 black steel pipe, for all platforms and complete with vertical stanchions at maximum 1.2 m (48") centres, top and intermediate horizontal railing, and toe plates at floor;

.5 vertical ladders constructed of Schedule 40 black steel pipe, 25 mm (1") dia. for equal height rungs, 40 mm (1-½") for stringers, anchored to floors and walls and sway braced as required;

.6 ships ladders, used wherever space conditions permit, of welded steel construction, climbing at an approximate 60º angle, and complete with channel iron stringers, open grate equal height risers approximately 165 mm (6-½") wide and factory made by grating manufacturer, handrails, and suitable anchoring and support.

3.04 Concrete Work for Mechanical Equipment Bases and Pads

.1 Concrete work required for mechanical equipment bases/pads will be provided as part of concrete work of Division 03.

.2 Exactly locate bases/pads at site and be present during concrete pour to ensure anchor bolts, inserts, plates and similar hardware are not damaged or dislodged.

.3 Coordinate base/pad installations with concrete trade and ensure bases and pads are keyed into structure to meet seismic restraint requirements where applicable.

End of Section

1 General

1.01 Submittals

.1 Submit heating cable and control shop drawings/product data sheets, complete with control schematics.

1.02 Closeout Submittals

.1 Submit a start-up certification letter from cable supplier as specified in Part 3 of this section.

.2 Submit certified cable megger test reports as specified in Part 3 of this section.

2 Products

2.01 Pipe Freeze Protection Heating Cable

.1 Raychem Canada Ltd. "XL-Trace-CR" CSA certified, self-regulating piping freeze protection cable sets as specified and/or scheduled on drawings, each set complete with:

.1 required lengths of "XL-TRACE" self-regulating heating cable;

.2 power connection with end seal per circuit;

.3 tee connections with end seals as required for pipe branches;

.4 splice connections as required;

.5 GT-66 glass tape to secure cable on pipe, and "Electric Traced" adhesive labels to be secured to pipe insulation;

.6 pipe temperature sensing thermostat.

.7 Complete with integral ground fault protection.

.2 Manufacturers:

.1 Raychem Canada Ltd.;

.2 Dimplex/Chromalox Inc.;

.3 Tyco Thermal Controls/Pyrotenax.

3 Execution

3.01 Installation of Freeze Protection Heating Cable

.1 Supply electric tracing cable sets to prevent piping from freezing.

.2 Hand cable sets and accessories and cable manufacturer's installation instructions to electrical trade at site for installation on piping. Clearly identify piping to be traced. Ensure piping has been pressure tested prior to cable installation and manufacturer's installation instructions are observed.

.3 Mount heat tracing controller as indicated on drawings or within 2 m of start of heat tracing.

.4 After cable installation but before application of piping insulation, megger test and commission cable in presence of the Consultant and in accordance with cable manufacturer's installation and operation manual. Replace any damaged or faulty cable, and when satisfactory results have been obtained, submit signed test reports to the Consultant.

.5 When traced piping has been insulated, install "Electrically Traced" labels on opposite sides of pipe at 3 m (10') intervals and in accordance with requirements specified in Section 20 05 00 – Common Work Results for Mechanical.

.6 When cable installations are complete, check and test operation of each cable set with heater manufacturer's representative, make any required adjustments, and have cable manufacturer certify in writing that cable sets have been properly installed and operate as intended.

End of Section

1 General

1.01 Section Includes

.1 This Section specifies vibration isolation product requirements that are common to mechanical work Sections of the Specification and it is a supplement to each Section and is to be read accordingly.

1.02 Submittals

.1 Submit copies of manufacturer's product data sheets for products specified in this Section. Product data sheets are to include product characteristics, limitations, dimensions, finishes, and installation recommendations.

1.03 Closeout Submittals

.1 Submit a letter from vibration isolation manufacturer to certify correct installation of products, as specified in Part 3 of this Section.

2 Products

2.01 General

.1 Vibration isolation products are to be in accordance with the most recent edition of the ASHRAE Handbook and/or as indicated on drawings, schedules, details, and as specified below.

.2 Springs are to be stable, colour coded, selected to operate at no greater than ⅔ solid load, designed in accordance with Society of Automotive Engineers Handbook Supplement 9 entitled Manual on Design and Application of Helical and Spiral Springs, and with spring diameters in accordance with manufacturer's recommendations to suit static deflection and maximum equipment load.

.3 Steel components of isolation products not exposed to the weather or moisture are to be zinc plated. Steel components of isolation products exposed to the weather or in a damp, moist environment are to be factory painted with rust inhibiting primer and 2 coats of neoprene.

.4 Where weight of isolated equipment may change significantly due to draining or filling with a liquid, vibration isolators are to be equipped with limit stops to limit spring extensions.

.5 Seismic rated isolators and snubbers are to be listed, rated, and approved by State of California Office of Statewide Health and Planning Department (O.S.H.P.D.) and carry an O.S.H.P.D. pre-approved number. Seismic restraints supplied with vibration isolation are to meet requirements specified in Section 20 05 48.16 – Seismic Controls for Mechanical Systems.

.6 Flexible piping connections to vibration isolated equipment are specified in the appropriate piping sections of the Specification.

2.02 Isolation Pads

.1 Sandwich type pads, 20 mm (¾") nominal thickness, selected for 3.2 mm (1/8") static deflection unless otherwise specified, consisting of 2 waffle type or ribbed 50 durometer neoprene pads permanently bonded to a minimum #10 gauge steel plate, and complete with rubber bushed bolt holes and equipment anchor bolts with neoprene isolation grommets.

.2 Manufacturers:

.1 Vibro-Acoustics Ltd. Type NSN;

.2 The VMC Group Vibration Mounting & Controls Inc. (Korfund-Dynamics) "SHEAR-FLEX PLATES";

.3 Kinetics Noise Control Vibron Products Group Type NGS/NGD;

.4 Mason Industries Inc. Type SW/S/SW with HG Bolt Insertion Washers;

.5 J. P. America Inc. Type JSJ.

2.03 Rubber Floor Isolators

.1 Captive, bridge bearing quality neoprene mount selected for a minimum 4 mm (0.15") static deflection unless otherwise specified, with an integral ductile iron housing and integral equipment anchor bolt.

.2 Manufacturers:

.1 Vibro-Acoustics Ltd. Type R;

.2 The VMC Group Vibration Mounting & Controls (Korfund-Dynamics) Type RSM;

.3 Kinetics Noise Control Vibron Products Group Type RQ;

.4 Mason Industries Inc. Type BR;

.5 J. P. America Inc. Type TRM.

2.04 Spring Floor Isolators

.1 Seismically rated captive spring mount isolator complete with levelling bolts, upper and lower neoprene spring cups, neoprene cushion, ductile iron housing, neoprene sound pads, and neoprene isolation grommets for securing bolts.

.2 Manufacturers:

.1 Vibro-Acoustics Ltd. Type SFS;

.2 The VMC Group Vibration Mounting & Controls (Korfund-Dynamics) Type AMSR;

.3 Kinetics Noise Control Vibron Products Group Type FLSS;

.4 Mason Industries Inc. Type SSLFH;

.5 J. P. America Inc. Type TSO-C-SC.

2.05 Open Spring Mounts

.1 Base mount free-standing assemblies, each complete with a stable colour coded steel spring welded in place, drilled mild steel mounting plate bonded to a ribbed rubber or neoprene acoustical pad, and an external 16 mm (5/8") diameter level adjustment bolt.

.2 Manufacturers:

.1 Vibro-Acoustics Ltd. Type FS;

.2 The VMC Group Vibration Mounting & Controls (Korfund-Dynamics) "Spring-Flex" Type A;

.3 Kinetics Noise Control Vibron Products Group Type FDS;

.4 Mason Industries Inc. Type SLFH;

.5 J. P. America Inc. Type TSO.

2.06 Closed Spring Mounts

.1 Base mount free-standing enclosed assemblies, each complete with stable colour coded spring(s), 2 piece cast housing, non-binding rubber horizontal stabilizers, a ribbed rubber or neoprene acoustical pad bonded to base of the closed housing, and an external level adjustment bolt.

.2 Manufacturers:

.1 Vibro-Acoustics Ltd. Type CM;

.2 The VMC Group Vibration Mounting & Controls (Korfund-Dynamics) "Spring-Flex" Types B and C;

.3 Kinetics Noise Control Vibron Products Group Type FLS;

.4 Mason Industries Inc. Type C;

.5 J. P. America Inc. Type TSC.

2.07 Totally Retained Spring Mounts

.1 Base mount free-standing enclosed and retained assemblies to limit both vertical and lateral movement of mounted equipment, each complete with stable colour coded spring(s), drilled welded steel housing and top plate, ribbed rubber or neoprene acoustical pad bonded to bottom of housing, vertical limit adjusting hardware, and a level adjustment bolt.

.2 Manufacturers:

.1 Vibro-Acoustics Ltd. Type CSR;

.2 The VMC Group Vibration Mounting & Controls (Korfund-Dynamics) "Spring-Flex" Type MS;

.3 Kinetics Noise Control Vibron Products Group Type SM;

.4 Mason Industries Inc. Type SLRSO;

.5 J. P. America Inc. Type TSR.

2.08 Spring Hangers

.1 Welded steel plate housing with top and bottom rod mounting holes and spring retainer, neoprene double deflection isolation element, stable colour coded spring, and heavy-duty rubber washers.

.2 Manufacturers:

.1 Vibro-Acoustics Ltd. Type SHR-SN;

.2 The VMC Group Vibration Mounting & Controls (Korfund-Dynamics) "Spring-Flex" Series HRSA;

.3 Kinetics Noise Control Vibron Products Group. Type SRH;

.4 Mason Industries Inc. Type 30N;

.5 J. P. America Inc. Type TSH.

2.09 Neoprene Hanger Isolators

.1 Neoprene double deflection rod isolators with steel housing and hanger rod bushing, selected for a minimum 4 mm (0.15") static deflection unless otherwise specified.

.2 Manufacturers:

.1 Vibro-Acoustics Ltd. Type NH;

.2 The VMC Group Vibration Mounting & Controls (Korfund-Dynamics) Type HR;

.3 Kinetics Noise Control Vibron Products Group Type RH;

.4 Mason Industries Inc. Type HD or WHD;

.5 J. P. America Inc. Type TRH.

2.10 Continuous Rail Type Isolation for Roof Mounted Equipment

.1 Continuous rooftop isolation shipped completely assembled, consisting of:

.1 galvanized steel sections formed to fit roof curb and associated equipment with a flexible air and weather seal joining upper and lower rail sections;

.2 stable springs, cadmium plated and selected to provide minimum deflection with 50% additional travel to solid;

.3 neoprene cushioned and wind restraints allowing 6 mm (¼") movement before engaging and resisting wind loads in any lateral direction.

.2 Manufacturers:

.1 Vibro-Acoustics Ltd. Vibro-Acoustics Type RTR;

.2 The VMC Group Vibration Mounting and Controls (Korfund-Dynamics) Type RTIR;

.3 Kinetics Noise Control Vibron Products Group Type KSR;

.4 Mason Industries Inc. Type RSC;

.5 J. P. America Inc. Type BRC.

3 Execution

3.01 Installation of Vibration Isolation Materials

.1 Unless otherwise stated in the drawings, schedules and/or typical details, vibration isolation is to be provided for all mechanical equipment as per the recommendations contained within in the most recent edition of the ASHRAE Handbook.

.2 Supply to vibration isolation product manufacturer or supplier a copy of a "reviewed" shop drawing or product data sheet for each piece of equipment to be isolated and dimensioned pipe layouts of associated piping to be isolated.

.3 Unless otherwise specified, vibration isolation products are to be product of one manufacturer.

.4 Ensure vibration isolation manufacturer coordinates material selections with equipment provided in order to ensure adherence to performance criteria. Allow for expansion and contraction when material is selected and installed.

.5 Unless otherwise indicated, install isolation materials for base mounted equipment on concrete housekeeping pad bases which extend at least over the full base and isolated area of the isolated equipment. Additional requirements are as follows:

.1 block and shim bases level so ductwork and piping connections can be made to a rigid system at proper operating level, before isolated adjustment is made, and ensure there is no physical contact between isolated equipment and building structure;

.2 steel bases are to clear the sub-base by 25 mm (1");

.3 concrete bases are to clear the sub-base by 50 mm (2").

.6 Isolate piping larger than 25 mm (1") dia. directly connected to motorized and/or vibration isolated equipment with 25 mm (1") static deflection spring hangers at spacing intervals in accordance with following:

.1 for pipe less than or equal to 100 mm (4") dia. – first 3 points of support;

.2 for pipe 125 mm (5") to 200 mm (8") dia. – first 4 points of support;

.3 for pipe equal to or greater than 250 mm (10") dia. – first 6 points of support;

.7 First point of isolated piping support is to have a static deflection of twice the deflection of the isolated equipment but maximum 50 mm (2").

.8 Secure top of spring hanger frame rigidly to structure, and do not install spring hangers in concealed locations.

.9 Where it is impossible to use at least 2 spring hangers, provide Senior Flexonics Ltd. Style 102 (or 102-U as required) or equal, twin sphere, moulded rubber flexible connection assemblies, selected by manufacturer and suitable in all respects for intended application, and complete with required nipples and connections to provide proper vibration isolation.

.10 Isolate designated piping risers at floor support points in accordance with drawing detail and/or where indicated on drawings.

.11 Erect roof curb vibration isolation in accordance with instructions shipped with assembly. Match vibration isolation with associated roof top unit and orient isolation as identified by manufacturer to ensure proper loading and optimum performance. Caulk top of roof curb with 2 beads of caulking provided and centre isolation assembly onto roof curb and, unless otherwise noted, screw in place with 50 mm (2") lag screws at 900 mm (36") O.C. Position gasket on top rail or alternatively, caulk with 2 beads of caulking provided and orient and lower roof top unit onto isolation rails and, unless otherwise noted, screw unit into top rail with 25 mm (1") lag screws at 900 mm (36") O.C. After roof top unit is secured in place, but before damageable work is installed, spray each isolated equipment assembly with water and correct any water leaks.

.12 For control wiring connections to vibration isolated equipment ensure flexible metallic conduit with 90° bend is used for conduit 25 mm (1") dia. and smaller, and for conduit larger than 25 mm (1") dia., use Crouse Hinds EC couplings. Connections are to be long enough so that conduit will remain intact if equipment moves 300 mm (12") laterally from its installed position, and flexible enough to transmit less vibration to structure than is transmitted through vibration isolation. Coordinate these requirements with mechanical trades involved. If electrical power connections are not made in a similar manner as part of the electrical work, report this fact to the Consultant.

.13 Arrange and pay for vibration isolation product manufacturer to visit site to inspect installation of his equipment. Perform revision work required as a result of improper installation. When vibration isolation equipment manufacturer is satisfied with the installation, obtain and submit a letter stating manufacturer has inspected the installation and equipment is properly installed.

.14 For requirements pertaining to seismically restrained vibration isolation, refer to Section 20 05 48.16 - Seismic Controls for Mechanical Systems.

End of Section

1 General

1.01 Section Includes

.1 Nameplates.

.2 Tags.

.3 Pipe Markers.

1.02 References

.1 ASME A13.1 – Scheme for the Identification of Piping Systems.

1.03 Submittals

.1 Section 01 33 00: Submittals.

.2 Submit list of wording, symbols, letter size, and colour coding for mechanical identification.

.3 Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.

.4 Product Data: Provide manufacturers catalogue literature for each product required.

.5 Samples: Submit two labels, tags samples to Consultant for approval.

.6 Manufacturer's Installation Instructions: Indicate special procedures, and installation.

1.04 Closeout Submittals

.1 Section 01 77 00: Project Closeout.

.2 Record actual locations of tagged valves.

2 Products

2.01 Mechanical Work Identification Materials

.1 Confirm with the Owner if an existing mechanical work identification system is in place and, if so, match accordingly.

.2 If an existing mechanical work identification system is not in place, the following is to be used:

.1 Equipment nameplates are to be minimum 1.6 mm (1/16") thick 2-ply laminated coloured plastic plates, minimum 12 mm x 50 mm (½" x 2") for smaller items such as damper motors and control valves, minimum 25 mm x 65 mm (1" x 2-½") for equipment, and minimum 50 mm x 100 mm (2" x 4") for control panels and similar items. Additional requirements are as follows:

.1 unless otherwise specified or required, each nameplate is to be white, complete with bevelled edges and black engraved wording to completely identify equipment and its use with no abbreviations;

.2 wording is generally to be as per drawings, i.e. Fan EF-1, and is to include equipment service and building area/zone served, but must be reviewed prior to engraving;

.3 supply stainless steel screws for securing nameplates in place;

.4 nameplates for equipment suspended above floor level or generally not within easy viewing from floor level are to be increased in size so as to be easily readable from floor level.

.2 Valve tags are to be coloured, 40 mm (1-½") square, 2-ply laminated plastic with bevelled edges, red-white, green-white, yellow-black, etc., to match piping identification colour, each complete with a 3.2 mm (1/8") diameter by 100 mm (4") long brass plated steel bead chain, and four lines of engraved maximum size identification wording, i.e.:

VALVE V12
200 mm (8")
CHILL. WATER
NORMALLY OPEN

.3 Standard pipe identification is to be equal to Smillie McAdams Summerlin Ltd., Brady or Primark Manufacturing Inc. vinyl plastic with indoor/outdoor type vinyl ink lettering and directional arrows, as follows:

.1 for pipe less than or equal to 150 mm (6") diameter, coiled type snap-on markers of a length to wrap completely around pipe or pipe insulation;

.2 for pipe larger than 150 mm (6") diameter, saddle type strap-on markers with 2 opposite identification locations and complete with nylon cable ties.

.4 Identification wording and colours for pipe identification materials are to be as follows:

PIPE SERVICE	IDENTIFICATION COLOUR	LEGEND
domestic cold water	green	DOM. COLD WATER
domestic hot water supply	green	DOM. HW SUPPLY
domestic hot water recirculation	green	DOM. HW RECIRC.
tempered domestic water	green	TEMP. DOM. WATER
chilled drinking water	green	CH. DRINK WTR.
storm drainage	green	STORM
sanitary drainage	green	SAN.
plumbing vent	green	SAN. VENT
fire protection sprinklers	red	F.P. SPRINKLER
natural gas	to Code	to Code, c/w pressure
natural gas vent	to Code	to Code
refrigerant suction	yellow	REFRIG. SUCTION
refrigerant liquid	yellow	REFRIG. LIQUID
refrigerant hot gas	yellow	REFRIG. HOT GAS

.5 Colours for pipe identification legends and directional arrows are to be as follows:

IDENTIFICATION COLOUR	LEGEND & ARROW COLOUR
yellow	black

IDENTIFICATION COLOUR	LEGEND & ARROW COLOUR
green	white
red	white

.6 Duct identification is to be custom made Mylar stencils with 50 mm (2") high lettering to accurately describe duct service, i.e. "AHU-1 SUPPLY", complete with a directional arrow, and coloured ink with ink pads and roller applicators. Ink colour is generally to be black but must contrast with lettering background.

3 Execution

3.01 Preparation

.1 Degrease and clean surfaces to receive adhesive for identification materials.

3.02 Installation

.1 Identify new exposed piping and ductwork as per Part 2 of this Section in locations as follows:

.1 at every end of every piping or duct run;

.2 adjacent to each valve, strainer, damper and similar accessory;

.3 at each piece of connecting equipment;

.4 on both sides of every pipe and duct passing through a floor, wall or partition, unless otherwise specified;

.5 at 6 m (20') intervals on pipe and duct runs exceeding 6 m (20') in length;

.6 at least once in each room, and at least once on pipe and duct runs less than 6 m (20') in length.

.2 Unless otherwise specified identify new concealed piping and ductwork as per Part 2 of this Section in locations as follows:

.1 at points where pipes or ducts enter and leave rooms, shafts, pipe chases, furred spaces, and similar areas;

.2 at maximum 6 m (20') intervals on piping and ductwork above suspended accessible ceilings, and at least once in each room;

.3 at each access door location;

.4 at each piece of connected equipment, automatic valve, etc.

.3 Provide an identification nameplate for equipment provided as part of this project, including items such as control valves, motorized dampers, instruments, and similar products. Secure nameplates in place, approximately at eye level if possible, with stainless steel screws unless such a practice is prohibitive, in which case use epoxy cement applied to cleaned surfaces. Locate nameplates in the most conspicuous and readable location.

.4 Paint new natural and/or propane gas piping with primer and 2 coats of yellow paint in accordance with Code requirements. Identify piping at intervals as specified above.

.5 Provide an identification nameplate for each motor starter or disconnect switch located in a motor control centre or on a motor starter panel, and on each individually mounted starter provided as part of

mechanical work, and on each disconnect switch provided as part of the electrical work for motorized equipment provided as part of mechanical work.

.6 For electrically traced mechanical work, identification wording is to include "ELECTRICALLY TRACED".

.7 Tag valves and prepare a valve tag chart in accordance with following requirements:

.1 attach a valve tag to each new valve, except for valves located immediately at equipment they control;

.2 prepare a digital valve tag chart to list tagged valves, with, for each valve, the tag number, location, valve size, piping service, and valve attitude (normally open or normally closed);

.3 if an existing valve tag chart is available at site, valve tag numbering is to be an extension of existing numbering and new valve tag chart is to incorporate existing chart;

.4 include a copy of valve tag chart in each copy of operating and maintenance instruction manuals.

.8 Where shut-off valves, control dampers, sensors, and similar items which will or may need maintenance and/or repair are located above accessible suspended ceilings, provide round coloured ceiling tacks in ceiling panel material, or stickers equal to Brady "Quick Dot" on ceiling grid material to indicate locations of items. Unless otherwise specified, ceiling tack or sticker colours are to be as follows:

.1	HVAC piping valves and equipment:	yellow
.2	fire protection valves and equipment:	red
.3	plumbing valves and equipment:	green
.4	HVAC ductwork dampers and equipment:	blue
.5	control system hardware and equipment:	orange

End of Section

1 General

1.01 Section Includes

.1 This Section specifies mechanical system testing, adjusting, and balancing requirements that are common to mechanical work Sections of the Specification and it is a supplement to each Section and is to be read accordingly.

1.02 Definitions

.1 "Agency" – means agency to perform testing, adjusting and balancing work.

.2 "TAB" – means testing, adjusting and balancing to determine and confirm quantitative performance of equipment and systems and to regulate specified fluid flow rate and air patterns at terminal equipment, e.g., reduce fan speed, throttling, etc.

.3 "hydronic systems" – includes heating water, chilled water, glycol-water solution, condenser water, and any similar system.

.4 "air systems" – includes outside air, supply air, return air, exhaust air, and relief air systems.

.5 "flow rate tolerance" – means allowable percentage variation, minus to plus, of actual flow rate values in Contract Documents.

.6 "report forms" – means test data sheets arranged for collecting test data in logical order for submission and review, and these forms, when reviewed and accepted, should also form permanent record to be used as basis for required future testing, adjusting and balancing.

.7 "terminal" – means point where controlled fluid enters or leaves the distribution system, and these are supply inlets on water terminals, supply outlets on air terminals, return outlets on water terminals, and exhaust or return inlets on air terminals such as registers, grilles, diffusers, louvers, and hoods.

.8 "main" – means duct or pipe containing system's major or entire fluid flow.

.9 "submain" – means duct or pipe containing part of the systems' capacity and serving 2 or more branch mains.

.10 "branch main" – means duct or pipe servicing 2 or more terminals.

.11 "branch" – means duct or pipe serving a single terminal.

1.03 Submittals

.1 Within 30 days of work commencing at site, submit name and qualifications of proposed testing and balancing agency in accordance with requirements of article entitled Quality Assurance below.

.2 Submit sample test forms, if other than those standard forms prepared by Associated Air Balance Council (AABC) or National Environmental Balancing Bureau (NEBB), are proposed for use.

.3 Submit a report by Agency to indicate Agency's evaluation of mechanical drawings with respect to service routing and location or lack of balancing devices. Include set of drawings used and marked-up by Agency to prepare report.

1.04 Closeout Submittals

.1 Submit a report by Agency after each site visit made by Agency during construction phase of this Project.

.2 Submit a draft report, as specified in Part 3 of this Section.

.3 Submit a final report, as specified in Part 3 of this Section.

.4 Submit a testing and balancing warranty as specified in Part 3 of this Section.

.5 Submit reports listing observations and results of post construction site visits as specified in Part 3 of this Section.

1.05 Quality Assurance

.1 Employ services of an independent testing, adjusting, and balancing agency meeting qualifications specified below, to be single source of responsibility to test, adjust, and balance building mechanical systems to produce design objectives. Agency is to have successfully completed testing, adjusting and balancing of mechanical systems for a minimum of 5 projects similar to this Project within past 3 years, and is to be certified as an independent agency in required categories by one of following:

.1 AABC – Associated Air Balance Council;

.2 NEBB – National Environmental Balancing Bureau.

.2 NBCTA certification in lieu of the above noted organizations is not permitted.

.3 Testing, adjusting and balancing of complete mechanical systems is to be performed over entire operating range of each system in accordance with 1 of following publications:

.1 National Standards for a Total System Balance published by Associated Air Balance Council;

.2 Procedural Standards for Testing, Adjusting and Balancing of Environmental Systems published by National Environmental Balancing Bureau;

.3 Chapter 37, Testing, Adjusting, and Balancing of ASHRAE Handbook HVAC Applications.

2 Products – Not Used

3 Execution

3.01 Scope of Work

.1 Perform total mechanical systems testing, adjusting, and balancing. Requirements include measurement and establishment of fluid quantities of mechanical systems as required to meet design specifications and comfort conditions, and recording and reporting results.

.2 Mechanical systems to be tested, adjusted and balanced include:

.1 TAB of domestic water systems (all piping extended from Municipal main) is to include:

.1 domestic hot water recirculation piping;

.2 tempered water piping flows.

.2 TAB of air handling systems is to include equipment and ductwork air temperatures, capacities and flows.

.3 TAB of heating systems is to include piping and equipment fluid temperatures, flows and control, and if TAB is not done during heating season, a follow-up site visit during heating season will be required to confirm proper flows and temperatures, and any required system "fine tuning".

.4 Following existing systems, revised as part of mechanical work, are to be tested, adjusted and balanced as for new systems:

.1 All existing Rooftop Air Handling Units.

3.02 Testing, Adjusting, and Balancing

.1 Conform to following:

.1 as soon as possible after award of Contract, Agency is to carefully examine a set of mechanical drawings with respect to routing of services and location of balancing devices, and is to issue a report listing results of the evaluation;

.2 set of drawings examined by Agency is to be returned with evaluation report, with red line mark-ups to indicate locations for duct system test plugs, and required revision work such as relocation of balancing devices and locations for additional devices;

.3 after review of mechanical work drawings and specification, Agency is to visit site at frequent, regular intervals during construction of mechanical systems, to observe routing of services, locations of testing and balancing devices, workmanship, and anything else that will affect testing, adjusting and balancing;

.4 after each site visit, Agency is to report results of site visit indicating date and time of visit, and detailed recommendations for any corrective work required to ensure proper adjusting and balancing;

.5 testing, adjusting and balancing is not to begin until:

.1 building construction work is substantially complete and doors have been installed;

.2 mechanical systems are complete in all respects, and have been checked, started, adjusted, and then successfully performance tested.

.6 mechanical systems to be tested, adjusted and balanced are to be maintained in full, normal operation during each day of testing, adjusting and balancing;

.7 obtain copies of reviewed shop drawings of applicable mechanical plant equipment and terminals, and temperature control diagrams and sequences;

.8 Agency is to walk each system from system "head end" equipment to terminal units to determine variations of installation from design, and system installation trades will accompany Agency;

.9 Agency is to check valves and dampers for correct and locked position, and temperature control systems for completeness of installation before starting equipment;

.10 wherever possible, Agency is to lock balancing devices in place at proper setting, and permanently mark settings on devices;

.11 Agency is to leak test ductwork as specified in Section entitled HVAC Air Distribution in accordance with requirements of SMACNA "HVAC Air Duct Leak Test Manual", coordinate work with work of aforementioned Sections, provide detailed sketch(es) to Sheet Metal Contractor and Consultant identifying ductwork not in accordance with acceptable leakage values specified in aforementioned Sections, and retest corrected ductwork;

.12 Agency is to balance systems with due regard to objectionable noise which is to be a factor when adjusting fan speeds and performing terminal work such as adjusting air quantities, and should objectionable noise occur at design conditions, Agency is to immediately report problem and submit data, including sound readings, to permit an accurate assessment of noise problem to be made;

.13 Agency is to check supply air handling system mixing plenums for stratification, and where variation of mixed air temperature across coils is found to be in excess of ±5% of design

requirements, Agency is to report problem and issue a detail sketch of plenum baffle(s) required to eliminate stratification;

.14 Agency is to perform testing, adjusting and balancing to within ±5% of design values, and make and record measurements which are within ±2% of actual values;

.15 for air handling systems equipped with air filters, test and balance systems with simulated 50% loaded (dirty) filters by providing a false pressure drop;

.16 test, adjust and balance air conditioning systems during summer season and heating systems during winter season, including at least a period of operation at outside conditions within 2.8°C (5°F) wet bulb temperature of maximum summer design condition, and within 5.5°C (10°C) dry bulb temperature of minimum winter design condition, and take final temperature readings during seasonal operation.

.2 Prepare reports as indicated below.

.1 Upon completion of testing, adjusting, and balancing procedures, prepare draft reports on AABC or NEBB forms. Draft reports may be hand written, but must be complete, factual, accurate, and legible. Organize and format draft reports in same manner specified for final reports and submit for review.

.2 Upon verification and approval of draft reports, prepare final reports organized and formatted as specified below. Use units of measurement (SI or Imperial) as used on Project Documents.

.3 Report forms are to be those standard forms prepared by the referenced standard for each respective item and system to be tested, adjusted, and balanced. Report forms complete with schematic systems diagrams and other data are to be consolidated in electronic format as a PDF. PDF file to be indexed and organized into sections, as it applies to the project, as follows:

.1 General Information and Summary;

.2 Air Systems;

.3 Hydronic Systems;

.4 Temperature Control Systems;

.5 Special Systems.

.4 Agency is to provide following minimum information, forms and data in report:

.1 inside cover sheet to identify Agency, Contractor, and Project, including addresses, and contact names and telephone numbers and a listing of instrumentation used for procedures along with proof of calibration;

.2 remainder of report is to contain appropriate forms containing as a minimum, information indicated on standard AABC or NEBB report forms prepared for each respective item and system;

.3 Agency is to include for each system to be tested, adjusted and balanced, a neatly drawn, identified (system designation, plant equipment location, and area served) schematic "as-built" diagram indicating and identifying equipment, terminals, and accessories;

.4 Agency is to include report sheets indicating building comfort test readings for all rooms.

.3 After final testing and balancing report has been submitted, Agency is to visit site with Contractor and Consultant to spot check results indicated on balancing report. Agency is to supply labour, ladders, and

instruments to complete spot checks. If results of spot checks do not, on a consistent basis, agree with final report, spot check procedures will stop and Agency is to then rebalance systems involved, resubmit final report, and again perform spot checks with Contractor and Consultant.

.4 When final report has been accepted, Contractor is to submit to Owner, in name of Owner, a certificate equal to AABC National Guaranty Certification or a NEBB Quality Assurance Program Bond, and in addition, Contractor is to submit a written extended warranty from Agency covering one full heating season and one full cooling season, during which time any balancing problems which occur, with exception of minor revision work done during scheduled site visits, will, at no cost, be investigated by Agency and reported on to Owner, and if it is determined that problems are a result of improper testing, adjusting and balancing, they are to be immediately corrected without additional cost to Owner.

End of Section

1 General

1.01 Section Includes

.1 This Section specifies insulation requirements common to Mechanical Divisions work Sections and it is a supplement to each Section and is to be read accordingly.

1.02 Definitions

.1 "concealed" – means mechanical services and equipment above suspended ceilings, in non-accessible chases, in accessible pipe spaces, and furred-in spaces.

.2 "exposed" – means exposed to normal view during normal conditions and operations.

.3 "mineral fibre" – includes glass fibre, rock wool, and slag wool.

.4 "domestic water" or "potable water" – means piping extended from building Municipal supply main.

1.03 Submittals

.1 At least 4 weeks prior to insulation work commencing, submit a sample of each type of insulation (and insulation accessories and finish), in applied form, for review. Mount samples on a plywood board. Identify each product with manufacturer's name and insulation type, and proposed use of insulation. When sample board has been approved, mechanical insulation work is to conform to approved sample board.

.2 Submit a product data sheet for each insulation system product.

.3 Submit a fabrication drawing for each custom made cover to indicate material and fabrication details, and a 300 mm (12") square sample of proposed cover material.

.4 Submit a colour chart for coloured lagging adhesive for canvas jacketed insulation.

1.04 Closeout Submittals

.1 In accordance with Part 3 of this Section, submit a letter from fire rated duct wrap supplier to certifying duct wrap has been properly installed.

1.05 Quality Assurance

.1 Mechanical insulation is to be applied by a licensed journeyman insulation mechanic, or by an apprentice under direct, daily, on-site supervision of a journeyman mechanic.

.2 Do not apply insulation unless leakage tests have been satisfactorily completed.

.3 Ensure surfaces to be insulated are clean and dry.

.4 Ensure ambient temperature is minimum 13°C (55°F) for at least 1 day prior to application of insulation, and for duration of insulation work, and relative humidity is and will be at a level such that mildew will not form on insulation materials.

.5 Company with sub-contract for mechanical insulation work is to be a member in good standing of Thermal Insulation Association of Canada.

.6 Insulation materials must be stored on site in a proper and dry storage area. Any wet insulation material is to be removed from site.

2 Products

2.01 Fire Hazard Ratings

.1 Unless otherwise specified, insulation system materials inside building must have a fire hazard rating of not more than 25 for flame spread and 50 for smoke developed when tested in accordance with ULC S102, Surface Burning Characteristics of Building Materials and Assemblies.

2.02 Thermal Performance

.1 Unless otherwise specified, thermal performance of insulation is to meet or exceed values given in Tables entitled Minimum Piping Insulation Thickness Heating and Hot Water Systems and Minimum Piping Insulation Thickness Cooling Systems, as stated in ANSI/ASHRAE/IES Standard 90.1 version referenced in Ontario Building Code.

2.03 Pipe Insulation Materials

.1 Horizontal pipe insulation at hangers and supports are to be equal to Belform Insulation Ltd. "Koolphen K-Block" insulated pipe support inserts consisting of minimum 150 mm (6") long, pre-moulded, rigid, sectional phenolic foam insulation (of same thickness as adjoining insulation) with a reinforced foil and kraft paper vapour barrier jacket and a captive galvanized steel saddle.

.2 Flexible foam elastomeric is to be closed cell, sleeve type, longitudinally split self-seal, foamed plastic pipe insulation with a water vapour transmission rating of 0.10 in accordance with ASTM E96, Procedure B, and required installation accessories.

.1 Manufacturers:

.1 Armacell AP/Armaflex SS;

.2 IK Insulation Group K-Flex "LS" Self-Seal Pipe Insulation.

.3 Fire rated pre-moulded mineral wool is to be non-combustible, fire-rated, rigid, sectional, longitudinally split mineral wool or basalt pipe insulation with a reinforced vapour barrier jacket and compatible with ULC S115 and ULC-S101 firestopping.

.1 Manufacturers:

.1 Roxul "Techton 1200";

.2 IIG (Johns Manville Inc.) MinWool-1200;

.3 Paroc 1200.

.4 Pre-moulded mineral fibre is to be rigid, sectional, sleeve type insulation to ASTM C547, with a factory applied vapour barrier jacket.

.1 Manufacturers:

.1 Johns Manville Inc. "Micro-Lok AP-T Plus";

.2 Knauf Fiber Glass "Pipe Insulation" with "ASJ-SSL" jacket;

.3 Manson Insulation Inc. "ALLEY K APT";

.4 Owens Corning "Fiberglas" Pipe Insulation.

.5 Blanket mineral fibre is to be blanket type roll insulation to CGSB 51-GP-11M, 24 kg/m3 (1-½ lb/ft^3) density, with a factory applied vapour barrier facing.

.1 Manufacturers:

.1 Johns Manville Inc. Microlite FSK Duct Wrap Type 150;

.2 Knauf Fiber Glass Blanket Insulation FSK Duct Wrap Type III;

.3 Manson Insulation Inc. ALLEY WRAP FSK Duct Wrap Type III;

.4 Certainteed Corporation Softtouch FSK Duct Wrap Type 150.

.6 Pre-moulded weatherproof jacketed mineral fibre is to be Knauf Insulation "Redi-Klad 1000" sectional, sleeve type pipe insulation with a self-sealing weather-proof jacket and a 100 mm (4") butt joint sealing strip with each section.

2.04 Barrier-Free Lavatory Piping Insulation Kits

.1 Removable, flexible, reusable, white moulded plastic insulation kits for barrier-free lavatory drain piping and potable water supplies exposed under lavatory.

.2 Manufacturers:

.1 Truebo "Lav-Guard 2" E-Z Series;

.2 Zeston "SNAP-TRAP";

.3 McGuire Manufacturing Co. Inc. "ProWrap".

2.05 Equipment Insulation Materials

.1 Blanket mineral fibre is to be blanket type roll form insulation to ASTM C553, 24 kg/m3 (1-½ lb/ft^3) density, with a factory applied vapour barrier facing.

.1 Manufacturers:

.1 Johns Manville Inc. Microlite FSK Duct Wrap Type 150;

.2 Knauf Fiber Glass Blanket Insulation FSK Duct Wrap Type III;

.3 Manson Insulation Inc. ALLEY WRAP FSK Duct Wrap Type III;

.4 Certainteed Corporation Softtouch FSK Duct Wrap Type 150.

.2 Semi-rigid mineral fibre board is to be roll form, moulded insulation to ASTM C1393, with a factory applied vapour barrier facing consisting of laminated aluminum foil and kraft paper.

.1 Manufacturers:

.1 Knauf Fiber Glass Pipe and Tank Insulation;

.2 Manson Insulation Inc. "AK FLEX";

.3 Johns Manville Inc. Pipe and Tank Insulation "Micro-Flex";

.4 Multi-Glass Insulation Ltd. "MULTI-FLEX MF";

.5 Owens Corning Pipe and Tank Insulation;

.6 Glass-Cell Fabricators Ltd. "R-Flex".

.3 Semi-rigid mineral wool blanket is to be equal to Roxul "Enerwrap MA 960" flexible, black fibrous scrim faced mineral wool blanket insulation to ASTM C553.

.4 Closed cell foamed glass is to be Owens Corning "FOAMGLAS" expanded, rigid board and block type insulation with a liquid or vapour permeability rating (as per ASTM C240) of 0.00.

2.06 Removable/Reusable Insulation Covers

.1 Valve, etc. covers are to be NO SWEAT reusable insulation wraps with vapour barrier jacket and self-sealing ends and longitudinal seam, with a length to suit the application and an insulation thickness equal to adjoining insulation.

.2 Custom manufactured equipment covers conforming to shape of item to be insulated, designed to be easily removable and replaceable to suit use and maintenance procedures of particular item, and to provide adequate personnel protection. Covers are to be complete with minimum 95 kg/m3 (6 lb/ft^3) density ceramic fibre insulation sewn between minimum 542.5 g/m2 (1.8 oz/ft^2) weight silicone impregnated fibreglass fabric in a quilted pattern using double stitches made with Kelvar or Teflon coated fibreglass thread. Overlap flaps are to be secured using laces, snaps, or Velcro double stitched in place.

.3 Manufacturers:

.1 Crossby Dewar Inc.;

.2 Insufab Systems Inc.;

.3 ADL Insulflex Inc.;

.4 Firwin Corp.;

.5 GlassCell Isofab Inc.

2.07 Ductwork System Insulation Materials

.1 Rigid mineral fibre board is to be pre-formed board type insulation to ASTM C612, 48 kg/m3 (3 lb/ft^3) density, with a factory applied reinforced aluminum foil and kraft paper facing.

.1 Manufacturers:

.1 Knauf Fiber Glass Insulation Board with FSK facing;

.2 Manson Insulation Inc. "AK BOARD FSK";

.3 Johns Manville Inc. Type 814 "Spin-Glas";

.4 Owens Corning 703.

.2 Semi-rigid mineral fibre board is to be roll form insulation to ASTM C1393, consisting of cut strips of rigid mineral board insulation glued to an aluminium foil and kraft paper facing.

.1 Manufacturers:

.1 Multi-Glass Insulation Ltd. "Multi-Flex MKF";

.2 Glass-Cell Fabricators Ltd. "R-FLEX";

.3 Owens Corning Pipe and Tank Insulation;

.4 Johns Manville Inc. Pipe and Tank Insulation.

.3 Blanket mineral fibre is to be blanket type roll form insulation to ASTM C553, 24 kg/m3 (1½ lb/ft3) density, 40 mm (1-½") thick, with a factory applied vapour barrier facing.

.1 Manufacturers:

.1 Johns Manville Inc. Microlite FSK Duct Wrap Type 150;

.2 Knauf Fiber Glass Blanket Insulation FSK Duct Wrap Type III;

.3 Manson Insulation Inc. ALLEY WRAP FSK Duct Wrap Type III;

.4 Certainteed Corporation Softtouch FSK Duct Wrap Type 150.

.4 Pre-moulded calcium silicate is to be rigid block and sheet insulation.

.1 Manufacturers:

.1 Johns Manville Inc. "Thermo-12 Gold";

.2 Industrial Insulation Group "Thermo-12 Gold".

.5 Flexible foam elastomeric sheet is to be sheet form, CFC free, closed cell, self-adhering elastomeric nitrile rubber insulation with a water vapour permeability rating of 0.08 in accordance with ASTM E96 Procedure A.

.1 Manufacturers:

.1 Armacell "AP/Armaflex SA";

.2 IK Insulation Group "K-Flex Duct Wrap", S2S.

.6 Extruded polystyrene tapered insulation – equal to Soprema Sopra-ISO Tapered, closed cell polyisocyanurate foam core with organic facers reinforced with glass fibres, 172 kPa compressive strength as per ASTM D1621, 32 kg/m3 density, 50mm minimum thickness, 2% slope. Thickness shall increase if width of duct work is larger than 1200mm to maintain 2% slope.

2.08 Fire Rated Duct Wrap

.1 Flexible, non-combustible, blanket type mineral fibre duct wrap completely encapsulated in reinforced foil, suitable for installation with zero clearance to combustibles (for grease ducts), and ULC tested and listed (ULC Designs FRD-17 & 23 for ventilation ducts, ULC Design FRD-19 for kitchen exhaust/grease duct) to facilitate a 2 hour fire resistance rating (76 mm (3") thick) to kitchen grease exhaust duct in accordance with requirements of NFPA-96, and/or a 1 or 2 hour fire resistance rating (38 mm (1-½") thick) to ventilation or pressurization ductwork in accordance with requirements of ISO 6944.

.2 Manufacturers:

.1 3M Fire Barrier Duct Wrap 615;

.2 CL4 Inc. "CL4Fire";

.3 Unifrax Corp. "FyreWrap Elite 1.5";

.4 Morgan Thermal Ceramics "FireMaster FastWrap XL".

2.09 Insulating Coatings

.1 Equal to Robson Thermal Manufacturing Ltd. insulating coatings as follows:

.1 anti-condensation coating, "No Sweat-FX";

.2 thermal insulating coating, "ThermaLite".

2.10 Insulation Fastenings

.1 Wire – minimum #15 gauge galvanized annealed wire.

.2 Wire with Mesh – minimum #15 gauge galvanized annealed wire factory woven into 25 mm (1") hexagonal mesh.

.3 Aluminium Banding – equal to ITW Insulation Systems Canada "FABSTRAPS" minimum 12 mm (½") wide, 0.6 mm (1/16") thick aluminium strapping.

.4 Stainless Steel Banding – equal to ITW Insulation Systems Canada "FABSTAPS" 0.6 mm (1/16") thick, minimum 12 mm (½") wide type 304 stainless steel strapping.

.5 Duct Insulation Fasteners – weld-on 2 mm (3/32") diameter zinc coated steel spindles of suitable length, complete with minimum 40 mm (1-½") square plastic or zinc plated steel self-locking washers.

.6 Tape Sealant – equal to MACtac Canada Ltd. self-adhesive insulation tapes, types PAF, FSK, ASJ, or SWV as required to match surface being sealed.

.7 Mineral Fibre Insulation Adhesive – clear, pressure sensitive, brush consistency adhesive, suitable for a temperature range of -20°C to 82°C (-4°F to 180°F), compatible with type of material to be secured, and WHMIS classified as non-hazardous.

.8 Flexible Elastomeric Insulation Adhesive – Armacell "Armaflex" #520 air-drying contact adhesive.

.9 Closed Cell Foamed Glass Insulation Adhesive – Pittsburgh Corning PC88 multi-purpose 2-component adhesive.

.10 Lagging Adhesive – white, brush consistency, ULC listed and labelled, 25/50 fire/smoke rated lagging adhesive for canvas jacket fabric, suitable for colour tinting, complete with fungicide and washable when dry.

.11 Screws – No. 10 stainless steel sheet metal screws.

2.11 Insulation Jackets and Finishes

.1 Canvas Jacket Material – ULC listed and labelled, 25/50 fire/smoke rated, roll form, minimum 170 g (6 oz.).

.2 Roll Form Sheet and Fitting Covers – minimum 15 mm (1/2") thick white PVC, 25/50 fire/smoke rated tested in accordance with ULC S102, complete with installation and sealing accessories.

.1 Manufacturers:

.1 Proto Corp. "LoSMOKE";

.2 The Sure-Fit System "SMOKE-LESS 25/50";

.3 Johns Manville Inc. "Zeston" 300.

.3 Rigid Aluminium Jacket – equal to ITW Insulation Systems Canada "Lock-on" 0.406 mm (0.016") thick embossed aluminum jacket material to ASTM B209, factory cut to size and complete with polysurlyn moisture barrier and continuous modified Pittsburgh Z-Lock, butt straps with "Fabstraps" to weatherproof the end to end joints, and 2-piece epoxy coated pressed aluminum fittings with weather locking edges.

.4 Adhesive backed flexible aluminium is to be MFM Building Products Corp. "Flex-Clad 400" roll form sheet material with an aggressive rubberized asphalt adhesive backing, high density polyethylene reinforcement, and an embossed aluminum facing.

.5 Heat resistant, trowel consistency thermal insulating and finishing cement to CAN/CGSB 51.12, and suitable for the application.

.6 Foamed glass insulation protective coating is to be Pittsburgh Corning "PITTCOTE 300e" flexible acrylic latex weather barrier coating, white unless otherwise specified.

.7 UV and moisture resistant flexible foam insulation with protective jacket equal to Armacell "ArmaFlex Shield".

.8 Self adhesive multilayer jacketing - equal to 3M Ventureclad 1577CW or 1579GCW series. Multi-ply laminate flexible jacketing, acrylic adhesive, zero permeability vapor barrier. Properties for 1577CW Flat White - 480N/mm tensile strength, 22N/25mm peel adhesion strength, 15.2 kPa shear adhesion after 72 hours, 147N puncture resistance, 0.2mm thickness. Properties for other colours or 1579GCW series shall match current technical data sheets from 3M.

3 Execution

3.01 General Insulation Application Requirements

.1 Unless otherwise specified, do not insulate following:

.1 factory insulated equipment and piping;

.2 heating piping within radiation unit enclosures, including blank filler sections of enclosures;

.3 heating piping in soffits and/or overhang spaces and connected to bare element radiation in spaces;

.4 branch potable water piping located under counters to serve counter mounted plumbing fixtures and fittings, except barrier-free lavatories;

.5 exposed chrome plated potable water angle supplies from concealed piping to plumbing fixtures and fittings, except barrier-free lavatories;

.6 heated liquid system pump casings, valves, strainers and similar accessories;

.7 heating system expansion tanks;

.8 fire protection pump casings;

.9 manufactured expansion joints and flexible connections;

.10 acoustically lined ductwork and/or equipment;

.11 factory insulated flexible branch ductwork;

.12 fire protection system water storage tanks;

.13 piping unions, except for unions in "cold" category piping.

.2 Install insulation directly over pipes and ducts, not over hangers and supports.

.3 Install piping insulation and jacket continuous through pipe openings and sleeves.

.4 Install duct insulation continuous through walls, partitions, and similar surfaces except at fire dampers.

.5 When insulating "cold" piping and equipment, extend insulation up valve bodies and other such projections as far as possible, and protect insulation jacketing from the action of condensation at its junction with metal.

.6 When insulating vertical piping risers 75 mm (3") diameter and larger, use insulation support rings welded directly above lowest pipe fitting, and thereafter at 4.5 m (14.7') centres and at each valve and flange. Insulate as per Thermal Insulation Association of Canada National Insulation Standards, Figure No. 9.

.7 Where piping and/or equipment is traced with electric heating cable, ensure cable has been tested and accepted prior to application of insulation, and ensure cable is not damaged or displaced during the application of insulation.

.8 Where existing insulation work is damaged as a result of mechanical work, repair damaged insulation work to Project work standards.

.9 Where mineral fibre rigid sleeve type insulation is terminated at valves, equipment, unions, etc., neatly cover exposed end of insulation with a purpose made PVC cover on "cold" piping, and with canvas jacket material on "hot" piping.

.10 Carefully and neatly gouge out insulation for proper fit where there is interference between weld bead, mechanical joints, etc., and insulation. Bevel away from studs and nuts to permit their removal without damage to insulation, and closely and neatly trim around extending parts of pipe saddles.

.11 Where thermometers, gauges, and similar instruments occur in insulated piping, and where access to heat transfer piping balancing valve ports and similar items are required, create a neat, properly sized hole in insulation and provide a suitable grommet in the opening.

3.02 Insulation for Horizontal Pipe at Hangers and Supports

.1 At each hanger and support location for piping 50 mm (2") diameter and larger and scheduled to be insulated, except where roller hangers and/or supports are required, and unless otherwise specified, supply a factory fabricated section of phenolic foam pipe insulation with integral vapour barrier jacket and captive galvanized steel shield. Supply insulation sections to piping installers for installation as pipe is erected.

.2 For 100 mm (4") diameter and larger heating system piping where roller type hangers and supports are provided, a steel saddle will be tack welded to pipe at each roller hanger or support location. Pack saddle voids with loose mineral wool insulation.

3.03 Pipe Insulation Requirements – Mineral Fibre

.1 Insulate following pipe inside building and above ground with mineral fibre insulation of thickness indicated:

.1 domestic cold water piping, less than 100 mm (4") dia. – 25 mm (1") thick;

.2 domestic cold water piping, greater than or equal to 100 mm (4") dia. – 40 mm (1-½") thick;

.3 domestic hot water piping, less than 40 mm (1-½") dia. – 25 mm (1") thick;

.4 domestic hot water piping, greater than or equal to 40 mm (1½") dia. – 40 mm (1-½") thick;

.5 tempered domestic water piping, supply and return, less than 40 mm (1-½") dia. – 25 mm (1") thick;

.6 tempered domestic water piping, supply and return, greater than or equal to 40 mm (1-½") dia. – 50 mm (2") thick;

.7 storm drainage piping from roof drains to the point where main vertical risers extend straight down, without offsets, and connect to horizontal underground mains – 25 mm (1") thick;

.8 condensate drainage piping from fan coil unit or any other air conditioning system/unit drain pans to main vertical drain risers or to indirect drainage point – 25 mm (1") thick;

.9 drainage piping from refrigerated drinking fountains to nearest 75 mm (3") dia. or larger drain pipe – 25 mm (1") thick;

.10 hot water heating piping, supply and return, less than 40 mm (1-½") dia. – 40 mm (1-½") thick;

.11 hot water heating piping, supply and return, greater than or equal to 40 mm (1-½") dia. – 50 mm (2") thick;

.12 glycol solution heating or heat reclaim piping, supply and return, less than 40 mm (1-½") dia. – 40 mm (1-½") thick;

.13 glycol solution heating or heat reclaim piping, supply and return, greater than or equal to 40 mm (1-½") dia. – 50 mm (2") thick;

.14 piping indicated to be traced with electric heating cable – minimum 50 mm (2") thick;

.2 Secure overlap flap of the sectional insulation jacket tightly in place. Cover section to section butt joints with tape sealant.

.3 Insulate fittings with sectional pipe insulation mitred to fit tightly, and cover butt joints with tape sealant, or, alternatively, wrap fittings with blanket mineral fibre insulation to a thickness and insulating value equal to the sectional insulation, secure in place with adhesive and/or wire, and cover with PVC fitting covers.

.4 Unless otherwise specified, insulate unions, valves, strainers, and similar piping system accessories in "cold" piping with cut and tightly fitted segments of sectional pipe insulation with joints covered with tape sealant, or, alternatively, wrap piping union, valve, strainer, etc., with blanket mineral fibre and cover with PVC covers as for paragraph above.

.5 Terminate sectional insulation approximately 50 mm (2") from flange or coupling on each side of flange or coupling. Cover flange or coupling with a minimum 50 mm (2") thickness of blanket mineral fibre insulation wide enough to butt tightly to ends of adjacent sectional insulation. Secure blanket insulation in place and cover with a purpose made PVC coupling cover.

.6 Drum drips in dry zone sprinkler and/or standpipe system piping will be traced with electric heating cable as part of electrical work, and are generally not shown on drawing(s). Confirm number and size of drum drips required with trade providing piping and include for insulation to suit. Wherever possible drum drips will be located in heated areas.

.7 Take special care at concealed water rough-in piping at plumbing fixtures to ensure piping is properly insulated. If necessary due to space limitations, use 12 mm (½") thick sectional pipe insulation in lieu of 25 mm (1") thick insulation.

.8 Insulate seismic restraint hardware such as hanger rods, braces, anchors, etc., directly connected to "cold" category piping and equipment for a distance of 300 mm (12") from piping or equipment with insulation and finish to match pipe or equipment insulation. Coat seismic restraint hardware for a distance of 300 mm (12") from the termination of insulation with Robson Thermal "NO-SWEAT-FX" water based anti-condensation coating.

3.04 Pipe Insulation Requirements – Flexible Foam Elastomeric

.1 Install flexible elastomeric pipe insulation in strict accordance with manufacturer's published instructions to suit the application, and using adhesive, joint sealants and finish to produce a water-tight installation. Insulate following pipe with flexible elastomeric pipe insulation of thickness indicated:

.1 refrigerant suction and hot gas piping outside building – 25 mm (1") thick.

.1 refrigerant suction and hot gas piping inside building – 12 mm (1/2") thick.

3.05 Pipe Insulation Requirements – Closed Cell Foamed Glass

.1 Install closed cell foamed glass insulation in strict accordance with manufacturer's published instructions to suit the application, and using adhesive, joint sealants, and jacketing to produce a water-tight installation. Insulate following pipe with closed cell foamed glass of thickness indicated:

.1 piping located outside building and indicated to be heat traced – minimum 50 mm (2") thick.

3.06 Pipe Insulation Requirements – Fire Rated Insulation

.1 Where pipe (inside building and above ground) which is to be insulated as specified above penetrates fire rated construction, provide fire-rated, non-combustible sectional insulation on portion of pipe in fire barrier and for a distance of 50 mm (2") on either side of fire barrier. Insulation thickness is to be as specified, but in any case minimum 25 mm (1").

3.07 Installation of Weather-Proof Jacketed Insulation

.1 Install sectional weather-proof jacketed pipe insulation in strict accordance with manufacturer's instructions to produce a water-tight weather-proof installation. Insulate fittings with blanket type glass fibre insulation of a thickness and insulating value equal to the sectional insulation and secured in place with adhesive and wire. Jacket fittings with manufactured aluminium fitting covers sealed water-tight. Insulate following pipe with weather-proof jacketed insulation:

.1 [ ];

.2 [ ].

3.08 Installation of Barrier Free Lavatory Insulation Kits

.1 Provide manufactured insulation kits to cover exposed drainage and water piping under barrier free lavatories.

3.09 Equipment Insulation Requirements – Blanket Type Mineral Fibre

.1 Insulate following equipment with mineral fibre blanket type insulation of thickness indicated:

.1 chilled water and/or domestic cold water pump casings – 40 mm (1-½") thick;

.2 roof drain sumps where inside the building – 25 mm (1") thick;

.3 water meter(s) – 40 mm (1-½") thick;

.4 top of radiant ceiling panels – 50 mm (2") thick.

.2 Unless otherwise noted, wrap equipment to a thickness and insulating value equal to an equivalent thickness of rigid sectional pipe insulation. Laminate insulation in place with a full coverage of adhesive and secure with wire. Apply a jacket of insulation vapour barrier material secured in place with adhesive or sealant tape.

.3 Cover roof drain sumps with purpose made PVC fitting covers.

.4 Lay fibreglass blanket on radiant ceiling panels after testing is complete.

3.10 Equipment Insulation Requirements – Semi-Rigid Mineral Fibre

.1 Insulate following equipment with semi-rigid mineral fibre board insulation of thickness indicated:

.1 heating main air separator – 40 mm (1-½") thick;

.2 Install insulation as required to fit shape and contour of equipment. Secure insulation in place with adhesive, and with aluminum straps on 450 mm (18") centres. Apply a 6 mm (¼") thick skim coat of insulating cement, then, when insulating cement has dried, apply a 6 mm (¼") thick coat of cement trowelled smooth.

.3 For "cold" equipment, prime insulation with suitable sealer and apply a jacket of glass thread reinforced foil and kraft paper vapour barrier jacket material laminated in place with a full coverage of adhesive.

.4 Provide removable and replaceable insulated metal covers for equipment with removable heads to permit heads to be removed and replaced without damaging adjacent insulation work.

3.11 Equipment Insulation Requirements – Removable/Reusable Type

.1 Provide custom designed and manufactured removable and reusable insulation covers for following:

.1 plate type heat exchanger(s);

.2 150 mm (6") dia. and larger piping strainers, backflow preventers, etc.;

.2 Provide "wrap type" removable and reusable insulation covers for "cold" circuit balancing valves, backflow preventers, and similar items, and for steam traps and similar items requiring service in piping less than 150 mm (6") dia.

3.12 Ductwork Insulation Requirements – Mineral Fibre

.1 Insulate following ductwork systems inside building and above ground with mineral fibre insulation of thickness indicated:

.1 outside air intake ductwork, casings and plenums from fresh air intakes to and including mixing plenums or sections, or, if mixing plenums or sections are not provided, to first heating coil, or if both mixing plenums or sections and heating coil sections are not provided, and fresh air is not tempered, then the fresh air ductwork system complete – minimum 40 mm (1-½") thick as required;

.2 mixed supply air or preheated supply air casings, plenums and sections to and including the fan section where not factory insulated – minimum 25 mm (1") thick rigid board or minimum 40 mm (1-½") thick flexible blanket as required;

.3 supply air ductwork outward from fans, except for supply ductwork exposed in area it serves – minimum 25 mm (1") thick rigid board or minimum 40 mm (1-½") thick flexible blanket as required;

.4 exhaust discharge ductwork for a distance of 3 m (10') downstream (back) from exhaust openings to atmosphere, including any exhaust plenums within the 3 m (10') distance – minimum 25 mm (1") thick rigid board or minimum 40 mm (1-½") thick flexible blanket as required;

.5 any other ductwork, casings, plenums or sections specified or detailed on drawings to be insulated – thickness as specified.

.2 Provide rigid board type insulation for casings, plenums, and exposed rectangular ductwork. Provide blanket type insulation for round ductwork and concealed rectangular ductwork.

.3 Liberally apply adhesive to surfaces of exposed rectangular ducts and/or casings. Accurately and neatly press insulation into adhesive with tightly fitted butt joints. Provide pin and washer insulation fasteners at 300 mm (12") centres on bottom and side surfaces. Secure and seal joints with 75 mm (3") wide tape sealant. Additional installation requirements as follows:

.1 at trapeze hanger locations, install insulation between duct and hanger;

.2 provide drywall type metal corner beads on edges of ductwork, casings and plenums in equipment rooms, service corridors, and any other area where insulation is subject to accidental damage, and secure in place with tape sealant.

.4 Liberally apply adhesive to surfaces of concealed rectangular or oval ductwork, and wrap insulation around duct with a top butt joint and tight section to section butt joints. Provide pin and washer insulation fasteners at 300 mm (12") centres on bottom surfaces. Secure and seal joints with 75 mm (3") tape sealant. At each trapeze type duct hanger, provide a 100 mm (4") wide full length piece of rigid mineral fibre board insulation between duct and hanger.

.5 Accurately cut sections of insulation to fit tightly and completely around exposed and concealed round or oval ductwork. Liberally apply adhesive to surfaces of duct, and wrap insulation around duct with a top butt joint and tight section to section butt joints. Seal joints with tape sealant. At duct hanger locations install insulation between duct and hanger. At each hanger location for concealed ductwork where flexible blanket insulation is used, provide a 100 mm (4") wide full circumference strip of semi-rigid board type duct insulation between duct and hanger.

.6 Insulation application requirements common to all types of rigid ductwork are as follows:

.1 at duct connection flanges, insulate flanges with neatly cut strips of rigid insulation material secured with adhesive to side surfaces of flange with a top strip to cover exposed edges of the side strips, then butt the flat surface duct insulation up tight to flange insulation, or, alternatively, increase insulation thickness to depth of flange and cover top of flanges with tape sealant;

.2 installation of fastener pins and washers is to be concurrent with duct insulation application;

.3 cut insulation fastener pins almost flush to washer and cover with neatly cut pieces of tape sealant;

.4 accurately and neatly cut and fit insulation at duct accessories such as damper operators (with standoff mounting) and pitot tube access covers;

.5 prior to concealment of insulation by either construction finishes or canvas jacket material, patch vapour barrier damage by means of tape sealant.

3.13 Ductwork Insulation Requirements – Flexible Elastomeric

.1 Insulate exposed exterior ductwork (except fresh air intake ductwork) and associated plenums and/or casings outside building with minimum 75 mm (3") thick flexible elastomeric sheet insulation as required, applied in 2 minimum 40 mm (1 ½") thick layers with staggered tightly butted joints.

.2 Install with adhesive in strict accordance with manufacturer's instructions to produce a weather-proof installation. Ensure sheet metal work joints are sealed watertight prior to applying insulation.

.3 Provide Calcium Silicate insulation between ductwork and duct supports. Tightly butt flexible elastomeric insulation to Calcium Silicate insulation. Cover Calcium Silicate insulation with a continuous sheet of self-adhesive multilayer jacketing which overlaps 75mm past the Calcium Silicate insulation to the adjacent flexible elastomeric insulation.

.4 Provide extruded polystyrene tapered insulation between flexible elastomeric insulation and jacketing to allow for water runoff on all exterior duct work.

3.14 Application of Insulating Coatings

.1 Apply, in accordance with manufacturer's instruction, insulating coatings to following bare metal surfaces:

.1 paint bare metal surfaces clear of "cold" piping and/or equipment insulation for a distance of from 300 mm (12") to 600 mm (24") clear of pipe or equipment insulation, with "No Sweat-FX" anti-condensation coating;

.2 paint bare metal surfaces associated with mechanical systems with an operating temperature 60°C (140°F) with "ThermaLite" insulating coating.

.2 Apply coatings with a brush. Remove any splatter or excess coating from adjacent surfaces.

3.15 Insulation Finish Requirements

.1 Unless otherwise shown and/or specified, jacket exposed mineral fibre insulation, and calcium silicate duct insulation work inside building with canvas secured in place with a full covering coat of lagging adhesive. Accurately cut canvas with scissors or a knife. Do not rip or tear canvas to size. Remove lagging adhesive splatter from adjacent uninsulated surfaces.

.2 Unless otherwise shown or specified, jacket exposed mineral fibre insulation listed below with canvas jacket secured in place with a full covering coat of coloured lagging adhesive. Accurately cut canvas with scissors or a knife. Do not rip or tear canvas to size. Remove lagging adhesive splatter from adjacent surfaces. Insulated services to receive coloured lagging adhesive are as follows:

.1 Domestic Cold Water Piping;

.2 Domestic Hot Water Piping;

.3 Domestic Hot Water Recirculation Piping;

.4 High Temperature Heating Water Piping;

.5 High Temperature Heating Glycol Piping;

.6 Heating Water Piping;

.7 Condensate Drain Piping;

.8 Low Pressure Steam Piping;

.9 High Pressure Steam Piping;

.10 Indoor Ductwork;

.3 Jacket exposed pipe insulation work inside building with white sheet PVC and fitting covers. Install sheet PVC and fitting covers tightly in place with overlapped circumferential and longitudinal joints arranged to shed water. Seal joints to produce a neat water-tight installation. Provide slip-type expansion joints where required by manufacturer's instructions.

.4 Install rigid aluminum jacket material tightly in place with overlapped circumferential joints positioned to shed water and covered with butt straps supplied with the jacket. Provide aluminum jacket for following insulation:

.1 Outdoor Piping;

.2 Outdoor Ductwork.

End of Section

1 General

1.01 Section Includes

.1 This Section specifies commissioning requirements that are common to Mechanical Divisions work Sections and it is a supplement to each Section and is to be read accordingly. When requirements of this Section contradict requirements of Division 00 or Division 01, conditions of Division 00 or Division 01 to take precedence.

1.02 References

.1 Refer to commissioning requirements specified in Division 01.

1.03 Commissioning Agent Involvement Versus Warranty Obligations

.1 Involvement of Commissioning Agent performing duties as described in this Section is not in any way to void or alter any Contractual warranty obligations.

1.04 Submittals

.1 Submit to Commissioning Agent, at same time as submittal to the Consultant, one copy of each shop drawing or product data sheet associated with equipment or systems to be commissioned.

.2 Submit for review, a Commissioning Plan with schedule, commissioning procedures for commissioning events, and a copy of Commissioning Agent's commissioning data sheets for equipment/systems to be commissioned.

.3 Submit a list of commissioning instruments and for each instrument, indicate purpose of instrument and include a recent calibration certificate.

.4 Submit equipment and system manufacturer's start-up and test report sheets for review a minimum of 1 month prior to equipment and system start-up procedures.

1.05 Closeout Submittals

.1 After start-up and successful pre-functional performance testing and submittal of completed forms, submit, for each system or subsystem, a letter confirming pre-functional performance testing has been successfully completed and system or subsystem is ready for functional performance testing and commissioning process to commence.

1.06 Definitions

.1 Commissioning: process of demonstrating to Owner and Consultant, for purpose of final acceptance, by means of successful and documented functional performance testing, that systems and/or subsystems are capable of being operated and maintained to perform in accordance with requirements of Contract Documents, all as further described below.

.2 Commissioning Agent: commissioning authority who will supervise commissioning process, and who will recommend final acceptance of commissioned mechanical work.

.3 Start-Up and Adjusting: process of equipment manufacturer's/supplier's technical personnel, with Contractor, starting and operating equipment and systems, making any required adjustments, documenting process, and submitting manufacturer's/supplier's start-up reports to confirm equipment has been properly installed and is operational as intended.

.4 Pre-Functional Performance Testing: testing, adjusting and operating of components, equipment, systems and/or subsystems, by Contractor, after start-up but before functional performance testing, to confirm components, equipment, systems and/or subsystems operate in accordance with requirements of Contract Documents, including modes and sequences of control and monitoring, interlocks, and

responses to emergency conditions, and including submittal of pre-functional performance testing documentation sheets.

.5 Functional Performance Testing: a repeat of successful pre-functional performance testing by Contractor, in presence of Commissioning Agent and the Consultant with completed Commissioning Agent's commissioning documentation sheets to document, validate and verify equipment, systems and subsystems are complete in all respects, function correctly, and are ready for acceptance.

.6 Commissioning Documentation Sheets: prepared sheets for pre-functional performance testing and for functional performance testing supplied by Commissioning Agent for each piece of equipment/system to be commissioned, each sheet or set of sheets complete with Project name and number, date of commissioning, equipment/system involved, equipment/system name and model number, equipment tag in accordance with drawings, and, for each commissioning procedure listed, a column giving expected data in accordance with Contract Documents, a column to fill in observed data during commissioning, and space for signatures of Contractor and Commissioning Agent.

.7 Systems Operating Manual: a manual prepared by Commissioning Agent to present an overview of building mechanical systems and equipment to be used by building maintenance personnel to assist them in daily operation of systems.

.8 Validate: to confirm by examination and witnessing tests correctness of equipment and system operation.

1.07 Commissioning Agent

.1 Commissioning Agent will be retained and paid by Owner to perform mechanical work commissioning specified in this Section. Cooperate in all respects with Owner's Commissioning Agent.

1.08 Quality Assurance

.1 Commissioning work is to be in accordance with requirements of following:

.1 CSA Z320, Building Commissioning Standard and Check Sheets;

.2 ASHRAE Guideline 0, The Commissioning Process;

.3 ASHRAE Guideline 1.1, The HVAC Commissioning Process;

.4 ASHRAE Guideline 1.2, The Commissioning Process for Existing HVAC&R Systems;

.5 ASHRAE Guideline 1.5, Commissioning Smoke Control Systems;

.6 Owner designated Commissioning Agent.

.2 Commissioning Agent is to meet following qualifications:

.1 be a member of Professional Engineers Association in Province of the work;

.2 be a member of Building Commissioning Association, and a Certified Commissioning Professional (CCP) as designated by Building Commissioning Association;

.3 have a minimum of 5 years of successful documented commissioning experience on projects of similar size and complexity as this Project;

.4 supply a qualified P. Eng. and a Building Commissioning Association Certified Commissioning Professional (CCP) or an ASHRAE Commissioning Project Management Professional (CPMP) on site to supervise commissioning process.

1.09 Commissioning Objectives

.1 Objectives of commissioning process:

.1 to support quality management by means of monitoring and checking installation;

.2 to verify equipment/system performance by means of commissioning of completed installation;

.3 to move completed equipment/systems from "static completion" state to "dynamic" operating state so as to transfer a complete and properly operating installation from Contractor to Owner.

1.10 Testing Equipment

.1 Supply instruments and test equipment required to conduct start-up, testing and commissioning procedures.

2 Products – Not Used

3 Execution

3.01 Commissioning

.1 Commission work in accordance with requirements of this Section and as required by Commissioning Agent.

.2 Prerequisites to successful completion of commissioning:

.1 submittal of signed start-up and test reports;

.2 completion of system testing, adjusting and balancing (TAB), and acceptance of TAB reports;

.3 permanent electrical and control connections of equipment;

.4 successful completion and documentation of pre-functional performance testing;

.5 submittal of letters to the Consultant certifying systems and subsystems have been started, tested, adjusted, successfully pre-functional performance tested, are ready for functional performance testing, and are in accordance with requirements of Contract Documents.

3.02 Phasing of Commissioning

.1 If Project will be constructed in phases, phase commissioning accordingly to suit progress and phases of Work.

3.03 Deficiencies Listed During Commissioning

.1 Correct deficiencies listed by the Consultant and Commissioning Agent during commissioning process within 15 calendar days of notification unless agreed otherwise with the Consultant, and when deficiencies have been corrected, notify the Consultant and Commissioning Agent immediately.

3.04 Systems to be Commissioned

.1 Mechanical systems to be commissioned include, but are not to be limited to, systems described below. Specific commissioning procedures are to be as directed by Commissioning Agent.

.2 Commissioning of drainage systems includes:

.1 commissioning of drainage pumps and controls by means of tests recommended by manufacturer to confirm proper operation and performance;

.2 commissioning of equipment such as interceptors and backflow preventers.

.3 Commissioning of fire protection systems will be considered complete upon preparation and submittal by Contractor of completion certificates required by applicable NFPA Standards, demonstration of proper system operation to local Fire Chief and any other authorities, including Owner's insurance underwriter as required, and coordination and cooperation with fire alarm system commissioning procedures, in particular smoke control systems and other such fan system control sequences.

.4 Commissioning of water systems (all piping extended from Municipal main) includes:

.1 commissioning of pumps and controls;

.2 commissioning of water heaters;

.3 commissioning of piping specialties such as backflow preventers, mixing valves, and similar components;

.4 commissioning of trap seal primer units, including adjustment of water flows and confirmation of water flow at each connected trap;

.5 commissioning of plumbing fixtures.

.5 Commissioning of natural gas system includes pressure regulating equipment. Perform commissioning in accordance with requirements of CAN/CSA B149.1, and any supplemental requirements of governing authorities.

.6 Commissioning of air handling systems includes equipment, ductwork, ductwork specialties, controls, interlocks, and checking and validating air capacities and flows in accordance with TAB reports.

.7 Control work commissioning includes confirmation of proper operation of individual control components, and overall operation of controls in conjunction with operation of connected building systems, including heating season/cooling season testing requirements specified above.

.8 Commissioning of BAS includes confirmation of proper operation of components, input/output points, hardware and software, and demonstration of system performing required procedures.

.9 Commissioning of noise and vibration control equipment includes noise and vibration measurements to confirm proper operation of equipment.

3.05 Commissioning Process

.1 Perform commissioning process in stages and include, but not be limited to, following:

.1 Stage 1: Commissioning of equipment/systems as listed in this Section, which is a prerequisite to an application for Substantial Performance of the Work and includes supervising and validating results of functional performance testing, and submittal of reviewed Systems Operating Manual.

.2 Stage 2: Commissioning work performed 12 months after issue of a Certificate of Substantial Performance and which includes supervision of Contractor's "fine tuning" of equipment/systems through seasonal occupancy, and any other such work to achieve optimal comfort and performance conditions.

.3 Stage 3: Successful completion of satisfactory equipment/system operation during 1st month after issue of a Certificate of Total Performance of the Work.

.4 Stage 4: Successful completion of satisfactory equipment/system operation during 3rd month after issue of a Certificate of Total Performance of the Work.

.5 Stage 5: Successful seasonal commissioning of building.

3.06 3.06 Responsibilities of Commissioning Agent

.1 During construction phase, Commissioning Agent is to:

.1 review Contractor's shop drawings for commissioning related issues, and report any such issues to the Consultant;

.2 as soon as possible after project start-up, prepare and issue a Commissioning Plan based on Contractor's construction schedule;

.3 prior to tests, supply pre-functional performance test commissioning data sheets for equipment and systems to be commissioned to Contractor;

.4 monitor and inspect installation on a regular basis throughout construction stages, issue reports identifying any issues which may have an impact on commissioning process, and work with project team to expeditiously resolve any problems that may arise due to site conditions;

.5 arrange with Contractor for on-site commissioning meetings on an as-required basis, to be attended by Contractor and applicable subcontractors, Owner, and the Consultant, chair meetings, and prepare and distribute meeting minutes to attendees;

.6 witness and validate tests, identify deficiencies, and issue progress reports;

.7 coordinate commissioning scheduling with Contractor;

.8 review final TAB report on site with Contractor, and check 100% of TAB results for fan equipment, 30% of TAB results for duct systems outward from fan equipment, and issue a report to the Consultant;

.9 for smaller multiple items of equipment such as air terminal boxes, fan coil units, backflow preventers, and similar equipment, review completed commissioning data sheets submitted by Contractor and review data sheet information on-site with Contractor for 30% of quantity of each item of equipment;

.10 review pre-functional performance test commissioning data sheets submitted by Contractor, then witness and supervise functional performance testing and supervise and direct commissioning process, validate commissioning procedures, witness completion of commissioning data sheets by Contractor, and sign completed data sheets;

.11 perform a preliminary review of Contractor's O & M Manuals, before they are issued to the Consultant, and issue any comments to the Consultant;

.12 coordinate, with Contractor and Owner, training and instructions by Contractor and his equipment and system manufacturers/suppliers to Owner's operating and maintenance personnel, and comment on quality of training and instructions to the Consultant;

.13 . prepare and issue Systems Operation Manual to Owner prior to equipment and system training by Contractor.

.2 During post construction phase, Commissioning Agent is to:

.1 prepare and issue final report on commissioning, identifying any deficiencies that remain outstanding;

.2 .2recommend any training and/or instructions to be given to Owner's operating and maintenance personnel in addition to training and instructions already given.

.3 after Substantial Performance of the Work, witness system checks and validate documentation by Contractor as follows:

.1 once during 1st month of building operation;

.2 once during 3rd month of building operation;

.3 once between 4th and 10th month of building operation but during a season opposite to 1st or 3rd month visits.

.4 . ensure any deficient work resulting from system checks described above are corrected;

.5 3 months after Substantial Performance of the Work, attend a question and answer session(s) with Contractor to answer any questions and concerns related to commissioning work from Owner's operating personnel.

3.07 Responsibilities of Contractor

.1 During construction phase, Contractor is to:

.1 prepare and submit an installation schedule which includes a time schedule for each activity with lead and lag time allowed and indicated, shop drawing and working detail drawing submissions, and major equipment factory testing and delivery dates;

.2 prepare and submit a commissioning schedule which is to include a time schedule coordinated with installation schedule referred to above and Commissioning Agent, and allowances for additional time for re-tests as may be required, and update schedule on a monthly basis as required;

.3 when requested by Commissioning Agent, arrange site commissioning meetings with Owner, the Consultant, and applicable subcontractors present, to be chaired by Commissioning Agent who will also prepare and distribute meeting minutes;

.4 promptly correct reported deficient work, and report when corrective work is complete;

.5 where required by Codes and/or Specification, retain equipment manufacturers/suppliers or independent 3rd parties to certify correct installation of equipment/systems;

.6 under supervision of equipment manufacturers/suppliers, start-up and adjust equipment to design requirements, and submit start-up sheets which include equipment data such as manufacturer and model number, serial number where applicable, and performance parameters, all signed by equipment manufacturer/supplier and Contractor;

.7 complete Commissioning Agent's commissioning data sheets for multiple items of smaller equipment such as air terminal boxes, fan coil units, backflow preventers, etc., submit sheets to Commissioning Agent, accompany Commissioning Agent for an on-site check of 30% of data sheet information for each type of equipment, and perform any corrective action required as a result of site checks;

.8 perform system testing, adjusting and balancing and, when complete, issue a copy of final report to Commissioning Agent for review and a site check of results, and perform any corrective work required as a result of site checks by Commissioning Agent;

.9 in accordance with updated commissioning schedule and actual progress at site, certify in writing to the Consultant and Commissioning Agent that equipment and/or systems are complete, have been checked, started and adjusted, successfully pre-functional performance tested and

documented, and are ready for functional performance testing and commissioning procedures, giving the Consultant and Commissioning Agent a minimum of 5 working days' notice;

.10 perform system and subsystem functional performance testing under supervision of Commissioning Agent, and submit to the Consultant and Commissioning Agent, completed and signed functional performance testing and commissioning data sheets (issued by Commissioning Agent) and also signed by Commissioning Agent.

.2 During post construction phase, Contractor is to:

.1 optimize system operation in accordance with building occupant's needs and comments using System Operation Manual prepared by Commissioning Agent as reference;

.2 complete commissioning procedures, activities, and performance verification procedures that were delayed or not concluded during construction phase;

.3 accompanied by Commissioning Agent, complete system checks and "fine tuning" with signed documentation as follows:

.1 once during 1st month of building operation;

.2 once during 3rd month of building operation;

.3 once between 4th and 10th months in a season opposite to 1st and 3rd month visits.

.4 correct deficiencies revealed by system checks described above, and, where required, involve equipment manufacturers/suppliers during corrective actions, and report completion of corrective work;

.5 3 months after Substantial Completion conduct a question and answer session(s) at building with Owner's operating and maintenance personnel, with duration of session(s) dictated by number of questions and concerns that have to be addressed.

End of Section

1 General

1.01 Submittals

.1 Submit shop drawings/product data sheets to regulatory authority for review and approval prior to submitting to the Consultant. Conform to following requirements:

.1 submit shop drawings/product data sheets for all products specified in this Section except pipe and fittings;

.2 sprinklers shall be referred to on drawings and product submittals, and be specifically identified by the manufacturer's listed model or series designation. Trade names and other abbreviated listings are not allowed;

.3 submit complete CAD layout drawings indicating source of water supply with test flow and pressure, "head-end" equipment piping schematic, pipe routing and sizing, and zones, all signed and sealed by a qualified professional mechanical engineer registered in jurisdiction of the work as specified below;

.4 submit copies of all calculations, including hydraulic calculations, stamped and signed by same engineer who signs layout drawings, and a listing of all design data used in preparing the calculations, system layout and sizing, including occupancy-hazard design requirements;

.5 in addition to submitting shop drawings to regulatory authority as specified above, shop drawings must be approved by Owner's insurer prior to being submitted to the Consultant for review.

1.02 Closeout Submittals

.1 Submit a complete sprinkler system test certificate as specified in Part 3 of this Section.

1.03 Spare Parts

.1 Fill spare sprinkler head cabinet complete with spare heads.

1.04 Quality Assurance

.1 Fire protection sprinkler system work is to be in accordance with following Codes and Standards:

.1 NFPA 13, Standard for the Installation of Sprinkler Systems;

.2 CSA B137.2, Polyvinylchloride (PVC) Injection-Moulded Gasketed Fittings for Pressure Applications;

.3 CSA B137.3, Rigid Polyvinylchloride (PVC) Pipe for Pressure Applications;

.4 ASTM A53, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded and Seamless;

.5 ASTM A135, Standard Specification for Electric-Resistance-Welded Steel Pipe;

.6 ASTM A234, Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service;

.7 ASTM A536, Standard Specification for Ductile Castings;

.8 ASTM A795, Standard Specification for Black and Hot-Dipped Zinc Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use;

.9 ANSI/ASME B16.4, Grey Iron Threaded Fittings (Classes 125 and 250);

.10 CAN/CSA B64.10, Backflow Preventers and Vacuum Breakers.

.2 Fire protection sprinkler work is to be performed by a sprinkler company who is a member in good standing of the Canadian Automatic Sprinkler Association. Site personnel are to be licensed in jurisdiction of the work and under the continuous supervision of a foreman who is an experienced fire protection system installer and a journeyman pipe fitter licensed in jurisdiction of the work.

.3 Check and verify dimensions and conditions at site and ensure work can be performed as indicated. Coordinate work with trades at site and accept responsibility for and cost of making adjustments to piping and/or spacing to avoid interference with other building components.

.4 Verify working condition of existing sprinkler system equipment which has direct interface with project work and is to remain. Replace with new equipment where necessary.

.5 System components must be ULC listed and labelled.

.6 All grooved couplings, and fittings, valves and specialties shall be the products of a single manufacturer. Grooving tools shall be of the same manufacturer as the grooved components.

.7 All castings used for coupling housings, fittings, valve bodies, etc., shall be date stamped for quality assurance and traceability.

1.05 Design Requirements

.1 Fire protection sprinkler work is to be designed in accordance with NFPA 13 and Provincial Standards, and, where required, local building and fire department requirements and standards of Owner's Insurer. If water supply flow and pressure test data is not available, conduct Municipal main water flow and pressure tests at nearest fire hydrant to obtain criteria to be used in system design. Include hydrant location and flow and pressure test data with system design calculations.

.2 Include for a qualified mechanical professional engineer registered and licensed in the jurisdiction of the work to design the fire protection standpipe work. For requirements regarding Contractor retained engineers, refer to Section 20 05 10 – Mechanical Work General Instructions.

.3 Sprinkler /System Occupancy – Hazard Design requirements: In accordance with NFPA 13 occupancy-hazard density requirements, unless otherwise specified.

2 Products

2.01 Pipe, Fittings, and Joints

.1 Pipe, fittings and joints are to be as follows, with exceptions as specified in Part 3 of this Section:

.1 PVC

.1 Class 200, DR14, rigid, hub and spigot pattern PVC pipe and CSA certified fittings to CAN/CSA B137.2 and B137.3 and complete with gasketed joints.

.2 Schedule 40 Steel – Grooved Coupling Joints

.1 Schedule 40 mild black carbon steel, ASTM A53, Grade B, complete with grooved ends and mechanical fittings and couplings equal to Victaulic "FireLock" fittings and Victaulic Style 009N, 107H, and 107N QuickVic and 005 rigid coupling joints. Strap type outlet fittings such as Victaulic "Snap-Let" are not acceptable.

.3 Schedule 40 Steel – Screwed and Welded Joints

.1 Schedule 40 mild black carbon steel, ASTM A53, Grade B. Screwed piping complete with Class 125 cast iron screwed fittings to ANSI/ASME B16.4. Welded piping complete with factory made seamless carbon steel butt welding fittings to ASTM A234, Grade WPB, long sweep pattern wherever possible.

.4 Schedule 10 Steel – Grooved Coupling Joints

.1 Schedule 10 mild black carbon steel, ASTM A53, Grade B, complete with grooved ends and fitings and couplings equal to Victaulic "FireLock" fittings and Victaulic Style 009N, 107H, and 107N QuickVic and 005 rigid coupling joints.

.5 Schedule 10 Steel – Screwed Joints

.1 Schedule 10 mild black carbon steel, ASTM A53, Grade B, complete with mill or site threaded ends, Class 125 cast iron screwed fittings to ANSI/ASME B16.4, and screwed joints.

.6 "Lightwall" Steel – Grooved Coupling Joints

.1 Commercial quality. "Lightwall" rolled mild carbon steel pipe to ASTM A135, Grade A, complete with a galvanized exterior, grooved ends, and fittings and couplings equal to Victaulic "Fire Lock" grooved fittings and Victaulic Style 009N QuickVic or 005 rigid coupling joints.

.7 "Lightwall" Steel – Screwed Joints

.1 Commercial quality, "Lightwall" rolled mild carbon steel pipe to ASTM A135, Grade A, ULC listed, mill or site threaded, complete with galvanized exterior, Class 125 cast iron screwed fittings to ANSI/ASME B16.4, and screwed joints.

.8 Flexible Pipe – Equal to Victaulic "VicFlex"

.1 The drop system shall consist of a braided type 304 stainless steel flexible tube, zinc plated steel 1" NPT Male threaded nipple for connection to branch-line piping, and a zinc plated steel reducer with a 1/2" or 3/4" NPT female thread for connection to the sprinkler head.

.2 Option: Victaulic FireLock IGS Groove Style 108 coupling for connection to branch-line piping, and a zinc plated steel reducer with a female thread for connection to the sprinkler head.

.3 The drop shall include a cULus/FM approved Series AH2 braided hose with a bend radius to 2" to allow for proper installation in confined spaces.

.4 The hose shall be listed for:

.1 (4) bends at 31" length;

.2 (5) bends at 36" length;

.3 (8) bends at 48" length;

.4 (10) bends at 60" length;

.5 (12) bends at 72" length.

.5 Union joints shall be provided for; ease of installation, prevention of hose torque stresses and on site changing of factory 5.75" straight reducing nipple in reduced spaces under obstructions (optional reducing nipples; 4.83" or 6.57" reducing 90 and 9" or 13" straight

reducer x ½ or ¾" outlet) All VicFlex assemblies and related accessories to be installed as per the guidelines and listings in Victaulic submittal 10.85.

.6 On T Bar ceiling grid with drop in tile application, the flexible drop shall attach to the ceiling grid using a one-piece open gate Series AB1 bracket. The bracket shall allow installation before the ceiling tile is in place.

.7 On T Bar ceiling grid designed for hard lid drywall application; the flexible drop shall attach to the ceiling grid using a one-piece open gate Series AB2 bracket. The bracket shall allow for the vertical adjustment of the reducer/head from below the drywall, post drywall installation.

.8 On Hat Furring Channel grid with hard lid drywall application; the flexible drop shall attach to the ceiling grid using a one-piece open gate Series AB4 bracket. The bracket shall allow for the vertical adjustment of the reducer/head from below the drywall, post drywall installation.

.9 The braided drop system shall be cULus listed and FM Approved for sprinkler services to 175 psi (1206 kPA).

.10 For dry sprinkler heads Victaulic VicFlex dry sprinkler model VS1. The sprinkler shall provide a vertical or horizontal flexible connection with a bend radius to 2", and allow for up to 4 bends. The sprinkler body shall be die cast brass with brass deflector, supplied finished to match application and to architectural direction, and glass bulb with glycerin solution. The product shall consist of a braided type 300 stainless steel flexible hose with a swivel type branch line threaded connection, EPDM gasket seal, with PTFE-coated Beryllium Nickel and stainless-steel spring-seal assembly. The bracket shall be open gate or metal strap to provide for sprinkler placement and alignment. The flexible dry sprinkler and bracket system is UL listed for sprinkler services to 175 psi.

.9 Copper – Solder Joint

.1 Type "L" hard drawn seamless copper to ASTM B88, complete with copper solder type fittings to ASME/ANSI B16.18 and soldered joints.

.10 CPVC Pipe

.1 Equal to IPEX BlazeMaster solvent weld, orange, SDR 13.5 pipe and Schedule 80 fittings, ULC listed for use in wet pipe automatic sprinkler systems, with a flame spread rating less than 25 and a smoke developed rating less than 50 when tested in accordance with CAN/ULC S102.2, and in accordance with NFPA 13 requirements.

.2 Victaulic Standard Mechanical Couplings: Manufactured in two segments of cast ductile iron, conforming to ASTM A-536, Grade 65-45-12. Gaskets shall be pressure-responsive synthetic rubber, grade to suit the intended service, conforming to ASTM D-2000. Mechanical Coupling bolts shall be zinc plated (ASTM B-633) heat treated carbon steel track head conforming to ASTM A-449 and ASTM A-183. Couplings shall comply with ASTM F1476 - Standard Specification for Performance of Gasketed Mechanical Couplings for Use in Piping Applications.

.3 Rigid Type: Coupling housings with offsetting, angle-pattern bolt pads shall be used to provide system rigidity and support and hanging in accordance
NFPA-13. Couplings shall be fully installed at visual pad-to-pad offset contact. Couplings that require exact gapping of bolt pads at specific torque ratings are not permitted.

.4 Flexible Type: Use in locations where vibration attenuation and stress relief are required. Victaulic Style 177 (Quick-Vic™), Installation ready flexible coupling.

2.02 Service Main Double Check Valve Assemblies

.1 Minimum 1205 kPA (175 psi) rated dual check valve backflow preventer assembly to CAN/CSA B64, complete with tight-closing resilient seated shut-off valves, test cocks and strainer.

.2 Manufacturers:

.1 Watts Industries Canada;

.2 Zurn/Wilkins;

.3 Apollo Valves (Conbraco Industries).

2.03 Shut-Off Valves

.1 Minimum 2070 kPA (300 psi) rated full port brass or bronze body screwed ball valves and lug body or grooved end type butterfly valves.

.2 Butterfly valves shall include a pressure responsive seat, and the stem shall be offset from the disc centerline to provide complete 360-degree circumferential seating.

.3 Basis of Design: Victaulic Style 705.

.4 OS&Y Gate Valves: 1725 kPA (250 psi), grooved ends. Ductile iron body, yoke, and handwheel conforming to ASTM A-536; EPDM coated ASTM A-126-B cast iron disc; ASTM B16 brass rising stem; flanged and epoxy coated ductile iron bonnet; EPDM O-ring stem seals and body gasket. Victaulic Series 771H (Grooved ends) and Series 771F (Grooved x Flanged).

.5 Supervised closed applications:

.1 Basis of Design: Victaulic Series 707C supervised closed butterfly valve.

2.04 Check Valves

.1 Minimum 1725 kPA (250 psi) resilient seat check valves, suitable for vertical or horizontal installations.

.2 Basis of Design: Victaulic Series 717.

.3 Check valves associated with Fire Department connections and fire pump test connection are to be tapped for site installation of a 20 mm (¾") diameter ball drip.

2.05 Ball Drips

.1 Equal to National Fire Equipment Ltd. Model #A58, 20 mm (¾") diameter automatic ball drip.

2.06 Shut-Off Valve Supervisory Switches

.1 Tamper-proof supervisory switches, each arranged to activate a fire alarm system trouble alarm condition if the valve is closed or tampered with, each suitable in all respects for the application, and each complete with all required mounting and connection hardware.

.2 Actuator housings shall be weatherproof.

2.07 Fire Department Connections

.1 Wall mounting polished brass clapper type dual inlet Fire Department connection with 2, 65 mm (2-½") diameter inlets threaded to Fire Department hose requirements and equipped with caps and chains, an outlet sized as shown, and a faceplate.

.2 Faceplate is to be polished brass and complete with "AUTO-SPKR" "STANDPIPE" cast-in raised lettering.

.3 Exposed metal parts of Fire Department connection are to be chrome plated.

.4 At the low point near each fire department connection, install a 90-degree elbow with drain connection to allow for system drainage to prevent freezing.

.5 Basis of Design: Victaulic #10-DR.

2.08 Sprinkler Main "Loss of Pressure" Alarm Sensors

.1 Piping mounted adjustable pressure sensor designed to actuate an alarm upon sensing a loss of pressure in the fire protection main. Switch is to be low voltage or line voltage as required.

2.09 Water Flow Alarm Switches

.1 Pipe mounting water flow alarm switch, minimum 1725 kPA (250 psi) rated, designed to actuate two 7 ampere rated (at 125/250 VAC) SPDT snap action switches when water flow exceeds 0.758 L/sec. (10 Imp gpm), complete with a tamper-proof cover with conduit connection opening, a piping saddle and U-bolt, and an automatic rest pneumatic retard device with field adjustable (0 to 70 second) switch actuation delay to reduce false alarms caused by a single or series of transient water flow surges.

2.10 Alarm Check Valves

.1 Equal to Victaulic Series 751 FireLock, enamelled cast iron check valve assembly designed for either vertical or horizontal mounting and to actuate alarms when wet type sprinkler system is activated. Assembly is to be minimum 1205 kPA (175 psi) cold water rated with all moving parts constructed of brass, bronze, stainless steel or EPDM, and is to be complete with:

.1 pipe, fittings and accessories for site connection of an excess pressure pump;

.2 basic trim including piping materials and check valve for an external by-pass, potable water supply and system water supply pressure gauges with gauge test ports and shut-off valves, an angle type main drain valve, and fittings for mounting an alarm test by-pass;

.3 alarm test by-pass piping with ball valve to permit alarm testing without operation of alarm valve;

.4 alarm trim with pipe and fittings for connection to a water motor alarm, and an adjustable pressure switch for electrical connection to an alarm system upon flow through valve.

2.11 Excess Pressure Pumps

.1 Close coupled, 1750 RPM, all bronze gear pump sized to maintain sufficient pressure in fire protection main to prevent alarm check valve(s) from initiating flow alarms during fluctuations in pressure of Municipal water supply. Pump is to be complete with:

.1 stainless steel shaft with maintenance free seal;

.2 lifetime lubricated carbon bearings;

.3 TEFC motor conforming to requirements specified in Section 20 05 00 – Common Work Results for Mechanical, and secured to a mounting base;

.4 accessory package consisting of flexible suction and discharge connection hoses, a Monel inlet strainer, relief valve factory set at 862 kPA (120 psi), and a steel mounting plate designed to mount pump to alarm check valve flange;

.5 power and control panel.

.2 Factory pre-wired power and control panel, CSA certified, designed to automatically start and stop pump in response to water pressure variations in the main and consisting of a surface wall mounting NEMA 2 enamelled steel panel with hinged front door equipped with Corbin catch, and following:

.1 door interlock fused disconnect with HRC fuses;

.2 protected type pump starter;

.3 door mounted H-O-A rotary selector switch;

.4 fused control transformer;

.5 115 volt adjustable pressure switch to suit the application;

.6 set of NO/NC dry contacts for connection of lack of power availability alarm;

.7 door mounted "POWER ON" LED.

2.12 Water Motor Alarms

.1 Surface wall mounting water motor driven alarm device consisting of a water motor assembly with 20 mm (¾") diameter inlet and 25 mm (1") or 32 mm (1-¼") diameter drain connections, inlet strainer, a red enamelled steel exterior wall mounting strike and gong assembly, a drive shaft sleeve with drive shaft to connect water motor and gong assembly and, at the exterior gong, identification to read "SPRINKLER FIRE ALARM - WHEN BELL RINGS CALL FIRE DEPARTMENT OR POLICE".

2.13 Dry Pipe Valves

.1 Equal to a Victaulic Series 768-NXT:

.1 Series 746-LPA accelerator quick opening device;

.2 Series 757 regulated air maintenance trim assembly;

.3 Required air pressure shall be 90 kPA (13 psig);

.4 The valve shall be externally resettable;

.5 Provide valve complete with internal components that are replaceable without removing valve from installed position;

.6 Systems requiring a quick opening device must use a regulated, tank mounted air supply;

.7 Series 757 Regulated Air Maintenance Trim Assembly.

2.14 Dry Pipe Zone Air Compressor

.1 Equal to a Victaulic 7C7 CSA certified, oil-less, piston type direct driven compressor with a motor conforming to requirements specified in Section 20 05 00 – Common Work Results for Mechanical, and a mounting bracket.

.2 Equal to General Air Products OLT Series, package type, oil-free, piston type, tank mounted air compressor set complete with horizontal, ASME rated and stamped steel tank with support feet, pressure gauge with gauge cock, tank drain, flexible compressor to tank and tank to piping flexible connections supplied loose for field installation, and a motor conforming to requirements specified in Section 20 05 00 – Common Work Results for Mechanical.

.3 Compressor set capacity and performance must suit final dry pipe system design and reviewed piping and sprinkler head layout shop drawings. If a larger compressor set than that specified is required,

provide larger set at no additional cost, and include any additional costs for a larger size motor starter and associated wiring.

2.15 Preaction Valve and Accessories

.1 Equal to Series 745 FirePac - Provide a pre-assembled [Dry] [Preaction] [Deluge] fire protection valve mounted completely within a steel cabinet for sizes 1½" [DN 40] through 8" [DN 200]. Cabinet shall be coated with red ASA-61 electrostatically applied polyester powder coating. Cabinet shall have field removable access panels on three sides to allow for ease of valve maintenance, servicing, and installation. Unit shall be UL Listed and FM-Global Approved with all materials and wiring conforming to NFPA requirements. Unit shall be provided with Series 728 ball valve or Series 705 butterfly shutoff valve with pre-wired supervisory switches, the sprinkler system fire protection valve, alarm line pressure switches, air supervisory pressure switches, alarm pressure switch and pressure gauges for proper operation and shall be pre-wired to Model RP-2001 control panel. All external electrical connections shall be able to be connected through a factory provided conduit connection to an enclosure inside of the cabinet. Water inlet, system supply, and drain connections shall be grooved for ease of installation. Victaulic FireLock® Series 745 Fire-Pac.

.2 [Dry] [Preaction] [or] [Deluge] valve [with specified configuration], valve shall be low differential, latched clapper design with a black enamel coated ductile iron body conforming to ASTM A536, aluminum bronze clapper, stainless steel spring and shaft, EPDM diaphragm and seal, brass seat with nitrile seat o-rings. Valve internal parts shall be replaceable without removing the valve from the installed position and shall be externally resettable. 300 psi pressure rating in sizes 1½" [DN 40] through 8" [DN 200] and shall be grooved ends for vertical installation only. Victaulic FireLock® NXT [Series 768N (Preaction)] [and] [or] [Series 769N Deluge].

.3 Trim configurations:

.1 Dry Valve: Pneumatic operation.

.2 Preaction Valve:

.1 Non-interlock; [Pneumatic] [and] [or] [Electric].

.2 Single interlock; [Pneumatic] [or] [Electric].

.3 Double interlock; [Pneumatic] [and] [Electric].

.3 Deluge Valve:

.1 Electric release.

.2 Wet pilot.

.3 Dry pilot.

.4 Electric Release Panel: Notifier Model RP-2001 is a compact single enclosure unit containing power supply, two 12Amp-hr batteries and availability to have factory installed all accessory options.

.5 Options: Preassembled cabinet shall have factory options to have pipe penetrations sealed to meet NEMA 4 protection of equipment inside of the enclosure with respect to the ingress of water, whether rain, sleet, snow, splashing water or hose directed water.

.6 Options: Preassembled cabinet shall have nitrogen fill options as well as a factory installed low nitrogen pressure alarm to augment low air alarms as needed in certain trim applications.

.7 Manufacturers:

.1 Victaulic Co.;

.2 FireFlex System Inc.

.8 Smoke detectors, each complete with a red LED that pulses during normal standby conditions and illuminates steadily during an alarm condition.

.9 Surface wall mounting (to a recessed box) non-break glass pull station with test/reset key.

2.16 Zone Control Riser Modules

.1 Equal to Victaulic Co. "FireLock" Series 747M factory assembled zone control riser modules, each complete with a painted cast ductile iron grooved end body, a ball type shut-off valve, a test and drain combination with properly sized orifice, a flow alarm switch, a pressure gauge with cock, and a pressure relief valve kit.

.2 Zone flow test and drain assembly cabinets are to be equal to National Fire Equipment Ltd. Model CV-200 recessed cold rolled steel cabinets, sized to suit assemblies, with a baked enamel finish, #18 gauge with universal knockouts for tubs, #14 gauge for doors and trim, with all metal edges ground and rounded. Doors are to be complete with:

.1 hollow channel reinforcement;

.2 full length semi-concealed piano hinge with paint stop feature and designed to permit 180° door opening;

.3 flush stainless steel door latch.

2.17 Sprinkler Heads

.1 Sprinkler heads, unless otherwise specified, are to be as scheduled in Part 3 of this Section.

.2 Sprinkler body shall be die-cast, with a hex-shaped wrench boss integrally cast into the sprinkler body to reduce the risk of damage during installation. Wrenches shall be provided by the sprinkler manufacturer that directly engage the wrench boss.

.3 For locations where corrosive resistant coatings are required, body shall be coated with UL listed and FM approved anti-corrosion VC-250 coating (silver coloring).

.4 Sprinkler heads for healthcare facilities are to be quick response type.

.5 Recessed sprinkler heads in finished areas are to be chrome plated unless otherwise specified. Concealed sprinkler head ceiling plates are to match ceiling colour.

.6 Where exposed pendent heads occurs in areas with suspended ceilings, they are to be complete with chrome plated escutcheon plates. Similarly, sidewall heads with concealed piping are to be complete with chrome plated escutcheon plates.

.7 Sprinkler heads which are exposed in areas where they may be subject to damage are to be complete with wire guards, chrome plated where in finished areas.

.8 Escutcheons and guards shall be listed, supplied, and approved for use with the sprinkler by the sprinkler manufacturer.

.9 Sprinkler heads located in areas or over equipment where high ambient temperature is present are to be, unless otherwise specified, 74°C (165°F) heads. All other heads, unless otherwise specified or required, are to be 57°C (135°F) rated.

.10 Manufacturers:

.1 Victaulic Co.;

.2 Tyco Fire Suppression & Building Products;

.3 The Viking Corporation;

.4 The Reliable Automatic Sprinkler Co.

2.18 Spare Sprinkler Head Cabinets

.1 Surface wall mounting, red enamelled steel, identified cabinet with hinged door, shelves with holes for mounting sprinkler heads, a wrench or wrenches suitable for each type of sprinkler head, and a full complement of spare sprinkler heads.

.2 Cabinet is to be sized to accommodate a minimum of 4 spare heads for each type of head used on the project, however, each cabinet is to be full of spare heads.

2.19 Indicator Post and Valves

.1 Cast iron, bronze trim, resilient seat, OS&Y gate valve with non-rising stem in accordance with AWWA 200W, minimum 1380 kPA (200 psi) cold water rated and complete with a square operating nut and ends to suit connecting piping.

.2 Adjustable indicator post assembly with a cast iron valve box of a length to suit valve depth and flange bolted to the valve, a cast iron lower barrel bolted to the valve box and of a length to suit valve location, and a cast iron upper housing bolted to the lower barrel and complete with wrench and operating mechanism with steel extension shaft and coupling nut sized to suit, operating handle, and valve "OPEN" and "CLOSED" identification visible through a clear polycarbonate window.

3 Execution

3.01 Monitoring of Systems

.1 Daily monitor and supervise existing sprinkler system serving renovated areas to ensure that each respective system is left in proper operating condition at end of each working day. Include for but not be limited to performing following:

.1 Under presence of Owner's representative, check each morning and evening (start and end of work) of each day, sprinkler system to ensure that it is in proper working condition;

.2 If portions of sprinkler system is not in proper working order, provide temporary provisions subject to approval of local fire authority or local governing authority, to ensure that proper sprinkler coverage is provided and/or provide supervisory personnel to monitor areas where sprinkler system is not operational;

.3 Document and sign off with Owner's representative signing off also, each respective daily check condition;

.4 Ensure that work to sprinkler system does not affect portion of system serving areas outside of renovation areas.

3.02 Demolition

.1 Refer to demolition requirements specified in Section 20 05 05 – Selective Demolition for Mechanical.

3.03 Piping Installation Requirements

.1 Provide required sprinkler system piping.

.2 Perform piping work in accordance with requirements of NFPA 13, governing regulations, and "Reviewed" shop drawings.

.3 Piping, unless otherwise specified, is as follows:

.1 for underground piping inside or outside building – Class 200, DR14 rigid PVC, braced and secured at bends and tees with concrete blocks in accordance with Municipal standards and details;

.2 for piping inside building and above ground except as noted below – Schedule 40 grooved end black steel with Victaulic or equal fittings and coupling joints, or, for piping to and including 50 mm (2") diameter, screwed fittings and joints, or, for piping 65 mm (2-½") diameter and larger, welding fittings and welded joints;

.3 for wet system piping inside building and above ground – at your option, CPVC sprinkler pipe and fittings;

.4 for piping downstream of "head end" alarm valve(s) and equipment – Schedule 10 or "Lightwall" black steel pipe with Victaulic or equal fittings and coupling joints or screwed fittings and joints;

.5 for branch piping to heads in suspended ceilings, etc. – at your option, flexible piping installed in accordance with manufacturer's instructions;

.6 for branch piping to heads in MRI suites – copper pipe, fittings, and sprinkler head adapters with stainless steel hangers and support hardware.

.4 Exceptions to piping requirements specified above are as follows:

.1 dry pipe zone steel piping, fittings, unions, couplings and flanges are to be galvanized;

.2 wet zone steel piping, fittings, unions, couplings and flanges for sprinkler work exposed to weather either inside or outside building (including parking garages), are to be galvanized;

.3 PVC piping is not to be used above grade;

.4 ferrous pipe hangers, supports, and similar hardware used for galvanized steel piping are to be electro-galvanized.

.5 Pipe sizes, pipe routing, sprinkler head quantities and locations, and layout of work shown on drawings are to assist during the tendering period. Ensure adequate head coverage, head quantities and pipe sizing as specified in Part 1 of this Section. Do not reduce size of sprinkler main or re-route the main unless approved by Consultant.

.6 Pipe, fittings, couplings, flanges and similar components are to be clean after erection is complete. Wire brush clean any ferrous pipe, fitting, coupling, flange, hanger, support and similar component which exhibits rust and carefully coat with suitably coloured primer.

.7 Where sprinklers are not protected by a dry system and may be subject to freezing, provide non-freeze, glycol-water solution filled sprinkler piping. Install piping complete with a CSA certified reduced pressure backflow preventer, valves and glycol solution fill facilities in accordance with requirements of Chapter 3 of NFPA 13. Fill piping with a solution of 50% Union Carbide Canada Ltd. "UCAR THERMO-FLUID 17" or Dow Chemical Co. "Dowtherm SR1" propylene glycol with corrosion inhibitors, and 50% clean water. Prior to filling piping, check the specific gravity of the solution using a hydrometer with proper scale. Specific gravity is to be approximately 1.069 at 15.6°C.

.8 When sprinkler work is complete, test system components and overall system(s) and submit completed test certificate and other documentation in accordance with Chapter 8 of NFPA 13.

.9 Grooved joints shall be installed in accordance with the manufacturer's latest published installation instructions. Grooved ends shall be clean and free from indentations, projections, and roll marks. Gaskets shall be molded and produced by the coupling manufacturer, and shall be verified as suitable for the intended service. A factory-trained field representative of the mechanical joint manufacturer shall provide on-site training for contractor's field personnel in the proper use of grooving tools and installation of grooved piping products. The factory-trained representative shall periodically review the product installation and ensure best practices are being followed. Contractor shall remove and replace any improperly installed products.

3.04 Installation of Double Check Valve Assembly

.1 Provide a double check valve assembly in sprinkler main inside the building.

.2 Equip assembly with inlet and outlet shut-off valves with supervisory switches as specified below.

.3 Support each end of assembly from floor by means of flanged pipe supports with saddles.

3.05 Installation of Shut-Off Valves and Check Valves

.1 Provide shut-off valves and check valves in piping where shown and wherever else required.

.2 Locate valves for easy operation and maintenance.

.3 Confirm exact locations prior to roughing-in.

3.06 Installation of Shut-Off Valve Supervisory Switches

.1 Equip each shut-off valve with a supervisory switch.

.2 Identify each supervised valve with a 150 mm (6") square, engraved, laminated red-white plastic tag to correspond with supervised valve numbering specified and/or shown as part of the electrical work fire alarm system.

3.07 Installation of Fire Department Connection

.1 Provide an exterior Fire Department connection. Confirm exact location prior to roughing-in. Confirm finish prior to ordering.

.2 Equip connection with a check valve. Equip check valve with a ball drip to drain piping between Fire Department connection and check valve, and extend drainage piping from outlet of ball drip to nearest suitable floor drain.

3.08 Installation of Loss of Pressure Sensor

.1 Supply and mount a pressure sensor in the fire protection piping main to activate a "LOSS OF PRESSURE" trouble alarm should Municipal water service pressure fall below the acceptable level.

.2 Locate sensor for easy access and maintenance, and set alarm pressure to suit site conditions. Confirm setting on site.

.3 Identify pressure sensor and its normal setting with a 150 mm (6") square red-white laminated plastic tag engraved to read "LOSS OF WATER PRESSURE SENSOR - NORMAL SETTING 210 kPA". Confirm wording prior to engraving.

3.09 Installation of Flow Alarm Switches

.1 Provide water flow alarm switches in accessible locations in zone piping.

.2 Adjust to suit site water pressure conditions. Check and test operation.

.3 Identify each switch with a 150 mm (6") square red-white laminated engraved plastic tag. Confirm wording prior to engraving.

3.10 Installation of Alarm Check Valves

.1 Provide alarm check valves, complete with trim, for wet zone fire protection sprinkler piping.

.2 Check and test operation of each valve and adjust as required to suit site water pressure conditions.

.3 Identify each valve with a 150 mm (6") square red-white laminated engraved plastic tag. Confirm wording prior to engraving.

3.11 Installation of Excess Pressure Pump and Controls

.1 Provide an excess pressure pump in wet fire protection sprinkler system piping, arranged to prevent activation of alarm check valve water flow alarms during normal water pressure fluctuations in the main. Locate pump on a steel mounting plate assembly at alarm check valve(s) and install accessories supplied with pump. Provide a pressure gauge in valved tubing across pump suction and discharge connections.

.2 Supply a starter and control panel for pump and surface wall mount adjacent to pump. Connect panel pressure switch with copper tubing in accordance with pump manufacturer's instructions. Adjust pressure switch to suit site conditions.

.3 Start-up the pump, test operation and adjust as required.

3.12 Installation of Water Motor Alarms

.1 Provide a water motor alarm. Secure gong on the exterior wall, impeller and motor assembly on the interior wall, and connect with drive assembly in accordance with manufacturer's instructions. Install inlet strainer supplied loose with assembly.

.2 Provide a galvanized steel drain pipe from impeller-motor assembly down the interior wall and terminate piping back out through the wall with a 45° piping elbow and wall plate located 600 mm (24") above finished grade.

.3 Confirm exact location of alarm gong prior to roughing-in.

.4 When installation is complete, check and test alarm operation and adjust as required.

3.13 Installation of Dry Pipe Valves

.1 Provide dry pipe valves for zones.

.2 Connect compressed air piping to each valve, as well as all compressed air piping trim.

.3 When installation is complete, check and test valve operation and adjust as required.

.4 Provide drum drips in dry type fire protection sprinkler zone piping where shown or required. Wherever possible locate drum drips in heated areas. Where drum drips are located in unheated areas ensure trades performing thermal insulation work and electric heating cable pipe tracing work are aware of the number of drum drips required, and the size and location. Identify each drum drip. Locate drum drips in heated areas wherever possible.

3.14 Installation of Dry Zone Air Compressors

.1 Provide an air compressor with air maintenance device and pressure control for the dry pipe zone and dry pipe valve. Secure compressor to a piping main by means of a mounting bracket supplied with compressor. Adjust to suit site conditions.

.2 Provide an air compressor set with receiver and secure in place on rubber-steel-rubber vibration isolation pads on a concrete housekeeping pad.

.3 Install flexible piping connections supplied loose with set.

.4 Extend valved drain piping from receiver to a floor drain.

.5 Connect receiver and control panel pressure switch with copper tubing.

.6 When installation is complete, check and test air compressor set, including automatic operation, and adjust as required.

3.15 Installation of Preaction Sprinkler Systems

.1 Provide a preaction sprinkler system.

.2 Install preaction deluge valve cabinet assembly with control panel and air compressor as indicated but confirm exact location prior to roughing-in.

.3 Provide required water supply, compressed air, sprinkler, and drain piping. Terminate drain piping over a funnel floor drain.

.4 Provide detection devices and install in accordance with manufacturer's instructions. Connect to control panel with wiring in conduit.

.5 Supply detection devices and hand to electrical trade on site for installation.

.6 Include for 4 hours of on-site operation demonstration and training session. Training is to be a full review of all components including but not limited to a full operation and maintenance demonstration, with abnormal events.

3.16 Installation of Zone Control Riser Modules

.1 Provide zone control riser modules with drain piping where required. Terminate drainage piping over a funnel floor drain unless otherwise shown or specified. Identify each assembly.

3.17 Installation of Zone Control Riser Module Cabinets

.1 Provide flush wall mounting cabinets for zone control and inspector's test connection assemblies where required in finished areas. Confirm exact locations prior to roughing-in.

.2 Identify each cabinet with a nameplate in accordance with requirements of Section 20 05 00 – Common Work Results for Mechanical.

3.18 Installation of Sprinkler Heads

.1 Provide required sprinkler heads in accordance with following schedule:

Application	Sprinkler HEAD TYPE
Rooms/areas with a suspended ceiling	Victaulic V38/V39 or Tyco Series RFII "Royal Flush II" concealed pendent Victaulic V27 or Tyco Series TY-FRB recessed pendent Victaulic V27 or Tyco Series TY-FRB pendent with escutcheon plates

Application	Sprinkler HEAD TYPE
Rooms/areas without a suspended ceiling	Victaulic V27 or Tyco Series TY-FRB pendent
Elevator shafts	Victaulic V27 or Tyco Series TY-FRB horizontal sidewall
Unheated exterior stairwells	Victaulic V36 or Tyco Series DS-1 dry pipe horizontal sidewall Victaulic V36 or Tyco Series DS-3 wet pipe horizontal sidewall
Air handling system outdoor air and relief air plenums (unheated)	Tyco Series DS-3 ECOH dry horizontal sidewalls in wet piping Victaulic V27 or Tyco Series TY-FRB upright or horizontal sidewall in dry pipe or anti-freeze piping
Unheated and unfinished areas	Victaulic V36 or Tyco Series DS-3 ECOH dry horizontal sidewall in wet piping Victaulic V27 or Tyco Series TY-FRB upright or horizontal sidewall in dry pipe or anti-freeze piping
Heated areas with overhead doors	Victaulic V27 or Tyco Series TY-FRB horizontal sidewall
At non-rated windows in rated walls	Tyco Model WS horizontal and pendent vertical sidewall

.2 Sprinkler head manufacturers indicated on schedule are for type indication purposes. Manufacturers are listed in Part 2 of this Section.

.3 Coordinate sprinkler head locations with all drawings, including architectural reflected ceiling plan drawings, and, where applicable, electrical drawings. Coordinate sprinkler head locations in areas with suspended ceilings with the location of lighting, grilles, diffusers, and similar items recessed in or surface mounted on the ceiling as per the reflected ceiling plans. In areas with lay-in tile, centre the sprinkler head both ways in the lay-in tile wherever possible. Confirm locations prior to roughing-in.

.4 Maintain maximum headroom in areas with no ceilings.

.5 Provide guards for heads where they are subject to damage.

.6 Provide high temperature heads in equipment rooms and similar areas over heat producing or generating equipment.

3.19 Installation of Spare Sprinkler Head Cabinets

.1 Supply a full complement (to fill cabinet) of spare sprinkler heads of types used (minimum 4 of each type) and place in a wall mounting storage cabinet located adjacent to sprinkler system "head end" equipment where later directed.

3.20 Installation of Indicator Post Valves

.1 Provide a shut-off valve in underground sprinkler main piping outside building. Equip valve with a valve box and an indicator post assembly.

.2 Confirm valve box length and steel shaft length prior to ordering and confirm exact location prior to roughing-in.

.3 When installation is complete, check and test operation of assembly and adjusts as required.

End of Section

1 General

1.01 References

.1 Domestic water piping and valves are to comply with following codes, regulations and standards (as applicable):

.1 applicable local codes and regulations;

.2 CAN/CSA B125.1, Plumbing Supply Fittings;

.3 CAN/CSA B125.3, Plumbing Fittings;

.4 CAN/CSA B137 Series, Thermoplastic Pressure Piping Compendium;

.5 NSF/ANSI 14, Plastics Piping System Components and Related Materials;

.6 NSF/ANSI 61, Drinking Water System Components – Health Effects;

.7 NSF/ANSI 372, Drinking Water System Components – Lead Content.

1.02 Submittals

.1 Submit shop drawings/product data sheets for all products specified in Part 2 of this Section except for pipe, fittings, and chlorine solution.

1.03 Closeout Submittals

.1 Submit laboratory water purity test results indicating chlorine residual prior to application for Substantial Performance of the Work.

.2 Prior Substantial Performance of the Work, submit a minimum of 3 identified keys for key operated hydrants.

.3 Submit signed test results and inspection and test log cards for each backflow preventer as specified in Part 3 of this Section.

.4 Submit anchor drawing(s) to detail fabrication and installation of water piping anchors. Drawing(s) are to be prepared and stamped by a professional structural engineer registered and licensed in jurisdiction of the work.

.5 As specified in Part 3 of this Section, submit a letter from anchor design engineer stating anchor installation has been examined at site and anchors are properly fabricated and installed.

2 Products

2.01 Pipe, Fittings, and Joints

.1 PVC

.1 ULC listed, rigid, Class 150, DR18, 1035 kPa (150 psi) pressure rated bell and spigot pattern PVC pipe to CAN/CSA B137.3, and CSA certified fittings to CAN/CSA B137.2, and AWWA C900, complete with gasket joints, and Ford "Uni-Flange" or equal restraint collars as per Part 3 of this Section.

.2 Soft Copper

.1 Type "K" soft copper to ASTM B88, supplied in a continuous coil with no joints if possible, and complete with, if joints are required, compression type flared joint couplings.

.3 Stainless Steel

.1 Schedule 10S type 304 stainless steel, ASTM A312, factory or site roll grooved, complete with Victaulic or equal type 304 stainless steel roll grooved end fittings and, unless otherwise specified, Victaulic Style 807, 877 or 889 couplings color coland coupling gaskets equal to Victaulic Grade P fluoroelastomer.

.4 Copper - Solder Joint

.1 Type "L" hard drawn seamless copper to ASTM B88, complete with copper solder type fittings to ASME/ANSI B16.18 and soldered joints using The Canada Metal Co. Ltd. "SILVABRITE 100" or equal lead-free solder for cold water pipe, and 95% tin / 5% Antimony or "SILVABRITE 100" solder for other services.

.5 Copper - Pressure Coupled Joint

.1 Type "L" hard drawn seamless copper to ASTM B88 with Viega "ProPress with Smart Connect feature" copper fittings with EDPM seals, and pressure type crimped joints made by use of manufacturer recommended tool.

.6 Copper - Grooved

.1 Type "L" hard drawn seamless copper to ASTM B88 with Victaulic QuickVic Style 607 non-reducing, bolted connection type suitable and approved for application intended, 2" - 8" for copper tubing consisting of ductile iron cast housings, complete with a Grade P fluoroelastomer gasket of a pressure-responsive design, with plated nuts and bolts to secure unit together.

.7 Semi-Rigid Polyethylene Tubing

.1 Versa Fittings and Mfg. Inc. 12 mm (½") dia., high density, semi-rigid polyethylene tubing, 1380 kPa (200 psi) rated.

.8 Flexible Polyethylene

.1 Flexible polyethylene pipe to CAN/CSA B137.1, 690 kPa (100 psi) rated, complete with insertion type fittings secured with Series 300 stainless steel gear type clamps.

.9 Cross-Linked Polyethylene (PEX) Tubing

.1 Non-barrier type PEX piping in accordance with CAN/CSA B137.5, ASTM F876 and tested for compliance by an independent third-party agency, 25/50 flame spread/smoke developed rated when tested to CAN/ULC S102.2 and complete with brass inserts and crimp-ring or cold-expansion joint fittings and couplings.

2.02 Shut-Off Valves

.1 Ball Valves

.1 Class 600, 4140 kPa (600 psi) WOG rated, lead-free, full port ball type valves, each complete with a forged brass body with solder ends, forged brass cap, blowout-proof stem, 304 stainless steel ball, "Teflon" or "PTFE" seat, and a removable lever handle. Valves in insulated piping are to be complete with stem extensions.

.2 Manufacturers:

.1 Toyo Valve Co.

.2 Milwaukee Valve Co.

.3 Kitz Corporation Code

.4 Apollo Valves

.5 Watts Industries (Canada) Inc.

.2 Butterfly Valves - Flanged Joint

.1 Non-corrosive, minimum 1200 kPa (175 psi) cold water pressure rated, resilient seated butterfly valves, each complete with a coated cast ductile iron lug type body, stainless steel shaft, bronze disc, and EPDM seat, and each suitable for domestic water bubble-tight dead end service with valve in position and either side of connecting piping removed. Butterfly valves to and including 100 mm (4") dia. are to be equipped with lever handles. Butterfly valves larger than 100 mm (4") dia. are to be equipped with worm gear operators.

.2 Manufacturers:

.1 DeZurik #632L Series;

.2 Kitz Corporation Code #6122EL/EG;

.3 Toyo Valve Co. #918BESL/EG;

.4 Bray Valve and Controls Canada Series 31;

.5 Apollo Valves #141 Series;

.6 Watts Industries (Canada) Inc. #BF-03.

.3 Butterfly Valves – Grooved End

.1 Equal to Victaulic Series 608N, for copper pipe rated to 300 psi and be both bi-directional and dead-end service capable to full rated pressure. Seat material shall be EPDM UL Classified in accordance with ANSI/NSF 61 for ambient +86°F and hot +180°F potable water service and ANSI/NSF 372.

.2 Victaulic Series 461, for stainless steel pipe rated to 300 psi and be both bi-directional and dead-end service capable to full rated pressure. Seat material shall be EPDM UL Classified in accordance with ANSI/NSF 61 for ambient +86°F and hot +180°F potable water service and ANSI/NSF 372.

2.03 Check Valves

.1 Horizontal

.1 Lead-free, Class 125, bronze, 1380 kPa (200 psi) WOG rated horizontal swing type check valves with solder ends.

.2 Manufacturers:

.1 Toyo Valve Co. Fig. 237A-LF;

.2 Milwaukee Valve Co. #UP1509;

.3 Kitz Corporation Code 823;

.4 Apollo Valves #61LF Series.

.2 Vertical

.1 Equal to Kitz Corp. Code 826, lead-free, 1725 kPa (250 psi) WOG rated vertical lift check valve with soldering ends.

2.04 Drain Valves

.1 Minimum 2070 kPa (300 psi) water rated, 20 mm (¾") dia., straight pattern full port bronze ball valves, each complete with a threaded outlet suitable for coupling connection of 20 mm (¾") dia. garden hose, and a cap and chain. Ball material to be 304 stainless steel.

.2 Manufacturers:

.1 Toyo Valve Co.

.2 Dahl Brothers Canada Ltd.

.3 Kitz Corporation

.4 Apollo Valves

.5 Watts Industries (Canada) Inc.

2.05 Domestic Hot Water Piping Balancing Valves

.1 Equal to Victaulic Series 76X Low Lead Balancing Valve, lead-free and compliant with NSF-61 and NSF-372 for use in potable water applications, automatic flow limiting balancing valve (+/-5% over rated operating pressure range), complete with removable flow cartridge.

.2 Equal to Victaulic TA Series 78BL, solder or flange end type as required, ball valve style, lead-free and compliant with NSF-61 and NSF-372 for use in potable water applications, circuit balancing valves designed to facilitate precise flow measurement, precision flow balancing, and positive shut-off, complete with capped and valved drain connection, and valved ports for connection to a differential pressure meter.

2.06 Partition Stops

.1 Equal to Dahl Brothers Canada Ltd. Fig. E2300 Series or equal lead-free partition stops with EDPM packing, slotted spindles, extension tubes, stainless steel access plates, and 3 identified keys.

2.07 Pressure Reducing Valves

.1 For piping less than or equal to 50 mm (2") diameter, lead-free, non-corrosive, non-ferrous direct spring acting pressure reducing valves to CAN/CSA B356, each factory set at 345 kPa (50 psi) unless otherwise specified or required, each field adjustable from 175 kPa (25 psi) to 520 kPa (75 psi) and each complete with an integral inlet strainer.

.1 Manufacturers:

.1 Apollo Valves #36HLF Series;

.2 Zurn/Wilkins #600XL Series;

.3 Watts Industries (Canada) Inc. #LF25AUB-Z3 Series;

.4 Cash-Acme EB-25 Series;

.5 Bermad Series 935-H

.2 For piping greater than or equal to 65 mm (2-½") diameter, lead-free, non-corrosive pilot operated pressure reducing valve to CAN/CSA B356, factory set at required pressure, field adjustable, and

complete with a bronze body and trim, screwed or flanged connections, and brass body pilot valve with stainless steel seat.

.1 Manufacturers:

.1 Singer Valve #106 PR;

.2 Zurn/Wilkins #ZW209;

.3 Watts Industries (Canada) Inc. #LFN223 Series;

.4 Bermad Series 972.

2.08 Domestic Hot Water Thermostatic Mixing Valves

.1 Lawler Manufacturing Co. Inc. 800 Series "High-Low Thermostatic Mixer" factory assembled rough bronze thermostatic mixing valve assembly complete with rotatable union end inlet piping with check stops and stainless steel strainer screens, union outlet piping with thermometer connection, all sized as shown, and following:

.1 mixing valve with liquid motor, stainless steel piston and liner, tamper-resistant control adjustment, and 3-way protection against runaway temperatures, thermal shock, and scalding;

.2 dial type thermometer conforming to requirement specified in Section 20 05 00 – Common Work Results for Mechanical;

.3 ball type outlet shut-off valve conforming to valve requirements specified in this section;

.4 surface wall mounting enamelled steel cabinet with hinged door, key lock, and permanent identification;

.5 recessed wall mounting type 304 stainless steel cabinet with a #4 finish, hinged door, key lock, and permanent identification.

.2 Manufacturers:

.1 Lawler Manufacturing Co. Inc.;

.2 Leonard Valve Co.;

.3 Symmons Industries Inc.

2.09 Chlorine

.1 Sodium hypochlorite to AWWA B300.

2.10 Water Meter

.1 Equal to Neptune Technology Group (Canada) Ltd. "Neptune T-10" tamper-proof, in line serviceable meter in accordance with requirements of AWWA C701 and NSF/ANSI 61, suitable for connection of a remote automatic reading and billing unit and complete with a cast bronze main case, a roll sealed register, and a positive displacement nutating disc measuring chamber.

.2 Equal to Neptune Technology Group (Canada) Ltd. "Neptune High Performance Turbine" tamper-proof, in-line serviceable meter in accordance with requirements of AWWA C701 and NSF/ANSI 61, suitable for connection of a remote automatic reading and billing unit and complete with a cast bronze main case, a roll-sealed magnetic drive register, and a turbine measuring element.

.3 Equip meter with a Neptune Technology Group (Canada) Ltd. or equal "ARB-V" surface wall mounting automatic meter reading and billing unit with encoder register, polycarbonate housing, roll-sealed copper shell, and ABS plastic receptacle.

.4 Meter is also to be complete with Neptune Technology (Canada) Ltd. or equal "Tricon" hardware for interface connection to building automation system for water flow and consumption monitoring.

2.11 Interior Hose Bibbs

.1 Flush-Concealed

.1 Recessed, 92 mm (3-5/8") deep, recessed, encased wall hydrant with lockable bronze or stainless steel box with hinged cover identified "WATER", bronze interior parts, a screwdriver operated stop in the supply, key operated control valve, 20 mm (¾") dia. hose connection, and a vacuum breaker.

.2 Manufacturers:

.1 Watts Industries (Canada) Inc. #HY-330.

.2 Jay R. Smith #5509QT-CL-SAP;

.3 Zurn #Z1350;

.4 Mifab #MHY-55;

.2 Semi-Recessed - Finished Areas

.1 Anti-siphon type, 100 mm (4") deep hose bibb with stainless steel face with operating key, bronze interior parts, 20 mm (¾") dia. solder inlet, 20 mm (¾") dia. hose connection, and integral vacuum breaker.

.2 Manufacturers:

.1 Watts Industries (Canada) Inc. #HY-430.

.2 Jay R. Smith #5619-SAP-98;

.3 Zurn #Z1333 "ECOLOTROL";

.4 Mifab #MHY-30;

.3 Surface – Exposed – Cold Water – Unfinished Areas

.1 Brass or bronze hose bibb with hose end vacuum breaker.

.2 Manufacturers:

.1 Watts Industries (Canada) Inc. #SC8-1;

.2 Jay R. Smith #5609QT-SAP.

.3 Zurn/Wilkins # Z1341 with hose end vacuum breaker;

.4 Chicago Faucets #293-E27CP;

.4 Exposed – Unfinished Areas – Hot and Cold Water

.1 Mixing faucet for surface mounting.

.2 Manufacturers:

.1 Watts Industries (Canada) Inc. #HY-300-2-VB.

.2 Jay R. Smith #5560QT-LB-SAP;

.3 Zurn #Z841L1-RC;

.4 Delta Commercial #28T8083;

2.12 Exterior Non-Freeze Wall Hydrants

.1 Flush-Concealed

.1 Recessed, encased, self-draining hydrants, each complete with a copper casing, operating rod assembly to suit wall thickness, polished nickel bronze box with hinged locking cover, 20 mm (¾") dia. threaded hose connection outlet, vacuum breaker, and a loose tee handle operating key.

.2 Manufacturers:

.1 Watts Industries (Canada) Inc. #HY-725.

.2 Jay R. Smith #5519-98;

.3 Zurn #Z1320;

.4 Mifab #MHY-26;

.2 Semi-Recessed

.1 Self-draining hydrants, each complete with a copper casing, operating rod assembly to suit the wall thickness, 20 mm (¾") dia. threaded hose connection outlet, vacuum breaker, and a loose tee handle operating key.

.2 Manufacturers:

.1 Watts Industries (Canada) Inc. #HY-420.

.2 Jay R. Smith #5619-98;

.3 Zurn #Z1321;

.4 Mifab #MHY-16;

2.13 Exterior Non-Freeze Ground Hydrants

.1 Flush

.1 Flush with grade mounting, encased head, self-draining bronze hydrants, each complete with a casing and operating rod assembly to suit the depth of piping bury, valve housing with drain port, grade box with hinged lockable cover and drain port, 20 mm (¾") dia. threaded hose connection, and a loose tee handle operating key.

.2 Manufacturers:

.1 Watts Industries (Canada) Inc. #HY-500.

.2 Jay R. Smith #5810-N-NV;

.3 Zurn #Z1360;

.4 Mifab #MHY-60;

.2 Exposed

.1 Self-draining exposed head bronze post hydrants, each complete with a casing and operating rod assembly to suit the height of hose outlet above grade and the depth of piping bury, valve housing with drain port, 20 mm (¾") dia. threaded hose connection assembly with vacuum breaker and gravel guard, and a loose tee handle operating key.

.2 Manufacturers:

.1 Watts Industries (Canada) Inc. #HY-600.

.2 Jay R. Smith #5910-NV-H;

.3 Zurn #Z1385;

.4 Mifab #MHY-65;

2.14 Non-Freeze Roof Hydrant

.1 Woodford Mfg. Model RHY2-MS non-freeze roof hydrant with 25 mm (1") diameter inlet connection, 20 mm (3/4") diameter hose end outlet with dual check backflow preventer, a 3.2 mm (1/8") diameter inlet connection drain hole to automatically drain hydrant when shut-off, a mounting system with cast iron support and under deck flange, and required mounting hardware and accessories.

2.15 Floor Drain Trap Seal Primers

.1 Primer Valve Type

.1 Precision Plumbing Products Inc. Model P2-500 trap primer valve, constructed of brass, adjustable to high or low water pressures and complete with "O" ring seals, 12 mm (½") threaded inlet and outlet connections, and, for priming two traps from the same primer, a DU-2 dual outlet distribution unit.

.2 Primer Valve Type with Manifold

.1 Precision Plumbing Products Inc. Model P1-500 trap primer valve constructed as specified above for the Model P2-500 primer valve, complete with a Model DU-3 or DU-4, 3 or 4 outlet distribution unit for priming 3 or 4 traps, and at Model "YS-8" supply tube with combinations of Model DU-3 and DU-4 distribution units for priming from 5 to 6 traps.

.3 Electronic Type

.1 Precision Plumbing Products #PT Series surface wall mounting, CSA certified, 115 volt, 1-phase, 60 Hz., electronic, automatic trap priming manifolds, each sized to suit the number of drain traps or interceptors serviced, and each complete with:

.1 galvanized steel cabinet with door;

.2 20 mm (¾") dia. NPT copper pipe inlet with shut-off valve and water hammer arrestor;

.3 solenoid valve, an atmospheric vacuum breaker, and a discharge manifold with 12 mm (½") dia. compression type copper tube connections on 40 mm (1-½") centres with quantity to suit the number of items to be primed;

.4 control panel with circuit breaker, 5 ampere fuse, 24 hour timer, and manual override toggle switch.

2.16 Shock Absorbers

.1 Type 304 stainless steel piping shock absorbers, each complete with a nesting type bellows and a casing of sufficient displacement volume to dissipate kinetic energy generated in piping system, and each sized to suit connecting potable water pipe and equipment it is provided for.

.2 Manufacturers:

.1 Watts Industries (Canada) Inc. "SG" Series.

.2 Jay R. Smith 5000 Series "HYDROTROL";

.3 Zurn #Z1700 "SHOKTROL";

.4 Mifab "HAMMERGUARD" WHB Series;

2.17 Water Hammer Arrestors

.1 Piston type, sealed, all stainless steel construction, pressurized water hammer arrestors suitable for either vertical or horizontal installation, each complete with a pressurized compression chamber, welded nesting-type expansion bellows surrounded by non-toxic mineral oil, and a male treaded nipple connection.

.2 Manufacturers:

.1 Jay R. Smith 5000 Series;

.2 Precision Plumbing Products "SS" Series.

.3 Piston type, sealed, pressurized water hammer arrestors suitable for either horizontal or vertical installation, each complete with a hard drawn copper body, "O"-ring piston seals, an air charge, and an inlet opening equal to diameter of pipe in which arrestor is required.

.4 Manufacturers:

.1 Watts Industries (Canada) Inc.;

.2 Zurn #Z1705;

.3 Precision Plumbing Products Inc. #SC;

.4 Mifab MWH Series.

2.18 Backflow Preventers

.1 Double Check Valve Assembly

.1 Minimum 1205 kPa (175 psi) rated lead-free dual check valve assembly backflow preventer to CAN/CSA B64 (including supplements), complete with tight-closing resilient seated shut-off valves, test cocks and strainer.

.2 Manufacturers:

.1 Watts Industries Canada;

.2 Zurn/Wilkins;

.3 Apollo Valves (Conbraco Industries).

.2 Reduced Pressure Zone Assembly

.1 Lead-free reduced pressure zone assembly backflow preventer in accordance with CAN/CSA B64 (including supplements), each of bronze or epoxy coated cast iron bronze fitted construction depending on size, and complete with inlet strainer, inlet and outlet shut-off valves, an intermediate relief valve, ball valve type test cocks, and a proper air gap fitting.

.2 Manufacturers:

.1 Watts Industries #LF009QT-S for 12 mm (½") size, #LF909QT-S for 20 mm to 50 mm (¾" to 2") size, and #LF909-NRS-S for 65 mm (2-½") and larger size;

.2 Zurn/Wilkins 975XL2 and 375 Series;

.3 "Apollo" Valves manufactured by Conbraco Industries Inc. Series 4ALF;

.4 Danfoss Flomatic Corp. Series RPZ.

2.19 Piping Expansion Compensators and Guides

.1 Pressurized type, selected to withstand system pressure and to suit calculated movement from -5°C (23°F) to maximum operating temperature plus 25% safety factor, complete with stainless steel bellows and shroud, copper tube sweat type female ends, anti-torque device, and proper and suitable alignment guides for both sides of each compensator.

.2 Manufacturers:

.1 Senior Flexonics Series HB;

.2 Hyspan Precision Products Series 8500.

2.20 Pipe Anchors

.1 Welded structural black steel anchors of a design, size, and type to securely anchor pipe at point shown. Each anchor is to withstand 150% axial thrust, and is to be designed and detailed by a professional structural engineer registered and licensed in jurisdiction of the work. Submit anchor design and fabrication shop drawings, stamped by design engineer.

2.21 Lavatory Supply Fitting Tempering Valves

.1 Equal to Powers "HydroGuard" Series 490, model LM490 12 mm (½") dia. or model LM491 20 mm (¾") dia. as required, each CSA B125 certified, forged brass, tamper-proof thermostatic mixing valves, adjustable for water supply between 29°C and 49°C (85°F and 120°F), sized to suit number of lavatories in grouping, and complete with a stop and check valve and a lockable handle.

.2 Each mixing valve is to be complete with a stainless steel flush wall mounting cabinet with vandal-proof hinged door.

2.22 Air Vents

.1 Equal to ITT Hoffman Specialty No. 78 cast brass, 1035 kPa (150 psi) rated, 20 mm (¾") straight water main vent valves, each tapped at the top for a 3.2 mm (1/8") safety drain connection.

2.23 Domestic Water Thermal Expansion Tank

.1 Pre-charged domestic water thermal expansion tank in accordance with Section VIII of the ASME Boiler and Pressure Code, carbon steel outer shell construction and complete with fixed butyl rubber bladder to prevent water from contacting shell interior, top NPT stainless steel system connection, 7.6 mm to 813 mm (0.301" to 32") charging valve connection and prime painted exterior.

.2 Manufacturers:

.1 Watts Industries (Canada) Inc. Series DETA;

.2 Zurn/Wilkins Model WTTA.

3 Execution

3.01 Demolition

.1 Refer to demolition requirements specified in Section 20 05 05 – Selective Demolition for Mechanical.

3.02 Underground Municipal Service Connection

.1 Make required arrangements with Municipality for installation of domestic water service piping from Municipal main to property line.

.2 Pay charges levied by Municipality for service connection work.

.3 Municipal charges for underground street service connection work will be paid out of a prime cost allowance. Submit original copies of invoices issued by Municipality for street service connection work.

3.03 Piping Installation Requirements

.1 Provide required domestic water piping.

.2 Piping, unless otherwise specified, is as follows:

.1 for underground piping 100 mm (4") dia. and larger outside and/or inside the building – rigid PVC;

.2 for underground piping less than 100 mm (4") dia. inside building – Type "K" soft copper;

.3 for pipe 75 mm (3") dia. and larger inside building and above ground – Schedule 10 stainless steel;

.4 for 12 mm (½") dia. trap seal primer tubing located underground or in concrete or masonry construction – semi-rigid polyethylene;

.5 for pipe inside building and aboveground in sizes to 100 mm (4") dia., except in vertical shafts and through fire barriers – rigid CPVC;

.6 for branch hot and cold piping aboveground from mains and risers to fixtures, fittings, and equipment where fire rated construction is not penetrated – at your option, PEX tubing installed and joined in strict accordance with manufacturer's instructions; when installed in unfinished areas, ensure piping is protected from ultra-violet light exposure.

.7 for underground piping outside building to fixtures/outlets at grade level – flexible polyethylene, snaked in the trench and in a continuous length wherever possible;

.8 for pipe inside building and aboveground in sizes to 100 mm (4") dia. – Type "L" hard copper with solder joints.

.1 Option: Type "L" hard copper with pressure coupled mechanical joints.

.2 Option: Type "L" hard copper with grooved end mechanical joints.

.1 Grooved pipe ends shall be clean and free from indentations, projections and roll marks in the area from pipe end to groove for proper gasket sealing. All couplings will meet Victaulic standards for visual inspection sizes 2" to 8". The

gasket style and elastomeric material (grade) shall be verified as suitable for the intended service as specified. Install in accordance with manufacturer's latest recommendations. A Victaulic factory trained representative shall periodically visit the job site and review the installation for best practices. The installing Contractor shall correct any identified deficiencies. Victaulic product that has been examined and has not met the visual inspection criteria for proper installation must be corrected and re-examined by Victaulic prior to the completion of the project.

.3 Brace and secure underground water service pipe at bends, tees and similar fittings with restraint devices, and provide concrete thrust blocks in accordance with Municipal standards and details. Regardless of what is specified elsewhere in this Specification regarding provisions of concrete, provide thrust block concrete. Paint restraint devices with 2 coats of corrosion resistant black asphalt base coating prior to backfilling.

.4 Lay pipes true to line and grade with bells upgrade. Fit sections together so that, when complete, pipe has a smooth and uniform invert. Keep pipe thoroughly clean so jointed compound will adhere. Inspect pipe for defects before being lowered into trench.

.5 Slope piping so it can be completely drained.

.6 Provide cast brass dielectric type adapters/unions at connections between ferrous and copper pipe or equipment.

3.04 Installation of Shut-Off and Check Valves

.1 Refer to Part 3 of Section 20 05 00 – Common Work Results for Mechanical.

.2 For shut off valves installed on solder joint copper piping up to and including 75 mm (3") diameter, provide ball type valves, and for flanged joints copper or stainless steel piping larger than 75 mm (3") diameter provide butterfly type valves.

3.05 Installation of Drain Valves

.1 Provide a drain valve at the bottom of domestic water piping risers, at other piping low points, and wherever else shown.

.2 Locate drain valves so they are easily accessible.

3.06 Installation of Domestic Hot Water Piping Balancing Valves

.1 Provide balancing valves in domestic hot water recirculation piping where shown or required.

.1 for pipe 25 mm (3/4") dia. and less ground – equal to Victaulic Series 76X

.2 for pipe greater than 25 mm (3/4") dia. – equal to Victaulic TA Series 78BL

.2 Locate each valve so it is easily accessible.

3.07 Installation of Partition Stops

.1 Provide partition stops in domestic water piping to each group of suite washroom plumbing fixtures. Locate partition stops in piping near floor level in inconspicuous but accessible locations. Confirm exact locations prior to roughing-in.

3.08 Installation of Pressure Reducing Valves

.1 Provide domestic water pressure reducing valves. Install so each valve is readily accessible. Whenever possible, provide pressure reducing valves factory pre-set to required pressures.

.2 Check and test operation, and adjust as required.

3.09 Installation of Domestic Hot Water Thermostatic Mixing Valves

.1 Provide a domestic hot water thermostatic mixing valve assembly and wall mount.

.2 Adjust each valve to design requirements and check and test operation. Set maximum temperature limit stops.

.3 Identify each valve and its water temperature delivery setting with an engraved nameplate.

3.10 Installation of Water Meter

.1 Provide domestic water service meter. Secure meter in place on a concrete housekeeping pad and connect with piping, including required valve by-pass.

.2 Installation of water meter must comply with local municipal requirement.

3.11 Installation of Hose Bibbs

.1 Provide hose bibbs.

.2 Unless otherwise shown, specified, or required, mount hose bibbs approximately 1 m (3') above floor. Confirm exact locations prior to roughing-in.

3.12 Installation of Exterior Non-Freeze Wall Hydrants

.1 Provide non-freeze wall hydrants.

.2 Install hydrants level and plumb such that hose outlets are approximately 600 mm (2') above grade level. Confirm exact locations prior to roughing-in.

.3 Provide a shut-off valve inside building to each exterior non-freeze wall hydrant.

3.13 Installation of Exterior Non-Freeze Ground Hydrants

.1 Provide non-freeze ground hydrants. Confirm exact locations prior to roughing-in.

.2 Ensure length of piping to outlet box suits depth of underground piping, and underground piping elbow and valve housing is set in an envelope of clean sharp, 100% Proctor density compacted sand. Provide a length of small bore copper tubing from valve drain port into sand envelope.

.3 Provide a shut-off valve inside building to each ground hydrant.

3.14 Installation of Non-Freeze Roof Hydrant

.1 Provide non-freeze roof hydrants. Confirm exact locations prior to roughing-in.

.2 Coordinate installation with trades providing roof opening and roofing work to ensure a water-tight roof penetration.

.3 Provide 3.2 mm (1/8") diameter drain piping from inlet connection assembly inside building to a funnel floor drain or other suitable indirect connection location.

3.15 Installation of Trap Seal Primers

.1 Provide required accessible trap seal primers to automatically maintain a water seal in floor drain traps, whether shown on drawings or not.

.2 Water closet flush valves may be used for priming washroom floor drain traps if flush tube is properly tapped and primer tubing exposed in washroom is chrome plated.

.3 Provide trap primer valves to prime single or multiple (1 to 6) traps. Install trap primer valves in domestic cold water piping to frequently used plumbing fixtures. Where from 2 to 6 traps are to be primed from same primer valve, provide appropriate supply and distribution tube assemblies. Ensure primer valves are accessible.

.4 Provide 115 volt, electronic, surface wall mounting trap primer assemblies for multiple (4 to 30) traps. Include for a 115 volt 15 ampere panel breaker and wiring in conduit from closest panelboards to primer assembly, all to wiring standards of Electrical Division. Adjust primer water flow and timing to suit number of traps served.

.5 Ensure trap primer piping is secured to floor drain primer tappings and not terminated through the tapping in the throat of the drain.

3.16 Installation of Shock Absorbers

.1 Provide accessible shock absorbers in domestic water piping.

.2 Ensure size of each shock absorber is properly selected to suit size of domestic water pipe and equipment pipe is connected to.

3.17 Installation of Water Hammer Arrestors

.1 Provide accessible water hammer arrestors in domestic water piping in locations as follows:

.1 in headers at groups of plumbing fixtures;

.2 at top of risers;

.3 at ends of long horizontal runs of piping;

.4 in piping connecting solenoid valves or equipment with integral solenoid valves;

.5 wherever else shown or required by Code.

.2 Install each unit in a piping tee either horizontally or vertically in the path of potential water shock in accordance with manufacturer's instructions and details.

3.18 Installation of Backflow Preventers

.1 Provide a reduced pressure zone assembly backflow preventer on incoming DCW service and in each direct domestic water connection to equipment other than plumbing fixtures and fittings.

.2 Provide a double check valve assembly backflow preventer on incoming DCW service. Provide a reduced pressure zone assembly backflow preventer in each direct domestic water connection to equipment other than plumbing fixtures and fittings.

.3 Locate each backflow preventer on floor or wall between 765 mm and maximum 1.5 m (30" and 60") above floor such that it is easily accessible for maintenance and testing. Equip each backflow preventer with an air gap fitting and pipe the reduced pressure zone water outlet to drain.

.4 Test operation of each backflow preventer in accordance with requirements of CAN/CSA B64 by personnel certified for such testing by governing authorities, and submit signed test results and a properly and clearly identified and marked inspection and test record card for each backflow preventer.

3.19 Installation of Expansion Compensators, Guides, and Anchors

.1 Provide expansion compensators in domestic water piping.

.2 Ensure pipe ends are properly aligned. Provide alignment guides on each side of expansion compensators, properly secured to building structure.

.3 Provide anchors to secure domestic water piping to structure. Locate anchors generally where shown but with exact locations to suit piping as installed and requirements of reviewed anchor shop drawings.

.4 When installation of anchors is complete, arrange, and pay for anchor design engineer to visit site to review anchor installation. Submit a letter from design engineer confirming each anchor is properly installed.

3.20 Installation of Lavatory Supply Fitting Tempering Valves

.1 Provide thermostatic water tempering valves for hot water supply to public washroom lavatory supply fittings. Conceal valves and piping.

.2 Provide a flush wall mount panel for each valve. Confirm exact location prior to roughing-in.

.3 Install in accordance with manufacturer's instructions and set mixing valves to deliver 32°C (90°F) tempered water.

3.21 Installation of Air Vents

.1 Provide accessible air vents in domestic water piping to prevent air binding.

.2 Extend copper indirect drain piping from top drain connection of each vent to nearest suitable drain.

.3 Locate exact vent locations on as-built record drawings.

3.22 Installation of Domestic Water Thermal Expansion Tanks

.1 Provide domestic water thermal expansion tanks.

.2 Unless otherwise specified, mount at least 450 mm (18") from cold water inlet to domestic water heater.

.3 Adjust pre-charge to match incoming water pressure after installation.

.4 Install in accordance with manufacturer's instructions and as per local governing Codes and Regulations.

3.23 Flushing and Disinfecting Piping

.1 Flush and disinfect all new and/or reworked domestic water piping after leakage testing is complete.

.2 Isolate new piping from existing piping prior to flushing and disinfecting procedures.

.3 Flush piping until all foreign materials have been removed and flushed water is clear. Provide connections and pumps as required. Open and close valves, faucets, hose outlets, and service connections to ensure thorough flushing.

.4 When flushing is complete, disinfect the piping with a solution of chlorine in accordance with AWWA C601.

.5 When disinfecting is complete, submit water samples to a certified laboratory for purity testing and, when testing indicates pure water in accordance with governing standards, submit a copy of test results and fill the systems.

End of Section

1 General

1.01 Submittals

.1 Submit shop drawings/product data sheets for all equipment and associated hardware specified in this Section.

1.02 Closeout Submittals

.1 Submit manufacturer/supplier installation certification letters as specified in Part 3 of this Section.

.2 Submit, prior to Substantial Performance of the Work, start-up or test data specified in Part 3 of this Section.

2 Products

2.01 Domestic Hot Water Recirculating Pumps

.1 All bronze construction centrifugal pumps in accordance with drawing schedule and complete with:

.1 lead free cast bronze casing with flanged pipe connections;

.2 alloy steel shaft with integral thrust collar, copper shaft sleeve, and oil lubricated bronze sleeve bearings;

.3 balanced lead free cast bronze impeller;

.4 motor conforming to requirements of Section 20 05 00 – Common Work Results for Mechanical, connected to motor by means of a 4-spring coupling with guard;

.5 mechanical seal.

.2 Manufactures:

.1 S.A. Armstrong Ltd.;

.2 ITT Bell & Gossett;

.3 Grundfos Canada Inc.;

.4 Patterson Pump Company.

.3 Domestic Hot Water Recirculating Pumps Automatic Controls

.1 Equal to ITT Bell & Gossett Model TC-1 115 volt, programmable, Automatic Timer Kit to control circulating pump on and off at pre-set minimum 15 minute intervals, and equipped with ON (continuous run), OFF (at all times), and TIMER (run at programmed times) modes.

.2 Equal to ITT Bell & Gossett AQS Series 115 volt Aquastat to automatically control pump on and off in response to domestic water temperature and equipped with a stainless steel pipe clip, bimetal sensing element, and insulated #18 AWG 450 mm (18") wire leads.

3 Execution

3.01 Installation of Domestic Hot Water Recirculating Pumps

.1 Provide horizontal in-line domestic hot water circulating pumps.

.2 Install pumps in place in vertical piping approximately 1.2 m (4') above floor in accordance with pump manufacturer's instructions.

.3 For equipment/system start-up requirements, refer to Section 20 05 00 – Common Work Results for Mechanical.

.4 Include for 2 hours of on-site training for 2 groups of 6 people. Training is to be a full review of all components including but not limited to a full operation and maintenance demonstration, with abnormal events.

3.02 Installation of Domestic Hot Water Recirculating Pumps Controls

.1 Provide a programmable timer and an aquastat to automatically control pump on and off in response to pre-set times and domestic water temperatures. Install in accordance with manufacturer's instructions. Programme both devices in accordance with Consultant's instructions.

End of Section

1 General

1.01 Submittals

.1 Submit shop drawings/product data sheets for all products specified in this Section except pipe and fittings.

1.02 Closeout Submittals

.1 Submit a copy of plumbing inspection certificate prior to application for Substantial Performance of the Work.

.2 Submit letters from product manufacturers/suppliers to certify correct installation of products as specified in Part 3 of this section.

.3 Record Drawings: Indicate inverts of new below grade sanitary and storm piping on as-builts drawings.

2 Products

2.01 Pipe, Fittings, and Joints

.1 PVC Sewer

.1 DR35 rigid, green PVC hub and spigot pattern sewer pipe and fittings to CAN/CSA B182.2, with gasket joints assembled with pipe lubricant.

.2 DR35 rigid, PVC sewer pipe and fittings, with solvent weld joints, all certified to CSA B182.1 and colour-coded as per local governing codes, regulations and standards.

.2 PVC - DWV

.1 For Low Buildings: Equal to IPEX System 15 drain, waste and vent pipe and fittings to CAN/CSA B181.2, complete with a flame spread rating not more than 25 when tested to CAN/ULC S102.2, with solvent weld joints or MJ Grey mechanical joint couplings, and, for fire barrier penetration, approved firestop conforming to CAN/ULC S115.

.2 For High Buildings and Plenums: Equal to IPEX System XFR drain, waste and vent pipe and fittings to CAN/CSA B181.2, complete with a flame spread rating not more than 25 and a smoke developed classification not more than 50 when tested to CAN/ULC S102.2, with solvent weld joints or MJ Grey mechanical joint couplings, and, for fire barrier penetration, approved firestop conforming to CAN/ULC S115.

.3 Copper - Solder Joint

.1 Type DWV hard temper to ASTM B306, with forged copper solder type drainage fittings and 50% lead - 50% tin solder joints.

.4 Cast Iron

.1 Class 4000 cast iron pipe, fittings, and mechanical coupling joints to CAN/CSA B70.

.5 Copper-Victaulic Coupling Joint

.1 Type DWV hard temper to ASTM B306, with factory or site rolled grooved ends (with grooving rolls designed for copper) and Victaulic "Copper Connection" wrought copper or cast bronze fittings and Style 606 gasket type couplings.

.6 Galvanized Steel - Victaulic Coupling Joint

.1 Schedule 40 mild steel, galvanized, ASTM A53, factory or site rolled grooved, complete with Victaulic galvanized ductile iron grooved end fittings and, unless otherwise specified, Victaulic Style 77 hot dip galvanized mechanical joint couplings with Grade M gaskets.

.7 PVC Weeper Piping

.1 150 mm (6") dia. corrugated perforated PVC pipe with an integral geodesic sock, supplied in coils.

2.02 Shut-Off and Check Valves

.1 Shut-off Valves

.1 Class 600, 4140 kPa (600 psi) WOG rated full port ball valves, each complete with a forged brass body, blowout-proof stem, chrome plated solid brass ball, solder or screwed ends as required, and removable lever handle.

.2 Manufacturers:

.1 Toyo Valve Co. Fig. 5049A or Fig. 5044A;

.2 Milwaukee Valve Co. #BA-155 or #BA -125;

.3 Kitz Corporation Code 58 or Code 59;

.4 Victaulic Co. of Canada Ltd. Series 722;

.5 Apollo Valves # 77-100 or # 77-200;

.6 Watts Industries (Canada) Inc. #FBVS-3C.

.2 Check Valves

.1 Class 125, bronze, 1725 kPa (250 psi) WOG rated vertical lift check valve with solder or screwed ends as required, and, for horizontal piping, Class 125, bronze 1380 kPa (200 psi) WOG rated swing check valves with solder or screwed ends.

.2 Manufacturers:

.1 Toyo Valve Co. Fig. 231 or Fig. 236 or Fig. 237;

.2 Milwaukee Valve Co. #1510 or #510;

.3 Kitz Corporation Code 36 or Code 22 or Code 23.

2.03 Vent Stack Covers

.1 Equal to Lexcor Model "Flash-Tite" seamless, spun aluminum, insulated vent stack covers with caps and a factory applied asphalt primer coating on top and bottom of flange.

.2 Each vent stack cover is to be complete with a vandal-proof cap.

2.04 Cleanouts

.1 Horizontal Piping

.1 TY pipe fitting with an extra heavy brass plug screwed into the fitting.

.2 Vertical Piping

.1 Bronze or copper cleanout tees in copper piping, each complete with a bronze ferrule, and, for cast iron piping, "BARRETT" type cast iron cleanout tees, each gas and water-tight and complete with a bolted cover.

.3 Urinal(s)

.1 Wall access cleanout assemblies, each complete with a tapered plug, threaded brass insert, urethane rubber seal, and polished stainless steel access cover with vandal-proof stainless steel securing screw.

.2 Manufacturers:

.1 Watts Industries (Canada) Ltd. #CO-590-RD.

.2 Jay R. Smith #SQ4-1819;

.3 Zurn #ZSS-1666-1;

.4 Mifab #C1440-RD;

2.05 Floor Cleanout Terminations

.1 Factory finished cast iron terminations, each adjustable and complete with a cast iron body with neoprene sleeve, solid, gasketed, polished nickel-bronze scoriated top access cover to suit floor finish, a seal plug, and captive, vandal-proof, stainless steel securing hardware.

.2 Manufacturers:

.1 Watts Industries (Canada) Ltd. # CO-200-R-1.

.2 Jay R. Smith #4020-F-C Series;

.3 Zurn # ZN-1602-SP Series;

.4 Mifab # C1100-XR-1 or #C1000-R-3;

.3 Cleanout terminations in areas with a tile or sheet vinyl floor finish are to be as above but with a square top in lieu of a round top.

2.06 Floor Drains, Funnel Floor Drains, and Hub Drains

.1 Unless otherwise specified or indicated, floor drains are to be vandal-proof drains in accordance with drawing symbol list, each complete with a cast iron body and a trap seal primer connection. Cast iron components are to be factory finished with latex based paint coating.

.2 Floor drains in areas with a tile or sheet vinyl floor finish are to be as above but with a square grate in lieu of a round grate.

.3 Manufacturers:

.1 Watts Industries (Canada) Ltd.;

.2 Jay R. Smith Manufacturing Co.;

.3 Zurn Industries Ltd.;

.4 Mifab Inc.

2.07 Roof Drains

.1 Unless otherwise specified or indicated, roof drains are to be cast iron body drains with aluminium domes, in accordance with the drawing symbol list. Cast iron components are to be factory finished with a latex based paint coating.

.2 Manufacturers:

.1 Watts Industries (Canada) Ltd.;

.2 Jay R. Smith Manufacturing Co.;

.3 Zurn Industries Ltd.;

.4 Mifab Inc.

2.08 Backwater Valves

.1 Heat bonded powder epoxy coated cast iron in-line type, each complete with a bolted and gasketed cover, bronze flapper, stainless steel extension, and stainless steel hardware.

.2 Manufacturers:

.1 Watts Industries (Canada) Inc. BV-230-R Series;

.2 Jay R. Smith #7022-CAN.

.3 Zurn #Z-1095-15-MJ;

2.09 Grease Interceptors

.1 Grease intercepting and recovery unit of #11 gauge type 304 stainless steel construction with sensor controlled grease draw-off solenoid valve, automatic shut-down with audible/visual alarm if maximum grease capacity is exceeded, integral heating element with thermostat, gasketed stainless steel cover, stainless steel solids interceptor, and remote surface wall mounting indicator panel with status indicating lights, audible alarm, 115/24 volt control transformer and NEMA 2 enclosure.

.2 Manufacturers:

.1 Watts Industries (Canada) Inc. WD-E Series;

.2 Jay R. Smith #8000-ELECT series or #8400-ELECT series.

.3 Zurn #Z1172-UN series;

3 Execution

3.01 Demolition

.1 Refer to demolition requirements specified in Section 20 05 05 – Selective Demolition for Mechanical.

3.02 Drain and Vent Piping Installation Requirements

.1 Provide required drainage and vent piping. Pipe, unless otherwise specified, as follows:

.1 for underground pipe inside building and to points 1.5 m (5') outside building lines – rigid PVC sewer pipe, minimum 75 mm (3") dia.;

.2 for pipe inside building and aboveground in sizes less than or equal to 65 mm (2-½") dia. – type DWV copper;

.3 for pipe inside building and aboveground in sizes greater than or equal to 75 mm (3") dia. – Class 4000 cast iron;

.4 for pipe inside building and aboveground in lieu of type DWV copper and cast iron, at your option and where permitted by governing Codes and Regulations – rigid PVC DWV;

.5 for drainage pump discharge pipe connections from pump to and including shut-off and check valve connections – Type "DWV" copper with Victaulic "Copper Connection" fittings and couplings, or Schedule 40 galvanized steel with Victaulic fittings and couplings.

.2 Unless otherwise specified, slope horizontal drainage piping aboveground in sizes to and including 75 mm (3") dia. 25 mm (1") in 1.2 m (4'), and pipe 100 mm (4") dia. and larger 25 mm (1") in 2.4 m (8').

.3 Install and slope underground drainage piping to inverts or slopes indicated on drawings to facilitate straight and true gradients between points shown. Verify available slopes before installing pipes.

.4 Unless otherwise specified, slope horizontal branches of vent piping down to fixture or pipe to which they connect with a minimum pitch of 25 mm (1") in 1.2 m (4').

.5 Extend vent stacks up through roof generally where shown but with exact locations to suit site conditions and in any case a minimum of 3 m (10') from fresh air intakes. Terminate vent stacks a minimum of 330 mm (13") above roof (including roof parapets) in vent stack covers. Where not shown on drawings, route vent piping from source to building exterior as required in order to satisfy local governing codes and authority. Coordinate vent routing with other building services and ensure there is no architectural impact.

.6 Provide cast brass dielectric unions at connections between copper pipe and ferrous pipe or equipment.

3.03 Installation of Shut-Off and Check Valves

.1 Provide a shut-off valve and a check valve in discharge piping of each drainage pump.

.2 Locate valves so they are easily accessible without the use of ladders or other such devices.

3.04 Supply of Vent Stack Covers

.1 Supply a properly sized vent stack cover for each vent stack penetrating roof.

.2 Hand vent stack covers to roofing trade at site for installation and flashing into roof construction as part of roofing work. Coordinate installation to ensure proper locations. Provide waterproofing caps over vent stacks.

3.05 Installation of Cleanouts

.1 Provide cleanouts in drainage piping in locations as follows:

.1 in building drain or drains as close as possible to inner face of outside wall, and, if a building trap is installed, locate cleanout on downstream side of building trap;

.2 at or as close as practicable to the foot of each drainage stack;

.3 at maximum 15 m (50') intervals in horizontal pipe 100 mm (4") dia. and smaller;

.4 at maximum 30 m (100') intervals in horizontal pipe larger than 100 mm (4") dia.;

.5 in the wall at each new urinal or bank of urinals in a washroom;

.6 wherever else shown on drawings.

.2 Cleanouts are to be same diameter as pipe in piping to 100 mm (4") dia., and not less than 100 mm (4") dia. in piping larger than 100 mm (4") dia.

.3 Where cleanouts in vertical piping are concealed behind walls or partitions, install cleanouts near floor and so cover is within 25 mm (1") of the finished face of the wall or partition.

3.06 Installation of Floor Cleanout Terminations

.1 Where cleanouts occur in horizontal inaccessible underground piping, extend cleanout TY fitting up to floor, and provide a cleanout termination set flush with finished floor.

.2 In waterproof floors, ensure each cleanout termination is equipped with a flashing clamp device. Cleanout terminations are to suit floor finish.

.3 Where cleanout terminations occur in finished areas, confirm locations prior to rough-in and arrange piping to suit.

.4 Ensure cleanout termination covers in tiled floor are square in lieu of round.

3.07 Installation of Floor Drains, Funnel Floor Drains and Hub Drains

.1 Provide floor drains, funnel floor drains and hub drains.

.2 Coordinate location of floor drains, funnel floor drains and hub drains with equipment provided by Mechanical Division and Owner's supplied equipment. Install in accordance with manufacturer's instructions.

.3 Equip each drain with a trap.

.4 In equipment rooms and similar areas, exactly locate floor drains to suit location of mechanical equipment and equipment indirect drainage piping. In washrooms, exactly locate floor drains to avoid interference with toilet partitions.

.5 Confirm exact location of drains prior to roughing in. Where floor drains occur in washrooms coordinate locations with toilet partition installations.

.6 Temporarily plug and cover floor drains during construction procedures. Remove plugs and covers during final clean-up work and when requested, demonstrate free and clear operation of each drain. Replace any damaged grates, and refinish any areas of the drain where cast iron finish has been damaged or removed, including rusted areas.

3.08 Installation of Roof Drains

.1 Supply roof drains and place roof drain bodies in position for flashing into roof construction as part of roofing work. Connect with piping and provide accessories.

.2 Protect roof drains from damage and entrance of debris until roofing work is complete, and refinish any areas where cast iron factory finish has been damaged or removed, including rusted areas.

3.09 Installation of Backwater Valves

.1 Provide backwater valves in drainage piping and connect with piping.

.2 Set backwater valve assembly such that cover is flush with finished floor. Provide an extension piece if required due to depth of piping.

3.10 Installation of Drainage Interceptor

.1 Provide an interceptor in drainage piping.

.2 Ensure unit is easily accessible for maintenance. Confirm exact location prior to roughing-in.

.3 Wall mount control panel and provide required 24 volt control wiring in conduit from control panel to interceptor.

.4 For equipment/system start-up requirements, refer to Section 20 05 00 – Common Work Results for Mechanical.

.5 For equipment/system manufacturer certification requirements, refer to Section 20 05 00 – Common Work Results for Mechanical. Submit a copy of the letter prior to Substantial Performance of the Work.

.6 Include for 2 hours of on-site training for 2 groups of 6 people. Training is to be a full review of all components including but not limited to a full operation and maintenance demonstration, with abnormal events.

End of Section

1 General

1.01 Submittals

.1 Submit shop drawings/product data sheets for all equipment and associated hardware specified in this Section.

.2 Include pump motor product data sheets and pump performance curves with shop drawing/product data sheet submission.

.3 Include design and fabrication shop drawings for shop fabricated heat exchanger support assemblies.

1.02 Closeout Submittals

.1 Submit with delivery of heater(s) a copy of the factory inspection and test report for each heater, and include a copy of each report with O&M Manual project close-out data.

.2 Submit manufacturer/supplier installation certification letters as specified in Part 3 of this Section.

.3 Submit influent water analysis of municipal water supply for the following minimum criteria and anticipated softening results in parts per million (ppm): Calcium, Iron, Manganese, Magnesium, Total Hardness, Total Dissolved Solids, Turbidity, Colour, PH.

.4 After installation is complete, submit a written report verifying that the installation provides softening based on influent water analysis, signed by manufacturer's technical representative.

.5 Submit a copy of a letter from the domestic cold water booster pump set supplier certifying proper installation, and a copy of pump supplier's start-up report, all as specified in Part 3 of this Section.

.6 Submit, prior to Substantial Performance of the Work, start-up or test data specified in Part 3 of this Section.

.7 Training attendance records.

1.03 Maintenance Material Submittals

.1 Submit sufficient granular salt for 12 complete regenerations

2 Products

2.01 Submersible Pump Set

.1 Hydromatic Pumps submersible duplex sump pump set as per drawing schedule, each pump complete with:

.1 cast iron pump casing and motor cover;

.2 oil-filled, overload protected, submersible, ball bearing type, 3-phase motor with a minimum of 3 m (20') of PVC jacketed power cord pre-wired to motor;

.3 open, 2-vane type, non-clog impeller secured to a stainless steel pump and motor shaft;

.4 MTM guide rail package complete with cast iron discharge elbow, discharge flanges for connection to pumps, steel spacer, stainless steel upper guide rail bracket, and lift chain.

.2 Pump set control components, supplied by pump manufacturer, are to consist of:

.1 4 switches, each sealed in a polyurethane float and complete with a minimum of 3 m (20') of control cord; 3 for pump set control and 1 for sump high water level alarm;

.2 bracket to support float switch cables in the sump pit;

.3 duplex factory pre-wired and tested power and control panel complete with a NEMA 3R enclosure with hinged and gasketed padlockable door, galvanized steel back panel with power and control wiring terminal blocks, bundled and identified wiring, and following:

.1 circuit breaker, a H-O-A switch, an overload protected magnetic motor starter with test and reset pushbuttons, an identified "RUN" pilot light for each pump, and a relay alternating circuit to automatically alternate lead pump after each successive pumping cycle;

.2 fused control transformer;

.3 solid state pump controller with LED indicator lights;

.4 high level alarm horn with push to silence switch and automatic reset flashing red light;

.5 dry contacts for high water level alarm condition connection to a building automation system.

.3 Pump power cords and float switch cords must be of sufficient length to extend unbroken through sump pit conduit to wall on which starter and control panel is to be located.

.4 Manufacturers:

.1 Hydromatic Pumps;

.2 Liberty Pumps;

.3 F.E. Myers (Canada) Ltd.;

.4 ITT Flygt Canada;

.5 Barnes Pumps (GSW Pump Company).

2.02 Sump Frames and Cover Plates

.1 Welded sump curb frame and cover plate assembly constructed of hot dip galvanized mild steel, suitable in all respects for the application and location, complete with angle frame designed for flush with floor cover plate mounting with trim bar and countersunk screws, centre brace, and two-piece minimum 8 mm (5/16") thick cover with lifting rings, gaskets, and, in one cover, a vent pipe opening and discharge pipe opening(s) with sealing flange(s), sealed opening(s) for pump power cord(s), and mounting plate with sealed opening(s) for control cables.

.2 Heavy-gauge hot-dipped galvanized steel sump curb frame with concrete anchors and 2-leaf minimum 8 mm (5/16") thick continuously hinged blank cover plate, complete with recessed lifting ring, gaskets, reinforced as required to suit the application and loading, and secured to frame by means of countersunk non-corrosive screws.

.3 Minimum 6.3 mm (1/4") thick, single or double leaf, steel or aluminium cover plate and reinforced as required to suit the application and loading, and complete with lift assistance, automatic hold-open arm(s) with grip handle release, type 316 stainless steel slam lock(s) with fixed interior handle and removable exterior turn/lift handle, type 316 stainless steel fasteners, and following:

.1 cover plate and curb frame designed/reinforced to withstand a live load of 732 kg/m2 (150 lb/ft2);

.2 cover plate and curb frame designed/reinforced to withstand a live load of 1464 kg/m2 (300 lb/ft2);

.3 cover plate and curb frame designed/reinforced to withstand a live load equal to AASHTO H-20 wheel loading;

.4 steel angle frame with strap anchors welded around perimeter or extruded aluminium angle frame with strap anchors bolted around perimeter;

.5 concealed cast steel, cam-action hinges;

.6 zinc plated/chromate sealed [for both] hardware or Type 316 stainless steel [for both] hardware;

.7 formed steel channel frame with full anchor angle welded around perimeter or extruded aluminium channel frame with anchor tabs around perimeter;

.8 heavy forged brass hinges with type 316 stainless steel pins [for steel] or heavy forged aluminium hinges with type 316 stainless steel pin [for aluminium];

.9 38 mm (1-1/2") drain coupling welded under frame for connection to dry well or disposal system;

.10 aluminium hardware [for aluminium construction] or zinc plated/chromate sealed [for steel construction] hardware or type 316 stainless steel [for both] hardware;

.11 mechanically attached dirt/debris EDPM gasket;

.12 cylinder lock with a keyway protected by a threaded cover plug;

.13 recessed padlock hasp covered by a flush hinged lid;

.14 factory finish, mill finish aluminium with bituminous coating applied to exterior of frame [for aluminium construction] or alkyd base red oxide primer [for steel construction];

.15 hot-dip galvanized finish (ASTM A123) [for steel construction] or anodized finish [for aluminium construction];

.16 corrosion resistant, independently operated fibreglass fall protection grating in high visibility safety orange colour and complete with lift assistance, an automatic hold-open arm with a release mechanism, and a padlock locking panel to prevent unauthorized access when grate is closed but cover is open;

.17 submersible pump guide rails;

.18 vent pipe opening and discharge pipe opening(s) with sealing flange(s), sealed opening(s) for pump power cord(s), and mounting plate with sealed opening(s) for control cables.

.4 Manufacturers:

.1 Bilco Corp.;

.2 Acudor Products Ltd.;

.3 Nystrom.

3 Execution

3.01 Drainage Coordination

.1 Coordinate drain requirements of plumbing equipment provided by Mechanical Division and or Owner with location of drains specified in Section 22 13 00.

3.02 Installation of Submersible Drainage Pump(s)

.1 Provide submersible drainage pump(s) in sump. Refer to drawing detail.

.2 Provide required sump piping, including a shut-off valve and a check valve for each pump. Ensure valves are readily accessible from floor level and piping is easily removable for removal of pump(s) from sump.

.3 Install pump removal guide rail system with accessories in accordance with manufacturer's instructions.

.4 Install float switch(es) at proper height in sump and secure cable to a sump wall mounted bracket such that cables cannot twist around each other.

.5 Leave pump power and control cables outside sump, neatly coiled, taped and identified for extension and connection to starting and control equipment.

.6 Hand pump starter and control panel(s) and high water level alarm panel(s) to electrical trade at site for installation.

.7 Provide sump and pump accessories.

.8 Clean sump(s) prior to Substantial Performance of the Work.

.9 For equipment/system start-up requirements, refer to Section 20 05 00 – Common Work Results for Mechanical.

.10 For equipment/system manufacturer certification requirements. Submit a copy of the letter prior to Substantial Performance of the Work, refer to Section 20 05 00 – Common Work Results for Mechanical.

.11 Include for 4 hours of on-site training for 2 groups of 6 people. Training is to be a full review of all components including but not limited to a full operation and maintenance demonstration, with abnormal events.

3.03 Installation of Sump Frames and Cover Plates

.1 Supply a frame and cover for each drainage sump. Covers and frames are to be delivered to site pre-assembled and installed as such. Carefully coordinate supply of frames and covers with concrete trade forming and pouring sumps. Hand frames to concrete trade for incorporation into formwork.

.2 Follow manufacturer's installation instructions.

End of Section

1 General

1.01 Submittals

.1 Submit shop drawings/product data sheets for all equipment and associated hardware specified in this Section.

.2 Submit with delivery of heater(s) a copy of the factory inspection and test report for each heater, and include a copy of each report with O&M Manual project close-out data.

1.02 Closeout Submittals

.1 Submit manufacturer/supplier installation certification letters as specified in Part 3 of this Section.

.2 Submit, prior to Substantial Performance of the Work, start-up or test data specified in Part 3 of this Section.

2 Products

2.01 Sealed Combustion Hot Water Heater

.1 A.O. Smith #BTH Cyclone Series 98% thermal efficiency, 160 psi maximum hydrostatic working pressure. Natural gas spiral shaped, glass lined heat exchanger high efficiency modulating pre-mix powered burner, Advance Electronic gas control system, direct spark ignitor. ASME heavy gauge steel tank construction, powered anodes for corrosion protection, Blue Diamond glass-lined, 3 year limited warranty against leaks. Power vent or direct vent design options. U.S. Department of Energy and current edition of ASHRAE/IESNA 90.1 thermal efficiency compliant, ANSI Z21.10.3 – CSA 4.3 Standards, UL to NSF Standard 5 design certified, SCAQMD Rule 1146.2 and other Air Quality Management Districts with similar requirements for low NOx emissions compliant. 120 V, 60Hz, 1Ø and 15 Amps.

.2 Contacts, relays and any other hardware, compatible with building automation system protocol and required to connect heater(s) to BAS in accordance with BAS control points list.

.3 Equip heaters with factory fabricated "EQUA-FLOW" type "L" hard copper inlet and outlet manifolds supplied loose.

.4 Manufacturers:

.1 A.O. Smith Water Products Co.;

.2 John Wood (GSW Water Heating Co.);

.3 Rheem-Ruud Canada Ltd.;

.4 Bradford White Canada Inc.

2.02 Condensate Neutralizing Kit

.1 Refillable, low-profile condensate neutralizing kit, suitable for no less than 12 months continuous operation at full condensing rate, and suitable in all respects for associated condensing heater.

3 Execution

3.01 Drainage coordination

.1 Coordinate drain requirements of plumbing equipment provided by Mechanical Division and or Owner with location of drains specified in Section 22 13 00.

3.02 Installation

.1 Provide gas fired domestic hot water heaters. Secure each heater in place, level, and plumb, on a concrete housekeeping pad.

.2 Ensure housekeeping pad is keyed to structure and tank assembly is secured to structure by slack cable restraints. Refer to Section 20 05 48.16 - Seismic Controls for Mechanical.

.3 Pipe temperature/pressure relief valve outlet to drain. Pipe condensate drain connection to drain.

.4 Coordinate installation with electrical trade who will connect heater with power wiring.

.5 Set thermostat to produce 48.8°C (120°F) hot water.

.6 Provide combustion air and flue gas vent piping for each heater in accordance with requirements of Section 23 51 23 - Gas Vents.

.7 Install inlet and outlet manifolds supplied with heaters.

.8 For equipment/system start-up requirements, refer to Section 20 05 00 – Common Work Results for Mechanical.

.9 For equipment/system manufacturer certification requirements, refer to Section 20 05 00 – Common Work Results for Mechanical. Submit a copy of the letter prior to Substantial Performance of the Work.

.10 Include for 2 hours of on-site training for 2 groups of 6 people. Training is to be a full review of all components including but not limited to a full operation and maintenance demonstration, with abnormal events.

.11 Provide condensate neutralizing kit and install in accordance with manufacturer's instructions.

End of Section

1 General

1.01 Submittals

.1 Submit product data sheets (fixture cuts) for all plumbing fixtures and fittings.

.2 Submit fixture manufacturer's standard colour charts for all fixtures where colours are available, but a particular colour is not specified.

2 Products

2.01 General Re: Plumbing Fixtures and Fittings

.1 Fixtures and fittings, where applicable, are to be in accordance with requirements of CAN/CSA B45 Series, General Requirements for Plumbing Fixtures, including supplements, ASME A112.1.18.1/CSA B125.1, Plumbing Supply Fittings, and CSA B125.3, Plumbing Fittings.

.2 Barrier-free fixtures and fittings are to be in accordance with governing Code requirements.

.3 Unless otherwise specified, vitreous china, porcelain enamelled, and acrylic finished fixtures are to be white.

.4 Unless otherwise specified, fittings and piping exposed to view are to be chrome plated and polished.

.5 Fittings located in areas other than private washrooms are to be vandal-proof.

.6 Fixture carriers are to be suitable in all respects for the fixture they support and construction in which they are located.

.7 Floor flanges for floor mounted water closets are to be cast iron or brass, secured to floor to prevent movement and complete with a wax seal and brass or stainless steel bolts, nuts, and washers. Plastic floor flanges will not be acceptable.

.8 Proper seal to mate with fixture carrier flange and produce a water-tight installation.

.9 Exposed traps for fixtures not equipped with integral traps, such as lavatories, are to be adjustable chrome plated cast brass "P" traps with cleanouts, minimum #17 gauge chrome plated tubular extensions, and chrome plated escutcheons, all to suit fixture type and drain connection.

.10 Concealed traps for fixtures not equipped with integral traps, such as counter sinks, are to be adjustable cast brass with cleanout plugs, all to suit fixture type and drain connection.

.11 Exposed supplies for fixtures which do not have supply trim/fittings with integral stops, i.e. lavatories, are to be solid chrome plated brass angle vales with screwdriver stops for public areas, wheel handle stops for private areas, flexible stainless steel risers, and stainless steel or chrome plated steel escutcheons, all arranged and sized to suit fixture.

.12 Water piping as specified, complete with ball type shut-off valves as specified with water piping, or Dahl Bros. Canada Ltd. ¼ turn Mini Ball Valves.

2.02 Plumbing Fixtures and Fittings

.1 WC-1 – Floor Mounted Water Closet, Flush Valve

.1 Toilet – Zurn Z5655-BWL1 - EcoVantage High Efficiency Toilet System. Vitreous China, 1.1 gpf [4.2 Lpf] high efficiency floor mounted bottom outlet toilet with siphon jet flushing action, elongated front rim with 1-1/2" [39 mm] top spud. This bowl is designed to perform

to industry standards with flush volumes of 1.1 gallons per flush. Complies with ASME A112.19.2 / CSA B45.1.

.2 Seat – Centoco 500STSCCFE-001 Seat - FAST-N-LOCK, for elongated bowl, Open front, Heavy-duty, For commercial applications, Polypropylene, Toilet seat, Less seat cover, Plastic commercial check hinges, and Stainless steel hinge pin, Specified in White finish, FAST-N-LOCK mounting system takes the guess work out when tightening the hardware. The specially designed fasteners in click" when the appropriate torque is reached. The bolt and nut material shall be stainless steel, Dimensions:25 mm (1") high, 473 mm (18-5/8") long, 371 mm (14-5/8") wide.

.3 Manual Flush Valve – Zurn Z6000AV - Exposed, quiet diaphragm-type, chrome plated flushometer valve with a polished exterior. Complete with Zurn's AquaVantage® TPE, chloramine resistant, dual seal diaphragm with a clog resistant, triple filtered by-pass. The valve is ADA compliant with a non-hold open and no leak handle feature. Internal seals are made of chloramine resistant materials. 292mm valve height. 1.1 gpf gallons per flush.

.2 WC-2 – Barrier Free Floor Mounted Water Closet, Flush Valve

.1 Toilet – Zurn Z5665-BWL1 - EcoVantage High Efficiency Toilet System. Vitreous China, 1.1 gpf [4.2 Lpf] high efficiency, ADA Height, floor mounted, bottom outlet toilet with siphon jet flushing action and elongated front rim with 1-1/2" [39mm] top spud. This bowl is designed to perform to industry standards with as little as 1.1 gallons per flush. Complies with ASME A112.19.2 / CSA B45.1. ADA Compliant.

.2 Seat – Centoco 500STSCCFE-001 Seat - FAST-N-LOCK, for elongated bowl, Open front, Heavy-duty, For commercial applications, Polypropylene, Toilet seat, Less seat cover, Plastic commercial check hinges, and Stainless steel hinge pin, Specified in White finish, FAST-N-LOCK mounting system takes the guess work out when tightening the hardware. The specially designed fasteners in click" when the appropriate torque is reached. The bolt and nut material shall be stainless steel, Dimensions:25 mm (1") high, 473 mm (18-5/8") long, 371 mm (14-5/8") wide.

.3 Manual Flush Valve – Flush Valve – Zurn Z6000AV-2 - Exposed, quiet diaphragm-type, chrome plated flushometer valve with a polished exterior. Complete with Zurn's AquaVantage® TPE, chloramine resistant, dual seal diaphragm with a clog resistant, triple filtered by-pass. The valve is ADA compliant with a non-hold open and no leak handle feature. Internal seals are made of chloramine resistant materials. 610mm valve height. 1.1 gpf gallons per flush.

.4 Backrest – Franke Commercial CM-16104-WM Backrest - wall mounting, back rest, solid core plastic laminate panel back, Antique white, 305 mm (12") wide, 102 mm (4") high, 137 mm (5-3/8"), 18-gauge stainless steel bar with #4 gloss with flanges and covers, concealed snap flanges and mounting hardware included, provide adequate backing in wall for support and comply to local codes for barrier free requirements.

.5 Waste outlet seal ring neoprene or graphite-felt.

.3 WC-3 – Baby Round Front Toilet

.1 American Standard Baby Devaro 10-1/4" High Round Toilet 2282001.020. Floor Mounted Toilet - White Finish - Vitreous china- Round Front Bowl -Siphon jet flush action - Round Front Bowl - 51 mm (2") fully glazed internal trapway - bolt caps - Toilet seat not included - designed for children - 38 mm (1-1/2") dia. Top spud. Minimum working pressure range: 25 psi to 80 P.S.I. (550 kPa) maximum. Nominal Dimensions: 347 mm (13-11/16") wide x 633 mm (24-15/16") front to back x 260 mm (10-1/4") high. Water Consumption: Low consumption Operates in the range of 4.8 L to 6 L (1.28 US Gal to 1.6 US Gal) per flush.

.2 Sloan Regal 111-1.6-XL-CP Regal Exposed Manual Flushometer For Top Spud Toilet, chrome plated, 6 L (1.6 US Gal) factory set flow, quiet action diaphragm type, non-hold open feature, A.D.A oscillating handle, back-check angle stop (screwdriver operated), vacuum breaker.

.3 American Standard Baby Devoro #5001G055.020 Baby Toilet Seat, Heavy Duty, For round bowl, open front, White Finish Solid polypropylene plastic with EverClean surface, Less cover, Top mount hinges, Post nuts and washers.

.4 McGuire #LFH172BV Toilet Supply, Chrome plated finish polished brass, commercial duty 1/4 turn ball valve angle stops, 13 mm (1/2") I.D. Inlet x 127 mm (5") long rigid horizontal integral copper sweat tube nipples, combination V.P. Loose key handles, Escutcheon and flexible copper risers.

.5 Provide Floor Flange, (Same material as the connecting pipe drain), with all brass bolts and with rubber gasket.

.4 L-1 – Wall Hung Lavatory

.1 Basin – 'American Standard Murro' #0954.004EC.020, Vitreous china, Wall-hung, White, three hole, 102mm (4") center, rear overflow, recessed self draining faucet ledge, Everclean anti-microbial surface, 32mm (1-1/4") waste assembly, bowl dimensions; 394mm (15-1/2") wide x 343mm (13-1/2") front to back x 127mm (5") deep, nominal dimensions; 540mm (21-1/4") wide x 520mm (20-1/2") front to back x 165mm (6-1/2") high, with 0059.020EC vitreous china, semi-pedestal P-trap cover, for concealed arm or wall support.

.2 Faucet – 'Moen Commercial' #8215F15, Two Handle Lavatory Faucet, chrome plated finish, 102mm (4") centerset, 12mm (1/2") IPS connections, 1.5 gpm (5.7 L/min) flow rate, vandal resistant aerator. 102mm (4") wrist blade handle with hot and cold colour indicators, vandal resistant torx head screws, brass shell, 1/4 turn operation, ceramic disc cartridge.

.3 Carrier – 'Watts' - #WCA-411, Floor Mounted Lavatory Carrier, adjustable epoxy coated cast iron, concealed arms.

.4 Mixing Valve – #570-86820, Point of Use Thermostatic Water Mixing Valve, nickel plated bronze body, temperature adjusting spindle, 10mm (3/8") inlet and outlet FNPT connections, integral checks, set valve temperature at 35°C (95°F) and 46°C (114.8°F).

.5 Supplies – #LFH165LKN3, chrome plated finish, polished brass, heavy duty angle stops, 10mm (3/8") I.P.S. inlet x 76mm (3") long rigid horizontal nipples, V.P. loose keys, escutcheon and flexible copper risers.

.6 Drain – #155A, Open Grid Drain, cast brass one piece top, 17 GA (1.5mm) tubular 32mm (1-1/4") tailpiece.

.7 P-Trap - #8872C, chrome plated finish, heavy cast brass adjustable body, with slip nut, 32mm (1-1/4") size, with cleanout, shallow wall flange and seamless tubular wall bend.

.5 L-2 – Barrier Free Wall Hung Lavatory

.1 Basin – 'American Standard Murro' #0954.004EC.020, Vitreous china, Wall-hung, White, three hole, 102mm (4") center, rear overflow, recessed self draining faucet ledge, Everclean anti-microbial surface, 32mm (1-1/4") waste assembly, bowl dimensions; 394mm (15-1/2") wide x 343mm (13-1/2") front to back x 127mm (5") deep, nominal dimensions; 540mm (21-1/4") wide x 520mm (20-1/2") front to back x 165mm (6-1/2")

high, with 0059.020EC vitreous china, semi-pedestal P-trap cover, for concealed arm or wall support.

.2 Faucet – 'Moen Commercial' #8215F15, Two Handle Lavatory Faucet, chrome plated finish, 102mm (4") centerset, 12mm (1/2") IPS connections, 1.5 gpm (5.7 L/min) flow rate, vandal resistant aerator. 102mm (4") wrist blade handle with hot and cold colour indicators, vandal resistant torx head screws, brass shell, 1/4 turn operation, ceramic disc cartridge.

.3 Carrier – 'Watts' - #WCA-411, Floor Mounted Lavatory Carrier, adjustable epoxy coated cast iron, concealed arms.

.4 Mixing Valve – #570-86820, Point of Use Thermostatic Water Mixing Valve, nickel plated bronze body, temperature adjusting spindle, 10mm (3/8") inlet and outlet FNPT connections, integral checks, set valve temperature at 35°C (95°F) and 46°C (114.8°F).

.5 Supplies – #LFH165LKNS3, chrome plated finish, polished brass, heavy duty angle stops, 10mm (3/8") I.P.S. inlet x 76mm (3") long rigid horizontal nipples, V.P. loose keys, escutcheon and flexible copper risers.

.6 Drain – #155A, Open Grid Drain, cast brass one piece top, 17 GA (1.5mm) tubular 32mm (1-1/4") tailpiece.

.7 P-Trap - #8872C, chrome plated finish, heavy cast brass adjustable body, with slip nut, 32mm (1-1/4") size, with cleanout, shallow wall flange and seamless tubular wall bend.

.6 L-3 – Children's Trough Sink – Two Wash Places

.1 'Franke Washino' #SANW200, Wall Mounted, Wave-Shape Basin, 2 wash places, faucet deck with 35mm (1-3/8") each wash place, integral back panel for wall mounting, centre waste location, #100 38mm (1-1/2") waste fitting, Outside Dimensions; 17-3/4" x 43-5/16" x 8-1/8", 6-9/16" bowl depth.

.2 Faucet – 'Franke' #HHF23T, Hands Free Electronic Faucet, IR sensor near faucet base, 1.0 gpm (3.8 L/min) flow rate, chrome finish, side mount temperature adjustable handle, plug in with batter backup.

.7 L-4 – Children's Trough Sink – Three Wash Places

.1 'Franke Washino' #SANW200, Wall Mounted, Wave-Shape Basin, 3 wash places, faucet deck with 35mm (1-3/8") each wash place, integral back panel for wall mounting, centre left/right waste location, #100 38mm (1-1/2") waste fitting, Outside Dimensions; 17-7/8" x 63" x 8-1/8", 6-9/16" bowl depth.

.2 Faucet – 'Franke' #HHF23T, Hands Free Electronic Faucet, IR sensor near faucet base, 1.0 gpm (3.8 L/min) flow rate, chrome finish, side mount temperature adjustable handle, plug in with batter backup.

.8 L-5 – Drop in Lavatory

.1 Basin – 'American Standard Studio' #0643.008, rectangular, self-rimming counter, drop in, vitreous china, white, three hole, 203mm (8") center, front overflow, faucet ledge, bowl dimensions; 457mm (18") wide x 305mm (12") front to back x 114mm (4-1/2") deep, nominal dimensions; 539mm (21-1/4") wide x 451mm (17-3/4") front to back x 166mm (6-1/2") high.

.2 Faucet – 'Moen Commercial' #8215F15, Two Handle Lavatory Faucet, chrome plated finish, 102mm (4") centerset, 12mm (1/2") IPS connections, 1.5 gpm (5.7 L/min) flow rate, vandal resistant aerator. 102mm (4") wrist blade handle with hot and cold colour

indicators, vandal resistant torx head screws, brass shell, 1/4 turn operation, ceramic disc cartridge.

.3 Mixing Valve – #570-86820, Point of Use Thermostatic Water Mixing Valve, nickel plated bronze body, temperature adjusting spindle, 10mm (3/8") inlet and outlet FNPT connections, integral checks, set valve temperature at 35°C (95°F) and 46°C (114.8°F).

.4 Supplies – #LFH165LKN3, chrome plated finish, polished brass, heavy duty angle stops, 10mm (3/8") I.P.S. inlet x 76mm (3") long rigid horizontal nipples, V.P. loose keys, escutcheon and flexible copper risers.

.5 Drain – #155A, Open Grid Drain, cast brass one piece top, 17 GA (1.5mm) tubular 32mm (1-1/4") tailpiece.

.6 P-Trap - #8872C, chrome plated finish, heavy cast brass adjustable body, with slip nut, 32mm (1-1/4") size, with cleanout, shallow wall flange and seamless tubular wall bend.

.9 S-1 – Single Compartment Sink

.1 Basin – 'Franke Kindred' LBS6808P-1/3, Single Compartment, Self-rimming, Topmount Sink with faucet ledge, single bowl, 3 faucet hole, 102mm (4") centres, 203mm (8") centerset, 304 stainless steel, 18 (1.2mm)) gauge, #4 Satin finish, fully undercoated, factory applied rim seal, factory installed EZ TORQUE fasteners, 89mm (3-1/2") vandal resistant grid, 38mm (1-1/2") (DN38) stainless steel tailpiece, centre back waste location, 89mm(3-1/2") stainless steel crumb cup strainer, Bowl Dimensions; 406mm (16") front to back x 457mm (18") wide x 203mm (8") deep, Overall Dimensions;522mm (20-9/16") x 508mm (20").

.2 Faucet – 'Moen Commercial' #8289, Two Handle Kitchen Faucet, chrome plated finish, 203mm (8") centers, 12mm (1/2") IPS connections, vandal resistant torx head screws, 1.5 gpm (5.7 L/min) flow rate @ 60 psi, 203mm (8") gooseneck spout, 102mm (4") wrist blade handle with hot and cold colour indicators, 1/4 turn operation, ceramic disc cartridge with free spinning handle hubs.

.3 Mixing Valve – #570-86820, Point of Use Thermostatic Water Mixing Valve, nickel plated bronze body, temperature adjusting spindle, 10mm (3/8") inlet and outlet FNPT connections, integral checks, set valve temperature at 35°C (95°F) and 46°C (114.8°F).

.4 Supplies – #LFH2165LKN3, chrome plated finish, polished brass, heavy duty angle stops, 13mm (1/1") I.P.S. inlet x 76mm (3") long rigid horizontal nipples, V.P. loose keys, escutcheon and flexible copper risers, low lead.

.5 P-Trap - #8912CB, chrome plated finish, heavy cast brass adjustable body, with slip nut, 38mm (1-1/2") size, with cleanout, box flange and seamless tubular wall bend.

.10 S-2 – Double Compartment Sink

.1 Basin – 'Franke Kindred' LBD6408P-1/3, Double Compartment, Self-rimming, Topmount Sink with faucet ledge, double bowl, 3 faucet hole, 102mm (4") centres, 203mm (8") centerset, 304 stainless steel, 18 (1.2mm)) gauge, #4 Satin finish, fully undercoated, factory applied rim seal, factory installed EZ TORQUE fasteners, 89mm (3-1/2") vandal resistant grid, 38mm (1-1/2") (DN38) stainless steel tailpiece, centre back waste location, 89mm(3-1/2") stainless steel crumb cup strainer, Bowl Dimensions; 406mm (16") front to back x 356mm (14") wide x 203mm (8") deep, Overall Dimensions; 521mm (20-1/2") x 794mm (31-1/4").

.2 Faucet – 'Moen Commercial' #8282, Two Handle Kitchen Faucet, chrome plated finish, 203mm (8") centers, 12mm (1/2") IPS connections, vandal resistant torx head screws, 2.2

gpm (8.3 L/min) flow rate @ 60 psi, 228mm (9") arc spout, 102mm (4") wrist blade handle with hot and cold colour indicators, 1/4 turn operation, ceramic disc cartridge with free spinning handle hubs.

.3 Mixing Valve – #570-86820, Point of Use Thermostatic Water Mixing Valve, nickel plated bronze body, temperature adjusting spindle, 10mm (3/8") inlet and outlet FNPT connections, integral checks, set valve temperature at 35°C (95°F) and 46°C (114.8°F).

.4 Supplies – #LFH165LKN3, chrome plated finish, polished brass, heavy duty angle stops, 10mm (3/8") I.P.S. inlet x 76mm (3") long rigid horizontal nipples, V.P. loose keys, escutcheon and flexible copper risers.

.5 P-Trap - #8912CB, chrome plated finish, heavy cast brass adjustable body, with slip nut, 38mm (1-1/2") size, with cleanout, box flange and seamless tubular wall bend.

.11 S-3 – Low Mounted Barrier Free Single Compartment Sink

.1 Basin – 'Franke Kindred' S4206-1 - Single compartment self rimming top mount sink less faucet ledge. 20 gauge (0.9 mm), type 302 (CNS 18/8) stainless steel. Exposed surfaces are #4 satin finished. Undercoated to reduce condensation and resonance. Includes waste fitting, factory applied rim seal, cutout template, and factory installed EZ TORQUE™ fasteners. Certified to ASME A112.19.3-2008 / CSAB45.4-08.Wheelchair accessible: meets ADA (Americans with disabilities act guidelines) and ANSI A117.1 (Accessible and usable buildings and facilities). Check local codes to ensure compliance. Centre back waste location. Includes 3 1/2" (89 mm) crumb cup strainer with 1 1/2" (DN38) brass tailpiece.16 1/8 x 14 1/8" Overall. 14 x 12 x 6" Bowl. (FB x LR x D). 410 x 359 mm Overall. 356 x 305 x 152 mm Bowl. (FB x LR x D).

.2 Faucet – 'Moen Commercial' #8282, Two Handle Kitchen Faucet, chrome plated finish, 203mm (8") centers, 12mm (1/2") IPS connections, vandal resistant torx head screws, 2.2 gpm (8.3 L/min) flow rate @ 60 psi, 228mm (9") arc spout, 102mm (4") wrist blade handle with hot and cold colour indicators, 1/4 turn operation, ceramic disc cartridge with free spinning handle hubs. Meets ADA requirements.

.3 Mixing Valve – #570-86820, Point of Use Thermostatic Water Mixing Valve, nickel plated bronze body, temperature adjusting spindle, 10mm (3/8") inlet and outlet FNPT connections, integral checks, set valve temperature at 35°C (95°F) and 46°C (114.8°F).

.4 Supplies – #LFH165LKN3, chrome plated finish, polished brass, heavy duty angle stops, 10mm (3/8") I.P.S. inlet x 76mm (3") long rigid horizontal nipples, V.P. loose keys, escutcheon and flexible copper risers.

.5 P-Trap - #8912CB, chrome plated finish, heavy cast brass adjustable body, with slip nut, 38mm (1-1/2") size, with cleanout, box flange and seamless tubular wall bend.

.6 P-Trap Insulation Kit – McQuire "PW2150" – Pro Wrap 1-1/2" P-Trap Insulation Kit.

.12 MS-1 – Floor Mounted Mop Sink

.1 Sink – 'Stern-Williams' #SB-900, Terrazzo floor mounted square mop sink, one piece 20 ga. 302 stainless steel cast integral on all four sides without tiling flange, cast brass drain with stainless steel strainer cast integral, caulked connection to a 3" pipe. Shoulders shall not be less than 9-3/4" high inside measurement, and not less than 1-1/4" wide. Nominal Dimensions: 610mm (24") wide x (610mm (24") long x 305mm (12") high.

.2 Faucet – 'Moen Commercial M-Dura' #8230, Wall Mounted Two Handle Service Sink Faucet, rough chrome plated, 12mm (1/2") IPS eccentric connections, 20mm (3/4") garden hose threaded spout, integral vacuum breaker, vandal resistant torx head screws,

colour indexed metal cross handles, 1/4 turn operation, brass shell ceramic disc cartridge, 20 GA (0.9mm) type 304 stainless steel back splash panel, with #8199 hose bracket and 914mm (36") garden hose, #8198 three station mop hanger.

.3 Trap – 75mm (3") diameter "P" trap, material to match connecting pipe drain.

.13 EW-1 – Emergency Eyewash – Barrier Free

.1 'Acorn Safety' # S0430-BF, Barrier Free, Wall Mounted, Eyewash Station. 298mm (11-3/4") dia. stainless steel bowl, two (2) ABS yellow plastic eyewash heads with flip dust covers, internal flow controls and filters, anti-microbial, 11 gag galvanized steel wall bracket with yellow powder coated finish, 12mm (1/2") NPT chrome pated brass stay open ball valve with stainless steel push handle, 50 mesh inline strainer, 12mm (1/2") NPT female threaded, chrome plated brass inlet, 32mm (1-1/4") chrome plated brass OD tailpiece.

.2 Mixing Valve – 'Lawler' #911E, Emergency Thermostatic Mixing Valve, lead-free brass and stainless steel design, vandal resistant temperature adjustment, stainless steel sliding piston control device, variable bypass, 13mm (1/2") inlet and outlet NPT connections, integral checks, factory set temperature at 29°C (84.2°F), 861.26kPa max. operating pressure, 6.9 gpm (26L/min) flow capacity @ 30 psi (207 kPa) pressure drop across the valve, 2.0 gpm (7.57 L/min) in flow rate, 4.8 gpm (18 L/min) bypass flowrate @ 30 psi.

2.03 Manufacturers

.1 Subject to compliance with requirements, manufacturers that may be incorporated into the Work include, but are not limited to, following:

.1 Mop Sinks:

.1 Stern Williams;

.2 Acorn Engineering;

.3 Zurn Industries.

.2 Emergency Eye Wash and Emergency Showers:

.1 Haws;

.2 Speakman;

.3 Bradley.

.3 Drain Fittings, Angle Supplies, and Traps:

.1 McGuire;

.2 American Standard;

.3 Delta Commercial;

.4 Zurn Industries.

.4 Fixture Carriers:

.1 Watts Industries;

.2 Jay R. Smith;

.3 Zurn Industries.

.5 Hose Bibbs:

.1 Jay R. Smith;

.2 Zurn Industries.

.6 Thermostatic Mixing Valves:

.1 Lawler;

.2 Delta Commercial;

.3 Leonard.

2.04 Caulking

.1 General Electric Series SCS-1200 Silicone Construction Sealant or Dow Corning 780 silicone rubber sealant with primers as recommended by sealant manufacturer. Caulking colour(s) for coloured fixtures other than white, if any, will be selected by the Consultant from sealant manufacturer's standard colour range.

3 Execution

3.01 Demolition

.1 Refer to demolition requirements specified in Section 20 05 05 – Selective Demolition for Mechanical.

3.02 Installation of Plumbing Fixtures and Fittings

.1 Provide required plumbing fixtures and fittings.

.2 Where new fixtures and fittings are to be connected to existing piping, include for required piping revisions.

.3 Connect plumbing fixtures and fittings with piping sized in accordance with drawing schedule. Refer to manufacturer's published connection (rough-in) requirements. Where manufacturer requires piping connection larger than shown below, provide piping accordingly:

Fixture and/or Fitting	Drain Size mm (IN)	Vent Size mm (in)	DHW Size mm (in)	DCW Size mm (in)	Temp Water Size mm (in)
Water Closets Flush Valve Type	100 (4)	38 (1-½)	----------	25 (1)	----------
Urinals	75 (3)	38 (1-½)	----------	25 (1)	----------
Lavatories	32 (1-¼)	32 (1-¼)	12 (½)	12 (½)	----------
Lavatories (Electronic Faucet)	32 (1-¼)	32 (1-¼)	12 (½)	12 (½)	12 (½)
Counter Sinks	38 (1-½)	32 (1-¼)	12 (½)	12 (½)	----------

Fixture and/or Fitting	Drain Size mm (IN)	Vent Size mm (in)	DHW Size mm (in)	DCW Size mm (in)	Temp Water Size mm (in)
Shower Valves and Heads	----------	----------	12 (½)	12 (½)	12 (½)
Shower Stalls	50 (2)	38 (1-½)	12 (½)	12 (½)	12 (½)
Prefab. Mop Sinks with Drain	75 (3)	38 (1-½)	20 (¾)	20 (¾)	----------
Emergency Eye Wash	----------	----------	----------	----------	12 (½)
Emergency Shower	----------	----------	----------	----------	25 (1)

.4 Confirm exact location of plumbing fixtures and trim prior to roughing-in. Refer to architectural plan and elevation drawings.

.5 When installation is complete, check, and test operation of each fixture and fitting. Adjust or repair as required.

.6 For barrier-free fixtures, comply with mounting height and other requirements of governing Code(s).

.7 For barrier-free water closets utilizing manual flush controls, controls to be installed so that it is operable from the transfer side of the fixture.

.8 Supply templates for counter mounted fixtures and trim and hand to trades who will cut the counter. Ensure openings in counter are properly located.

.9 Locate control panels for electronic faucets under lavatories and recessed into wall. Coordinate panel installations with electrical trade who will provide 115 volt power wiring to panels. Install flexible conduit (supplied with box) and extend cord from faucet through the flexible conduit to control box. Connect hot and cold water piping to mixing valve in each box, and tempered water piping from each mixing valve to faucet. Set mixing valve maximum temperature limit stops to 43°C (110°F) after domestic water systems (hot and cold) are complete. Ensure each programmable controller is properly programmed and water off after deactivation is set for 3 seconds.

.10 For electronic flush valves, locate transformer in ceiling space above electronic units to be served. Coordinate locations with electrical trade who will provide 120 volt line supply to transformers. Provide low voltage wiring from transformers to each electronic flush valve terminal point. Electrical line supply and low voltage wiring is to be concealed and access to transformer must be provided for servicing.

.11 Protect baths from damage during construction and finishing work. Unless otherwise specified, pack concealed voids under baths with batt type glass fibre insulation as baths are installed.

.12 Protect shower bases from damage during construction and finishing work.

.13 Confirm exact mixing valve and shower head locations prior to roughing-in.

.14 Install refrigerated drinking fountains in accordance with manufacturer's instructions. Plug into a wall receptacle provided as part of electrical work. Coordinate receptacle installation with electrical trade on site.

.15 For emergency showers, install so bottom of shower head is approximately 2 m (82") above floor, and approximately 400 mm (16") out from the wall. Wall mount mixing valve approximately 1.5 m (5') above floor and adjacent shower head. Set valve temperature limit stop to 35°C (95°F). Ensure valve is open and exposed piping is chrome plated or stainless steel.

.16 Install eye wash fixtures in accordance with manufacturer's instructions. Ensure exposed piping is painted.

.17 Wall mount mixing valves for emergency fixtures approximately 1.5 m (5') above floor and secure in place. Check and confirm valve operation and temperature of tempered water supply. Provide cabinets. Identify each cabinet and hand 3 identified cabinet keys to Consultant prior to Substantial Performance of the Work.

.18 Set mop service basins on floor over drain piping and connect to roughed-in service. Install wall supply trim and any accessories specified.

3.03 Caulking at Plumbing Fixtures and Fittings

.1 Caulk around plumbing fixtures and fittings where they contact walls, floors, and any other building surface.

.2 Clean areas/surfaces to be caulked and prime in accordance with sealant manufacturer's instructions. Where damage to a building surface may occur, mask surface to prevent damage and ensure a clean exact edge to the caulking bead.

.3 Apply caulking using a gun with proper size and shape of nozzle and force sealant into joints to ensure good surface contact and a smooth and even finished bead of sealant.

.4 If joints have been masked sealant may be tooled in a continuous stroke to obtain complete void filling. Remove masking tape immediately after tooling and before sealant begins to skin.

3.04 Dishwasher Connections

.1 Provide roughed-in water and drain connections for Owner supplied dishwasher consisting of:

.1 15 mm (½") dia. domestic hot water connection with a Dahl "Mini-Ball" valve with hose end and water hammer arrestor;

.2 40 mm (1-½") dia. DWV copper drain connection with "P" trap and cleanout plug.

3.05 Clothes Washer Connections

.1 Provide roughed-in water and drain connections for Owner supplied clothes washer consisting of:

.1 15 mm (½") dia. piping connection for both hot and cold water, each terminated in a Dahl "Mini-Ball" Valve with hose end and water hammer arrestor;

.2 50 mm (2") dia. standing waste with a height to suit the washer drain and complete with a "P" trap.

End of Section

1 General

1.01 Submittals

.1 Submit shop drawings/product data for all products specified in Part 2 of this section except for pipe, fittings, and unions. Indicate performance criteria, conformance to appropriate reference standards, and limitations.

.2 For each gas pressure regulating station, submit:

.1 a selection sheet for each PRV, indicating connected equipment, heating loads, design allowance, meter model, body size, spring range and orifice size;

.2 a selection sheet for each relief valve(s) serving a PRV.

1.02 References

.1 CSA B149.1:20, Natural Gas and Propane Installation Code.

.2 TSSA FS-255-21, Gaseous Fuels Code Adoption Document Amendment: Ontario requirements effective May 1, 2021.

1.03 Quality Assurance

.1 All gas system work is to be in accordance with requirements of CSA B149.1, Natural Gas and Propane Installation Code, as amended by local Gas Codes.

.2 All gas system work is to be performed only by licensed gas pipe fitters (holding Gas Technician 1 Certificate) authorized under the TSSA Act.

.3 Apply for, on TSSA forms, approval of the gas system design by the TSSA prior to work beginning at the site and prior to ordering any equipment. Submit the completed TSSA Form and copies of shop drawings/product data sheets as required to the TSSA and obtain an approval certificate. Pay all costs for the TSSA review and approval process. If the TSSA requires revisions to the system and the revisions result in an extra cost, a Notice of Change will be issued by the Consultant for the revision.

2 Products

2.01 Pipe, Fittings, and Joints

.1 Coated Black Steel - Welded Joints: "Yellow Jacket" Schedule 40 mild black carbon steel, ASTM A53, Grade B, factory coated with yellow plastic, mill or site bevelled, and complete with forged steel butt welding fittings and welded joints. All bare metal surfaces are to be cleaned and corrosion protected with a suitable Denso primer and tape corrosion protection system.

.2 Polyethylene: Safety yellow coloured polyethylene pipe, fittings, and joints to CSA-B137.4.

.3 Coated Copper: Type "K" soft temper copper with a factory applied external yellow plastic coating and flare fittings with forged brass nuts to CAN/CSA-B149.1. Nuts are to be stamped with the designation C37700 to indicate that they are forged brass.

.4 Uncoated Black Steel - Screwed Joints: Schedule 40 mild black carbon steel, ASTM A53, Grade B, complete with malleable cast iron screwed fittings to ANSI B2.1, and screwed joints.

.5 Uncoated Black Steel - Welded Joints: Schedule 40 mild black carbon steel, ASTM A53, Grade B, mill or site bevelled, complete with factory made forged steel butt welding fittings and welded joints.

.6 Copper-Uncoated: Type "G" seamless copper tubing to ASTM B837, hard temper with wrought copper capillary brazed joint type fittings to ASTM B.61, and brazed joints made with "Sil-Fos" or "Sil-Fos 5" brazing alloy, or, soft temper with flared brass fittings of a single 45º flare type, forged or with a machined long nut and copper to copper threaded connectors, and, where required, flared brass copper to NPS adapters.

.7 Flexible Stainless Steel: Flexible, CSA certified, 860 kPa (125 psi) rated, gas-tight, convoluted stainless steel tubing factory jacketed with a bright yellow PVC coating which is continuously identified. The tubing is to be supplied in coils and is to be complete with factory attached stainless steel end fittings, and adapter unions, protective plates, and steel clamps.

.1 Manufacturers:

.1 Tru-Flex Metal Hose LLC. "Pro-Flex";

.2 Titeflex Corp. "Gastite";

.3 Omega Flex Canada "TracPipe".

2.02 Piping Unions

.1 Screwed Piping: Malleable iron, ground joint, bronze or brass to iron or bronze to bronze seat screwed unions and union elbows with a minimum pressure rating of 1725 kPa (250 psi) steam at 260°C (500°F).

.2 Flanged Piping: Forged carbon steel slip-on type raised faced welding flange unions to ASTM A105, 150 lb. Class for steel pipe, and slip-on type 150 lb. Class bronze flanges for copper pipe.

.3 Copper to Steel: Equal to Kamco Products "Copper Stopper".

2.03 Shut-Off Valves

.1 Ball Type: CSA certified, minimum 3100 kPa (450 psi) WOG rated, 1/4 turn, full port non-lubricated brass ball valves, each complete with a Teflon PTFE seat, chrome plated solid ball, removable lever handle, and screwed ends.

.1 Manufacturers:

.1 Neo Valves Inc. #425;

.2 Kitz Corp. Code 58;

.3 Toyo Valve Co. Fig. 5044A.

.2 Plug or Ball Type: CSA certified, plain face flanged, Class 125, 1380 kPa (200 psi) rated, 1/4 turn, cast iron lubricated plug valves, each wrench operated and complete with cylindrical plug with lubricant grooves, lubricant screw, and lubricant receptacle, or full port carbon steel ball valves with flanged ends.

.1 Manufacturers:

.1 Neo Valves Inc. #1AS40114 plug valve;

.2 Newman Hattersley #171M plug valve;

.3 Kitz Corp. Code No. 150 SCTAM-FS-CGA ball valve.

2.04 Pressure Regulators

.1 CSA certified pressure regulators as follows:

.1 vented type: spring-loaded self-operated design, tight closing, selected for the facility gas pressure and piping pressure loss, and connected equipment load at full firing rate plus 20% spare, and complete with:

.1 1035 kPa (150 psi) rated cast iron body finished with corrosive resistant epoxy enamel;

.2 aluminum diaphragm and spring case with Nitrile diaphragm, disc, and body o-ring;

.3 throttling type, high flow rate, tight shut-off relief valve selected to protect equipment downstream of the regulator in coordination with regulator capacity.

.2 Manufacturers:

.1 Maxitrol Co.;

.2 Fisher Controls;

.3 Leslie Controls Inc.;

.4 Lakeside Process Controls.

2.05 Natural Gas Piping Roof Supports

.1 Bases and blocks are to be UV resistant.

.2 Clamps for gas piping to be one (1) size larger than pipe to allow for expansion.

.3 Clamps and screws to be galvanized.

.4 Piping supports to be provided with two (2) year warranty.

.5 Acceptable products are as follows:

.1 Pipe Ease – Quick Block – Polypropylene support block with rigid foam base;

.2 Mifab – CX/C Series – UV Resistant Recycled Rubber support with base;

.3 Nelson/Olsen – Quick Pipe Block – HDPE support with rigid foam base;

.4 Erico – Caddy Pyramid Series – Thermoplastic support with base.

3 Execution

3.01 Demolition

.1 Do all required gas system demolition work. Refer to demolition requirements specified in Section 20 05 05 – Selective Demolition for Mechanical.

3.02 Natural Gas Service

.1 Make all required arrangement with the natural gas supply utility on behalf of the Owner for installation of natural gas service piping with gas pressure regulator and meter assembly.

.2 Provide an earthquake activated automatic shut-off valve in gas service piping outside the building in accordance with the valve manufacturer's installation instructions. Provide an angle iron framed wire mesh enclosure around the valve and bolted to the wall.

.3 Provide 2 m (7') high minimum 200 mm (8") diameter Schedule 80 galvanized steel concrete filled bollards at the meter-regulator location in a pattern to protect the meter-regulator. Install the pipe straight and plumb a 1.2 m (4') below grade in a continuous 600 mm (2') diameter reinforced concrete footing. Smoothly crown the top of the concrete above the top of the pipe.

3.03 Natural Gas Piping Installation Requirements

.1 Provide all required natural gas distribution piping and connect gas fired or operated equipment, and provide all required vent piping to atmosphere, including vent piping from pressure regulators. Do all piping work in accordance with requirements of CAN/CSA-B149.1, Natural Gas and Propane Installation Code, as amended by local Gas Codes.

.2 Piping is to be as follows:

.1 for underground piping, coated Schedule 40 black steel, coated soft copper, or polyethylene;

.2 for above ground piping, uncoated Schedule 40 black steel, hard temper or soft copper, or, if permitted, flexible stainless steel.

.3 Install flexible stainless steel pipe in strict accordance with the pipe manufacturer's printed instructions.

.4 Slope gas piping in the direction of flow to low points.

.5 Ensure that supports for roof mounted piping are sized (height) to accommodate the roof slope and the required piping slope, and to permit the installation of low point dirt pockets.

.6 Provide full pipe diameter 150 mm (6") long drip pockets at the bottom of all vertical risers, at all piping low points, and wherever else shown and/or required.

.7 Identify all natural gas piping above ground with two coats of safety yellow enamel applied over primer and coil type vinyl identification makers with arrows. SMS Ltd. or equal can be used for identification markers.

.8 For all underground gas piping, provide continuous 75 mm (3") wide yellow PVC warning tape with "CAUTION - GAS LINE BURIED BELOW" wording at 750 mm (30") intervals located above the pipe approximately 250 mm (10") below grade.

.9 Rough-in all required natural gas piping for kitchen and laundry equipment in accordance with drawing plans and schedules. Obtain accurately dimensioned rough-in drawings for the equipment and confirm exact locations prior to roughing-in. When the equipment has been installed, connect the equipment from the roughed-in Work. Provide shut-off valves in all piping connections to the equipment.

.10 Include for mounting only of a solenoid valve in the gas piping to kitchen cooking equipment.

3.04 Installation of Shut-Off Valves

.1 Provide CSA approved ball type or lubricated plug type shut-off valves to isolate equipment, and wherever else shown.

.2 Ensure that valves are located for easy accessibility and maintenance.

3.05 Installation of Natural Gas Convenience Outlets

.1 Provide natural gas convenience outlets and wall mount.

.2 Provide a shut-off valve in connecting piping, confirm exact location prior to roughing-in, and ensure that the outlet is rigidly secured in place.

3.06 Installation of Pressure Regulators

.1 Provide pressure regulators in gas distribution piping where indicated and/or required.

.2 For indoor appliances, use lever acting design vent limiter type, sized as shown and mounted in a horizontal upright position in strict accordance with the manufacturer's instructions. Note that these pressure regulators do not require vent piping.

.3 Use vented type pressure regulators for all other applications.

.4 Install regulating stations in accordance with requirements of CAN/CSA-B149.1.

.5 Provide 6 mm (¼") diameter test ports upstream and downstream of each regulator assembly.

.6 Locate outdoor regulating stations a minimum of 300 mm (12") away from walkways, and 3 m (10') away from equipment air intakes and building openings. Provide all required vent piping and terminate vents in a turn-down elbow fitting with bronze bug screen secured in place.

.7 Locate indoor regulating stations in locations accessible without the use of ladders or lifts. Combine vents where permitted and increase vent pipe size accordingly. Extend vent piping up through the roof 3 m (10') away from equipment air intakes and building openings and terminated in a turn-down elbow fitting with bronze bug screen secured in place.

.8 Indicate operating set-points, relief settings and vent arrangements for each regulating station on as-built record drawings.

End of Section

1 General

1.01 Submittals

.1 Submit shop drawings/product data sheets for all products specified in this section except piping and unions.

.2 Submit motor product data sheets and certified performance curves with all pump shop drawings.

1.02 Closeout Submittals

.1 Submit with delivery of each unit a copy of factory inspection and test report, and include a copy of each report with O&M Manual project closeout data.

.2 Submit a site inspection and start-up report from manufacturer's representative as specified in Part 3 of this section.

.3 Prior to Substantial Performance of the Work, submit a spare seal flush line filter for each pump equipped with a seal flush line.

.4 Shop drawings for piping anchors must be prepared and stamped by a professional Structural Engineer registered in the jurisdiction of the work. Refer to requirements for Contractor retained engineers specified in Section 20 05 10 - Mechanical Work General Instructions.

.5 Submit a letter from pipe anchor design engineer to stating engineer has visited site to examine installation of pipe anchors and pipe anchor installation is in accordance with reviewed anchor shop drawing.

1.03 Quality Assurance

.1 Pump motors are to comply with requirements of Section 20 05 00 – Common Work Results for Mechanical.

2 Products

2.01 Pipe, Fittings, and Joints

.1 Black Steel - Screwed Joint

.1 Mild black carbon steel, Grade B, ASTM A53, complete with Class 125 cast iron threaded fittings to ANSI/ASME B16.4, and screwed joints.

.2 Black Steel - Welded Joint

.1 Mild black carbon steel, Grade B, ASTM A53, mill or site bevelled, complete with factory made seamless carbon steel butt welding fittings to ASTM A234, Grade WPB, with long sweep pattern elbows unless otherwise specified, and welded joints.

.3 Black Steel – Plain End Mechanical Joint

.1 Mild black carbon steel, Grade B, ASTM A53, mill or site bevelled, complete with cast ductile iron end fittings conforming to ASTM A536.

.2 Manufacturers:

.1 Equal to Victaulic QuickVic SD rigid couplings for sizes 1/2" to 2", rated for a working pressure of 300 psi.

.4 Black Steel – Pressure Coupled Joints

.1 Mild black carbon steel conforming to ASTM F3226, IAPMO PS117, ICC LC1002, ASME B31.1, B31.3, or B31.9. MegaPress fittings ½-inch thru 4-inch for use with schedule 40 ASTM A53 carbon steel pipe.

.2 Pressure connect fittings shall carry CRN numbers.

.3 Pressure connect fitting shall have Viega Smart Connect technology to detect unpressed fittings shall be integrated into the body of the fitting.

.4 1/2 inch thru 2 inch fittings shall have stainless-steel grip ring with bidirectional teeth, 304 stainless separator ring, EPDM or FKM sealing element at each press connection. 2-1/2 inch thru 4 inch shall have stainless-steel grip ring with bidirectional teeth, PBT separator ring, and FKM sealing element at each press connection

.5 There shall be no mixing of manufacturers.

.6 The manufacturer's installation instructions shall be strictly adhered to.

.7 Special attention shall be given to the required two step pressure test.

.8 Initial test for unpressed fitting detection per manufacturer's installation manual.

.9 Full pressure test in accordance with code requirements.

.10 Installers shall be field trained by Viega factory representative.

.5 Soft Copper Pipe

.1 Type "L" seamless soft copper to ASTM B77.

.6 Hard Copper - Solder Joint

.1 Type "L" hard drawn seamless copper to ASTM B88, complete with wrought copper fittings to ANSI B16.22, and 95% tin / 5% Antimony solder joints.

.7 Hard Copper - Pressure Coupled Joint

.1 Type "L" hard drawn seamless copper to ASTM B88, complete with Viega "ProPress with Smart Connect feature" system copper fittings with EDPM seals, and pressure type crimped joints made by use of manufacturer recommended tool.

2.02 Piping Unions

.1 Screwed Piping

.1 Malleable iron, ground joint, bronze or brass to iron or bronze to bronze seat screwed unions and union elbows with a minimum pressure rating of 1725 kPa (250 psi) steam at 260°C (500°F).

.2 Flanged Piping

.1 Forged carbon steel slip-on type raised faced welding flange unions to ASTM A105, 150 lb. Class for steel pipe, and slip-on type 150 lb. Class bronze flanges for copper pipe.

2.03 Shut-Off Valves

.1 Ball Type

.1 Class 600, 4140 kPa (600 psi) WOG rated full port ball valves, each complete with a forged brass or bronze body and cap, blowout-proof stem, solid forged brass chrome plated ball, "Teflon" or "PTFE" seat, threaded ends, and removable lever handle.

.2 Manufacturers:

.1 Toyo Valve Co. Fig. 5044A;

.2 Watts Industries (Canada) Inc. #FBV-3;

.3 Kitz Corp. Code 58;

.4 Victaulic Co. of Canada Ltd. Series 722;

.5 Apollo Valve #77-100.

.2 Butterfly Type

.1 Cast ductile iron, lug body style, 1200 kPa (175 psi) rated butterfly valve, each complete with a neck to permit 50 mm (2") of insulation above the flange, a field replaceable EPDM seat, ductile iron disc, stainless steel shaft with EPDM seal, a lever handle for valves to and including 150 mm (6") diameter, a handwheel and gear type operator for valves larger than 150 mm (6") diameter, and each suitable for bubble-tight dead end service with valve closed and either side of connecting piping removed.

.2 Manufacturers:

.1 DeZurik of Canada Ltd., Figure No. 632;

.2 Victaulic Co. of Canada Ltd. Vic-300 MasterSeal or AGS Vic-300;

.3 Apollo Valve 143 Series;

.4 Watts Industries (Canada) Inc. #BF-03;

.5 Kitz Corp. 6112 Series;

.6 Toyo Valve Co. 918DESL/G2.

2.04 Swing Check Valves

.1 Bronze - Screwed

.1 Class 125, 1380 kPa (200 psi) WOG rated horizontal swing check valves, each complete with a "Y" pattern bronze body, hinged brass disc, easy access screw-in cap, and screwed ends.

.2 Manufacturers:

.1 Toyo Valve Co. Fig. 236;

.2 Nibco #T-433;

.3 Kitz Corp. Code No. 22.

.2 Cast Iron - Screwed and Flanged

.1 Cast iron, bronze trim, 1380 kPa (200 psi) rated swing check valves, each complete with a bronze disc and seat, malleable iron hinge, bolted cover, and screwed or flanged ends as required.

.2 Manufacturers:

.1 Toyo Valve Co. Fig. 435A;

.2 Watts Industries (Canada) Inc. #F-511;

.3 Kitz Corp. Code No. 78.

2.05 Vertical Lift Check Valves

.1 Class 150, 1380 kPa (200 psi) WOG rated bronze vertical lift check valves, each complete with screwed ends and a bronze disc.

.2 Manufacturers:

.1 Toyo Valve Co. Fig. 231;

.2 Watts Industries (Canada) Inc. #600;

.3 Kitz Corp. Code No. 36.

2.06 Wafer Check Valves

.1 Threaded lug body type, full bore, ANSI Series 150, 1965 kPa (285 psi) rated at 38°C (100°F), non-slam wafer check valves, each complete with a carbon steel body, stainless steel discs, a shaft, springs, disc stop and thrust bearings constructed of type 316 stainless steel, and seat materials to suit the application. The inside diameter of the valve must equal the inside diameter of the connecting pipe.

.2 Manufacturers:

.1 Gulf Valve Co. "WAFER CHECK";

.2 Watts Industries (Canada) Inc. Series ICV-125;

.3 The Metraflex Co. Style CVXX.

2.07 Drain Valves

.1 Minimum 2070 kPa (300 psi) WOG rated, 20 mm (¾") diameter straight pattern bronze ball valves, each complete with a threaded outlet suitable for coupling connection of 20 mm (¾") diameter hose, and a cap and chain.

.2 Manufacturers:

.1 Toyo Valve Co. Ltd. Fig. 5046;

.2 Watts Industries (Canada) Inc. #B-6000-CC;

.3 Kitz Corp. Code No. 68AC;

.4 Apollo Valves #78-104-01.

2.08 Circuit Balancing Valves

.1 Screwed or flanged as required, globe style, non-ferrous circuit balancing valves designed to facilitate precise flow measurement, precision flow balancing, and positive shut-off, complete with capped and valved drain connection, and valved ports for connection to a differential pressure meter.

.2 Manufacturers:

.1 Equal to Victaulic Co. of Canada Ltd. (Tour & Anderson) Series 787 screwed, Series 788 flanged, , and Series 78K "Koil Kit" valves.

2.09 Radiator Shut-Off and Balancing Valves

.1 Heavy pattern, straight, 1750 kPa (250 psi) rated at 120°C (250°F) bronze radiator valves, each complete with composition disc, spring loaded packing, and union. Equip inlet valves with a handle for shut-off. Equip outlet valves with a lockshield for shut-off and balancing.

.2 Manufacturers:

.1 Dahl Brothers Canada Ltd. #11042 and #13013;

.2 Spirax Sarco Ltd. Type R.

2.10 Pressure Relief Valves

.1 ASME tested, rated, and certified, bronze or cast iron bronze fitted, 1725 kPa (250 psi) rated pressure relief valves, each capable of relieving full output of equipment it is associated with, and each factory set at 415 kPa (60 psi) unless otherwise specified.

.2 Manufacturers:

.1 ITT Bell & Gossett 3301/4100, or 790/1170;

.2 Dresser Industries "CONSOLIDATED";

.3 Spirax Sarco Ltd. SVI Series;

.4 McDonnell & Miller Models 250 and 260;

.5 Conbraco 10-600 Series;

.6 Watts Industries (Canada) Inc. 174A or 740.

2.11 Air Vents

.1 Manual Air Vents

.1 Equal to Conbraco 27 Series, 3.2 mm (⅛") diameter with a key handle.

.2 Automatic Air Vents

.1 Float actuated air vents, each complete with a semi-steel body and cap, a stainless steel float assembly and seat, and a neoprene head.

.2 Manufacturers:

.1 Spirax Sarco Ltd., Type 13 W for system working pressures to 1035 kPa (150 psi), 13 WH for system working pressures greater than 1035 kPa (150 psi);

.2 Armstrong International Inc. No. 1-AV.

2.12 Strainers

.1 Cast iron wye shaped strainers, minimum 890 kPa (125 psi) rated and complete with a removable type 304 stainless steel screen with perforations sized to suit the application, and, for strainers 50 mm (2") diameter and larger, a blowdown pipe connection tapping.

.2 Manufacturers:

.1 Spirax Sarco Ltd. Type IF-125 screwed or Type AF-250 flanged;

.2 Toyo Valve Co. Ltd. Fig. 380A screwed or Fig. 381 flanged;

.3 Victaulic Co. of Canada Style 732 or W732 "Vic-Strainer";

.4 Armstrong International Inc. A1 Series;

.5 Watts Industries (Canada) Inc. #77SCI;

.6 Mueller Steam Specialty Products Model 11M screwed or Model 758 flanged.

2.13 Piping Expansion Joints

.1 Steel Piping Mains:

.1 Controlled flexing, flanged expansion joints, 2070 kPa (300 psi) rated, with corrugated stainless steel bellows with closely matched neck rings and reinforcing or control rings, and selected for operating pressure plus 25% safety factor.

.2 Manufacturers:

.1 Senior Flexonics Ltd. Series CSF "High-Corr";

.2 Victaulic Co. of Canada Ltd. Style 155 with Style 07 or 107 "Zero-Flex" couplings on each side of assembly and a full length steel "V" shaped support trough with hangers;

.3 The Metraflex Co. Model MC.

.2 Steel or Copper Branch/Runout Piping:

.1 Externally pressurized, 1380 kPa (200 psi) rated expansion joints with a stainless steel bellows and shroud, welding or threaded steel nipple ends for steel piping, and copper sweat nipple ends for copper piping.

.2 Manufacturers:

.1 Senior Flexonics Ltd. Series "H";

.2 The Metraflex Co. Model "HP".

2.14 Piping Alignment Guides

.1 Prime coat painted black carbon steel pipe alignment guides sized and fabricated to suit pipe size and pipe insulation thickness.

.2 Manufacturers:

.1 Senior Flexonics Ltd. Series PGT;

.2 E. Myatt & Co. Ltd. Fig. 1267;

.3 Empire Tool & Mfg. Inc. Fig 256;

.4 The Metraflex Co. Style IV.

2.15 Pipe Anchors

.1 Welded structural black steel anchors of a design, size, and type to securely anchor pipe at point shown. Each anchor is to withstand 150% of axial thrust, and, as specified in Part 1 of this section, is to be designed and detailed by a Professional Structural Engineer.

2.16 Flexible Pump Connections

.1 Flexible metal hose assemblies, each complete with annular corrugated unbraided type 321 stainless steel inner core, braided type 321 stainless steel hose, and a collar and flange at each end, all suitable for twice the working pressure of the system.

.2 Manufacturers:

.1 Senior Flexonics Inc. A1 and A6 Series;

.2 The Metraflex Co. Model SST and "METRA-MINI".

.3 Option: Victaulic Series 380, 381 or 382 pump drop assemblies. Includes flow control, vibration-controlling flexible couplings, access ports for gauges and thermowells and an integral flanged pump connection. Rated to the working pressure of Class 150 flange connection. Sizes 2" to 12".

2.17 Air Separators

.1 Vortex type vertical air separator with side tangential inlet and outlet connections, a top air outlet connection, and bottom drain connection. Separator is to be constructed of cast iron or fabricated steel for a pressure of 1105 kPa (160 psi) at 180°C (350°F) in accordance with Section VIII, Division 1 of the ASME Boiler and Pressure Vessel Code.

.2 Manufacturers:

.1 S.A. Armstrong Ltd. Model "VA";

.2 ITT Bell & Gossett "Rolairtrol";

.3 Taco Canada Ltd. "Vortech".

.4 Flo-Fab Inc. "SEP-T" Series

2.18 Expansion Tanks

.1 Replaceable bladder type, factory pressurized expansion tank with permanent separation of air and water, in accordance with drawing schedule and complete with:

.1 steel pressure tank suitable for a working pressure of 870 kPa (125 psi) at 115°C (240°F), constructed and stamped in accordance with the ASME Code for Unfired Pressure Vessels and complete with a system connection, drain connection, air charging valve, and a red oxide primer finish;

.2 heavy-duty butyl rubber (EDPM) bladder;

.3 tapping for installation of a pressure gauge;

.4 for horizontal tanks only, mounting saddles supplied loose;

.2 Manufacturers:

.1 Hamlet & Garneau Inc. AL Series "Expanflex";

.2 S.A. Armstrong Ltd. Series "AX-V" Series "L";

.3 ITT Bell & Gossett Series "B" (ASME);

.4 Amtrol "Extrol" Series.

.5 Taco (Canada) Ltd. "CBX" Series.

.6 Flo-Fab Inc. "WX-C" Series, "ABT" Series

2.19 Glycol Solution Mixing and Storage Tanks

.1 Package type glycol solution mixing, storage and automatic feed assembly designed to maintain minimum system pressure levels and complete with:

.1 round, polyethylene or polypropylene tank sized to suit system capacity, complete with a solution level scale in litres and Imperial gallons, removable cover, and a welded steel angle stand assembly with legs, pump shelf, and control panel bracket, all factory finished with enamel;

.2 factory pre-piped minimum 1/3 HP, 115 volt, 1-phase rotary bronze gear pump with capacity and pressure differential to suit system requirements, factory wired to control panel, mounted on a shelf integral with steel stand assembly, and complete with shut-off valve and strainer;

.3 tank pressure relief valve with discharge piped back into tank;

.4 tank low level switch;

.5 pressure gauge;

.6 Honeywell #L404A "Pressurtrol" or equal pipe mounting differential pressure switch with a 100 to 1000 kPa (15 to 150 psi) range;

.7 115 volt, 1-phase, factory mounted and pre-wired control panel with an NEMA 2 enamelled steel enclosure, designed to control and operate glycol gear pump either manually or automatically to pump glycol solution into system, and to stop pump and initiate an audible/visual alarm if a low glycol solution level occurs in tank, and complete with:

.1 terminal blocks for power and control wiring connections;

.2 H-O-A switch with green "Power On" indicator light;

.3 120 volt/12 volt control transformer;

.4 low glycol solution level alarm buzzer with silencing switch, an alarm light which remains illuminated until low-level switch is reset, and an alarm push-to-test button;

.5 dry contacts for building automation system alarm annunciation.

.2 Manufacturers:

.1 ITT Bell & Gossett Series GMU;

.2 S. A. Armstrong Ltd. GLA Standard Series;

.3 HG Spec. Inc.

2.20 Glycol

.1 Propylene glycol blended with Nitrite based corrosion inhibitors.

2.21 General Re: Circulating Pumps

.1 Pumps are to be bronze fitted centrifugal pumps in accordance with drawing schedule, each non-overloading under all operating conditions and factory tested at specified operating conditions.

2.22 Split Coupled Vertical In-Line Pump

.1 Split coupled, single stage, vertical in-line pump complete with:

.1 radially split, gasketed cast iron volute with equally sized suction and discharge flanged connections, tappings for gauge, drain and flush line connections, and a cast iron motor mount bracket;

.2 dynamically balanced cast bronze impeller secured to a type 416 stainless steel shaft which is connected to motor by means of a high tensile strength aluminium bar split type spacer coupling with guard designed to permit servicing of mechanical seal without disturbing pump, motor, or electrical wiring;

.3 TEFC vertical mount motor;

.4 watertight John Crane Inc. #JC8B2, XP1D1 or Durametallic #RA EU5-FV carbon rotating face type outside mechanical seal with tungsten carbide stationary seat, Viton secondary seal and alloy 20 springs, and bronze gland plate with stainless steel gland bolts to secure stationary seat;

.5 factory installed seal flush line tubing with 50 micron Cuno cartridge type filter with 2 extra cartridges, a sight flow indicator, air vent, and valved tubing;

.6 for pump(s)___ , in lieu of a flush line filter, factory installed valved seal flush line tubing with cyclone type separator and sight flow indicator.

.2 Manufacturers:

.1 S.A. Armstrong Ltd.;

.2 ITT Bell & Gossett;

.3 Grundfos CBS Inc. PACO;

.4 Patterson Pump Company.

2.23 Close Coupled Vertical In-Line Pump

.1 Close coupled, single stage vertical in-line pump complete with:

.1 radially split, gasketed cast iron volute with equally sized suction and discharge flanged connections, and tappings for gauge, drain and flush line connections;

.2 dynamically balanced bronze impeller with bronze shaft sleeve, secured to motor shaft;

.3 face mounted TEFC vertical motor;

.4 watertight John Crane Inc. #JC 8B2, XP1D1 or Durmetallic #RA EU5-FV carbon rotating face type inside mechanical seal with tungsten carbide stationary seat, Viton secondary seal and alloy 20 springs, and bronze gland plate with stainless steel gland bolts to secure stationary seat.

.2 Manufacturers:

.1 S.A. Armstrong Ltd.;

.2 ITT Bell & Gossett;

.3 Grunfos CBS Inc. PACO;

.4 Patterson Pump Company.

2.24 Vertical In-Line Pump Variable Frequency Drives

.1 Variable frequency drives for vertical in-line pumps as scheduled are to be in accordance with Section 20 05 13.13 - Variable Frequency Drives for Mechanical Equipment.

2.25 Circulating Pump Suction and Discharge Connection Accessories

.1 Circulating pump manufacturer supplied suction guides with a cast iron body, stainless steel strainer screen, removable fine mesh start-up strainer screen and steel guide vanes, and cast iron body, angle, or straight type control valve assemblies, each acting as a check valve, balancing valve, and shut-off valve. Unless otherwise shown or specified, suction and discharge connection accessories are to be piping line size.

.2 Manufacturers:

.1 S.A. Armstrong Ltd. Type "SG" suction guides;

.2 ITT Bell & Gossett Bulletin B-820D suction guides.

2.26 Horizontal In-Line Pump

.1 Horizontal, in-line pump complete with:

.1 cast iron casing with flanged in-line pipe connections;

.2 alloy steel shaft with integral thrust collar, copper shaft sleeve, and oil lubricated bronze bearings;

.3 balanced, corrosion resistant steel, cast bronze, or stamped brass impeller;

.4 motor connected to pump by means of a 4-spring coupling with guard;

.5 mechanical seal.

.2 Manufacturers:

.1 S.A. Armstrong Ltd.;

.2 ITT Bell & Gossett;

.3 Grundfos Canada Inc.

3 Execution

3.01 Demolition

.1 Perform required hydronic piping system demolition/revision work. Refer to demolition requirements specified in Section 20 05 05 – Selective Demolition for Mechanical.

3.02 Piping Installation Requirements

.1 Provide required hydronic piping. Pipe, unless otherwise specified, is to be:

.1 for pipe sizes up to and including 50 mm (2") diameter, Schedule 40 black steel, screwed, or type "L" hard copper with solder joints or pressure coupled joints;

.2 for pipe 65 mm (2-½") to 300 mm (12") dia. and larger, Standard weight black steel pipe, 10 mm (0.375") thickness, with welding fittings and welded joints;

.3 for short branch connections, 25 mm (1") pipe diameter size and less, to heating equipment where structural obstructions occur and site bending of pipe is advantageous, a single length of type "L" soft copper.

.2 Slope horizontal piping mains to provide a minimum continuous up-grade of 25 mm (1") in 6 m (20') to high points. Slope branch supply and return piping connections to equipment a minimum of 25 mm (1") in 1.2 m (4'). Leave sufficient room at high points for installation and maintenance of air vents.

.3 Install automatic control valves, piping wells and similar piping and/or equipment mounted control components required for automatic temperature control systems supplied as part of the control work. Refer to drawing control diagrams and details.

.4 Connect equipment provided as part of the work of other sections with piping as indicated and/or required. Refer to pipe connection details on drawings.

.5 Provide screwed unions, removable mechanical joint couplings, or weld-on or solder-on flanges in piping at all connections to valves, strainers and similar piping system components which may need maintenance or repair, at equipment connections, in runs of piping exceeding 9 m (30') at 4.5 m (15') regular intervals to permit removal of sections of piping, and wherever else indicated on drawings.

.6 Provide shut-off valves in piping connections to equipment, to isolate piping risers, to isolate other sections of systems as shown, and wherever else indicated on drawings. Valves in piping to and including 50 mm (2") dia. are to be ball type. All other shut-off valves are to be ball or butterfly type unless otherwise specified. Locate valves so they are easily accessible. Wherever possible, install valves at uniform height. Provide chain operators for valves which are inaccessible for operation from floor level.

.7 Provide a check valve in discharge piping of every pump, and elsewhere in piping where shown on drawings. Where check valves are required in vertical piping, ensure they are suitable in all respects for the application. Check valves for vertical in-line and/or base mounted circulating pumps are integral with the discharge accessory.

.8 Provide a drain valve at base of each piping riser, in drain connections to equipment, in low points of horizontal piping, and wherever else shown and/or specified.

.9 Provide circuit balancing valves in piping generally where shown on drawings but with exact locations in accordance with instructions of personnel doing system flow balancing work. Confirm locations prior to installation.

3.03 Installation of Pressure Relief Valves

.1 Provide factory set pressure relief valves. Pipe discharge of each water piping relief valve to drain unless otherwise shown or specified.

.2 Pipe discharge of each glycol solution piping relief valve back to system expansion tank or return piping.

.3 Confirm relief valve settings.

3.04 Installation of Air Vents

.1 Provide an air vent in piping mains at all high points, at equipment connections, and wherever else shown and/or specified. Equip each air vent with a ball type shut-off valve. Install vents in 100 mm (4") dia. and larger piping and all vents in mechanical rooms in accordance with drawing detail.

.2 Provide 9 mm (3/8") dia. copper drain piping from each automatic air vent to nearest suitable drain and terminate so discharge is visible. Identify drain piping.

3.05 Installation of Strainers

.1 Provide strainers in piping. Locate strainers so baskets are easily accessible and removable. Clean strainer baskets during and after piping system flushing and cleaning is complete, and before water quantity balancing commences.

3.06 Installation of Expansion Compensators

.1 Provide expansion compensation in piping.

.2 Generally, locate expansion compensation where shown, but with exact locations to suit piping as installed.

.3 Provide double pipe alignment guides in horizontal piping at each side of expansion compensation facilities to permit movement in axial direction only. Secure guides to building structure only.

.4 Provide a pipe guide at each side of expansion joints in vertical risers.

3.07 Installation of Piping Anchors

.1 Provide anchors to secure piping to structure. Locate anchors generally where shown but with exact locations to suit piping as installed and requirements of reviewed anchor shop drawings.

.2 When installation of anchors is complete, arrange, and pay for anchor design engineer to visit site to review anchor installation. Submit a signed letter with engineer's stamp from design engineer confirming each anchor is properly installed.

3.08 Installation of Air Separator

.1 Provide an air separator in piping and connect with valved inlet and outlet piping.

.2 Extend valved blowdown piping from bottom pipe connection tapping to nearest floor drain location.

.3 Equip top pipe connection tapping with an automatic air vent, and piping as detailed.

3.09 Installation of Expansion Tank

.1 Provide an expansion tank.

.2 Secure horizontal expansion tank in place from structure by means of properly sized galvanized steel hanger rods and support saddles supplied with tank.

.3 Secure tank stand to a concrete housekeeping pad by means of machine bolts.

.4 Connect tank with system piping. Extend a drain line from tank piping and terminate drain line with a drain valve. Provide an air vent.

.5 Provide a water make-up connection line complete with relief valve and pressure gauge and connect to system piping. Terminate make-up piping for connection to domestic cold water piping as part of the work of Section 22 11 00 – Facility Water Distribution. Check relief valve operation and adjust as required.

.6 Check tank air charge and adjust to suit system.

3.10 Installation of Glycol Solution Mixing and Storage Tank

.1 Provide a mixing and storage tank and feed assembly for each glycol solution circulating system.

.2 Secure tank stand to a concrete housekeeping pad. Connect with system piping. Refer to drawing detail.

.3 Fill tank with, unless otherwise specified, a solution of 50% water, 50% propylene glycol, and test solution to confirm proper concentrations.

.4 When installation is complete, test operation of assembly, including alarms, and adjust as required. Adjust pressure switch to suit glycol solution circulating system pressure.

3.11 Installation of Flexible Piping Connections

.1 Provide flexible connections in piping connections to equipment.

.2 Install in accordance with manufacturer's instructions.

3.12 Installation of Circulating Pumps

.1 Provide centrifugal circulating pumps.

.2 Secure base mounted pumps in place on a concrete housekeeping pad. Shim pump baseplate level using metal wedges prior to tightening bolts. When installation is complete and pump-motor alignment has been checked, fill void between pump base and housekeeping pad with KPM Industries Ltd. "In-Pakt" or equal non-shrink grout. Provide flexible connections in pump suction and discharge piping 450 mm (18") from suction and discharge connection accessories.

.3 Secure vertical inline pumps in place in accordance with requirements of drawing detail and provide flexible piping connections in vertical suction and discharge piping approximately 450 mm (18") above suction and discharge connection accessories.

.4 Provide a shut-off valve and suction guide in pump suction piping, and a combination check-balance-shut-off valve assembly in pump discharge piping, installed in accordance with manufacturer's instructions. Remove suction guide start-up strainer screens after piping flushing and cleaning is complete. Combination check-balance-shut-off valve assemblies are to be 150 mm (6") away from pump discharge for discharge piping to 150 mm (6") dia., and 300 mm (12") away from pump discharge for discharge pipe larger than 150 mm (6") dia.

.5 For pumps equipped with seal flush line filters, replace flush line filter cartridge when pipe flushing and cleaning is complete, and hand identified spare filter cartridges to Owner at site.

.6 Supply variable frequency drives (VFD) for pumps as scheduled. Hand VFD's to electrical trade at site for installation as part of the electrical work.

.7 Install horizontal inline pumps in place in vertical piping approximately 1.2 m (4') above floor in accordance with pump manufacturer's instructions.

.8 If circulating pumps are used for piping flushing and cleaning, and pump seal flush line filters are not installed, replace pump mechanical seals when flushing and cleaning is complete.

.9 For equipment/system manufacturer certification requirements, refer to Section 20 05 00 – Common Work Results for Mechanical.

.10 For equipment/system start-up requirements, refer to Section 20 05 00 – Common Work Results for Mechanical.

.11 Include for a 1/2 day on-site operation demonstration and training session. Training is to be a full review of all components including but not limited to a full operation and maintenance demonstration, with abnormal events.

3.13 Flushing and Cleaning Piping

.1 Flush and clean new piping in accordance with requirements specified in Section 23 25 00 - HVAC Water Treatment.

3.14 Testing, Adjusting and Balancing

.1 When work is complete and equipment is operating as intended, test, adjust and balance water flows in accordance with requirements specified in Section 20 05 93 - Testing, Adjusting, and Balancing for Mechanical Systems, and Section 20 08 00 – Commissioning of Mechanical Systems.

End of Section

1 General

1.01 Submittals

.1 Submit shop drawings/product data sheets for all products specified in Part 2 of this section except for pipe and fittings.

.2 Submit, in shop drawing form, a schematic piping diagram for each refrigerant piping system indicating pipe sizes, slopes, valves, traps, and piping specialties. Piping schematics must be reviewed, approved, and signed by refrigeration equipment manufacturers prior to being submitted to the Consultant for review.

1.02 Closeout Submittals

.1 Submit letters from equipment suppliers certifying proper installation and start-up of piping systems and equipment as specified in Part 3 of this section.

1.03 Quality Assurance

.1 Refrigerant piping systems are to be in accordance with CSA B52, Mechanical Refrigeration Code, and any applicable local Codes and Regulations.

.2 Refrigerant piping installing contractor is to be certified by Technical Standards and Safety Authority (TSSA). Installing contractor is to install refrigerant piping in accordance with manufacturer's installation instructions and in accordance with local codes. Contractor is responsible for all regulatory approvals, if required. Upon completion of installation, documentation of refrigerant amount, test certificates and verification documentation, etc., is to be provided in a binder, in accordance with requirements of local authorities having jurisdiction.

.3 Refrigerant piping and direct expansion refrigeration equipment must be installed by or under direct on site supervision of a licensed journeyman refrigeration mechanic.

2 Products

2.01 Pipe, Fittings, and Joints

.1 Type ACR hard drawn seamless copper refrigerant tubing to ASTM B280, factory degreased, dehydrated and capped or nitrogen filled and capped, complete with factory washed and bagged wrought copper soldering fittings to ASME B16.22, and brazed joints made with high melting point silver brazing alloy conforming to AWS Classification BcuP-5.

2.02 Piping Line Sets

.1 Equal to Great Lakes Copper Inc. "EZ-Roll" soft annealed copper to ASTM B280, suitable for use with refrigerant involved, factory cleaned and capped, and with sizes and lengths as required.

2.03 General Re: Valves and Piping Specialties

.1 Refrigerant valves and piping specialties specified below are to factory cleaned, degreased, and supplied to site with capped ends.

2.04 Shut-Off Valves

.1 Ball Valves

.1 ¼ turn, CSA certified forged brass ball valves, each suitable for a maximum working pressure of 3445 kPa (500 psi) and complete with carbon filled Teflon ball seals, 2 O-ring stem seals, a gasketed seal cap, a flow direction arrow cast into body, a ball position indicator on stem, and

extended copper tube connections to permit brazing the valve into line without disassembling valve.

.2 Manufacturers:

.1 Mueller Industries Inc.;

.2 Sporlan Valve Co.;

.3 Superior Refrigeration Products/Sherwood.

.2 Diaphragm Valves

.1 Forged brass, frost-proof, Type 1 Series, CSA certified packless diaphragm valves, each suitable for a 3445 kPa (500 psi) working pressure and complete with an O-ring to prevent moisture from entering diaphragm chamber, one phosphor bronze and 2 stainless steel diaphragms, and extended copper tube brazing connections.

.2 Manufacturers:

.1 Mueller Industries Inc.;

.2 Sporlan Valve Co.;

.3 Superior Refrigeration Products/Sherwood.

2.05 Check Valves

.1 Straight through type for valves 6.4 mm to 16 mm (¼" to 5/8") diameter, globe type for valves 22 mm (7/8") diameter and larger, each complete with extended tubing for brazing connections, and as follows:

.1 straight through type check valves complete with a machined brass gasketed body, phosphor bronze spring, and neoprene seat;

.2 globe type check valves complete with a cast bronze body, forged brass cap, phosphor bronze spring, Teflon seat disc, and neoprene O-ring seal.

.2 Manufacturers:

.1 Mueller Industries Inc.;

.2 Sporlan Valve Co.;

.3 Superior Refrigeration Products/Sherwood.

2.06 Piping Traps

.1 Mueller Industries Inc. Style No. WE-554P brazing end copper "P" traps.

.2 Manufacturers:

.1 Mueller Industries Inc.;

.2 Sporlan Valve Co.;

.3 Superior Refrigeration Products/Sherwood.

2.07 Pressure Vessel Relief Valves

.1 Factory set pressure relief valves, straight through or angle type as required, each constructed in accordance with requirements of ANSI B9.1 and the ASME Code for Unfired Pressure Vessels, and each complete with a brass body, neoprene seat disc, and lead seal and locking wire.

.2 Manufacturers:

.1 Mueller Industries Inc.;

.2 Sporlan Valve Co.;

.3 Superior Refrigeration Products/Sherwood.

2.08 Refrigerant Liquid Moisture Indicators

.1 Forged brass, triple sealed, CSA certified liquid moisture indicators, each suitable for a maximum working pressure of 3445 kPa (500 psi) and complete with a liquid indicator which shows "FULL" when system is fully charged with refrigerant and remains blank when there is a restriction or shortage of refrigerant in liquid line, a moisture indicator which changes colour from blue to pink when moisture is present in system, a plastic dust cover, and extended copper tube brazing connections.

.2 Manufacturers:

.1 Mueller Industries Inc.;

.2 Sporlan Valve Co.;

.3 Superior Refrigeration Products/Sherwood.

2.09 Liquid Line Filter-Drier

.1 Mueller Industries Inc. "Drymaster" CSA certified filter-driers, each suitable for a maximum 3445 kPa (500 psi) working pressure and complete with a combination of desiccants in a fluted briquette for drying, and a fluted briquette type filter.

.2 Manufacturers:

.1 Mueller Industries Inc.;

.2 Sporlan Valve Co.;

.3 Superior Refrigeration Products/Sherwood.

2.10 Flexible Piping Connections

.1 Senior Flexonics Canada "VIBRA-SORBERS" phosphor bronze construction, factory cleaned, dried, and sealed flexible piping connections with copper tube brazing ends.

.2 Manufacturers:

.1 Senior Flexonics Canada;

.2 The Metraflex Co.

2.11 Thermostatic Expansion Valves

.1 Factory tested, balanced port design thermostatic expansion valves, with exact selection to suit the application and refrigerant used, each complete within a replaceable stainless steel diaphragm and

welded element construction thermostatic element charged with hydraulic fluid, and removable inlet strainer.

.2 Manufacturers:

.1 Mueller Industries Inc.;

.2 Sporlan Valve Co.;

.3 Superior Refrigeration Products/Sherwood.

2.12 Refrigerant Piping Roof Supports

.1 Bases and blocks are to be UV resistant.

.2 Clamps for refrigerant piping to be one (1) size larger than pipe to allow for expansion.

.3 Clamps and screws to be galvanized.

.4 Piping supports to be provided with two (2) year warranty.

.5 Acceptable products are as follows:

.1 Pipe Ease – Quick Block – Polypropylene support block with rigid foam base;

.2 Mifab – CX/C Series – UV Resistant Recycled Rubber support with base;

.3 Nelson/Olsen – Quick Pipe Block – HDPE support with rigid foam base;

.4 Erico – Caddy Pyramid Series – Thermoplastic support with base.

3 Execution

3.01 Demolition

.1 Perform required refrigerant piping system demolition work. Refer to demolition requirements specified in Section 20 05 05 – Selective Demolition for Mechanical.

3.02 Installation of Refrigerant Piping, Valves and Specialties

.1 Provide required refrigerant piping. Piping is to be type ACR copper with wrought copper fittings. Install piping in accordance with requirements of reviewed refrigerant piping schematics referred to in Part 1 of this section.

.2 Make refrigerant piping joints using a light coat of approved brazing flux applied to both pipe and fitting. Do not use acid flux. During brazing process, ensure pipe and fittings are kept full of nitrogen or carbon dioxide to prevent scale formation inside pipe and fitting.

.3 Where shown or specified, use soft copper refrigerant piping line sets.

.4 Provide shut-off valves to isolate each piece of equipment if shut-off valves are not supplied integral with equipment. Provide ball or diaphragm type shut-off valves inside building. Provide diaphragm shut-off valves outside building.

.5 Provide a refrigerant charging valve for each system if such a valve is not supplied integral with equipment.

.6 Provide refrigerant piping accessories shown and/or required and install in accordance with manufacturer's recommendations.

.7 Provide required refrigerant.

.8 Provide flexible connections at piping connections to roof mounted condensing units. Install in accordance with manufacturer's instructions.

.9 Provide expansion valves where shown and/or required, each matched to coil and installed in accordance with manufacturer's instructions.

End of Section

1 General

1.01 Submittals

.1 Submit shop drawings/product data sheets for all water treatment chemical feed equipment and associated hardware.

.2 Submit product literature sheets for all chemicals, as well as WHMIS Material Safety Data Sheets for all chemicals.

1.02 Closeout Submittals

.1 Submit water treatment manufacturer/supplier certification letters as specified in Part 3 of this section.

.2 Training attendance records.

1.03 Maintenance Material Submittals

.1 Submit water treatment test sets and spare chemicals as specified below and in Part 3 of this section.

.2 Supply water softener salt sufficient for 2 months of normal softener operation and store salt on-site where directed by Owner.

2 Products

2.01 Characteristics of Chemicals and Spare Chemicals

.1 Chemicals specified in this section are to be non-toxic when released to atmosphere, non-corrosive and non-staining if a leak occurs, and compatible with all system components.

.2 Chemicals must be approved by governing authorities for release into Municipal sewer system.

.3 For each treatment system for which chemicals are supplied, supply and hand to Owner, at Substantial Performance of the Work, spare chemical in original containers/packaging sufficient for 2 months of treatment system operation.

2.02 Manufacturers/Suppliers of Chemicals and Feed Equipment

.1 Manufacturers:

.1 Ashland Hercules Water Technologies;

.2 Klenzoid Inc.;

.3 Magnus Canada;

.4 Chem-Aqua Canada.

2.03 Piping System Flushing and Cleaning Chemical

.1 Liquid form alkaline type cleaner consisting of a concentrated blend of highly active penetrating agents and detergents with a 12.5 pH and specifically formulated to remove oil, mill scale and oxides from piping and equipment.

2.04 Closed Heat Transfer System Treatment

.1 Chemicals, chemical feed equipment, and test equipment to control corrosion in closed heat transfer circulating systems as indicated on drawings and as specified below.

.2 Enamelled steel or cast iron by-pass feeders sized as shown, 2060 kPa (300 psi) rated and complete with 20 mm (¾") diameter NPT pipe connection tappings, and a screw-on cast iron cap with "Buna N" "O" ring seal.

.3 By-pass filter and flow indicator assembly equal to a Shelco Inc. FOS78, 1725 kPa (250 psi) rated replaceable cartridge filter assembly with a stainless steel housing and 20 mm (¾") diameter piping connections, sized for approximately 5% of rated circulating pump flow and complete with a minimum of 6, 20 micron filter cartridges, and a sight flow indicator equal to an Anderson Midwest Model 350SS with 20 mm (¾") diameter piping connections.

.4 Piping tee mounting coupon holders, each complete with 25 mm (1") diameter NPT plugs with a minimum of one coupon for copper and one coupon for steel.

.5 Chromate free, nitrite/borate type corrosion inhibitor suitable for use with both ferrous and non-ferrous metals.

.6 Test kit for measuring inhibitor level.

3 Execution

3.01 Piping System Flushing and Cleaning

.1 After new heat transfer system piping has been installed and leakage testing has been satisfactorily completed, but before mechanical equipment start-up and performance tests, flush and chemically clean piping systems.

.2 Provide required temporary piping connections, including bypass piping to isolate dirt sensitive mechanical plant equipment. Remove instrumentation such as flow meters and switches, orifice plates, meter valves and similar devices and plug pipe openings. Reinstall when flushing and cleaning work has been certified complete by chemical manufacturer/installer. Ensure control valves are operational and fully open during flushing and cleaning.

.3 Prior to chemical cleaning, flush piping, including dead ends, with water to remove loose solids. Clean all strainers. Replace chemical feeder line filters as required. Flush and drain until water runs clear.

.4 When flushing with water is complete, fill systems with fresh clean water. Meter amount of water required to fill each system or otherwise calculate system capacity. Ensure all air is vented from systems. Add cleaning chemical as instructed by chemical manufacturer and circulate solution for a period of time and at a temperature as required to produce a clean piping system. Conduct daily pH, conductivity, and total iron tests in accordance with chemical supplier's instructions.

.5 After chemical cleaning when test results indicate a clean system, drain solution from piping, refill with clean water and circulate water for a minimum of 24 hours to flush out remaining chemical solution, then drain water from piping using all drain points and again clean all system strainers and replace filters. Arrange for chemical supplier to check each system after flushing and cleaning is complete and to certify in writing that flushing and cleaning procedures have been properly performed. Submit a copy of the certification letter. Fill systems.

3.02 Installation of Closed Heat Transfer System Treatment

.1 After flushing and cleaning procedures have been certified complete, provide a by-pass chemical feeder, a cartridge filter assembly, and corrosion test coupons for each closed heat transfer system. Install in accordance with requirements of drawing details.

.2 Supply and feed into each system sufficient chemical to charge system to proper concentrations of chemical, and maintain proper levels in system until Substantial Performance of the Work.

3.03 Manufacturer's Certification, Start-Up, and Training

.1 For all water treatment equipment include for on-site certification, start-up supervision, and system training by treatment chemical manufacturer's representative as follows:

.1 For equipment/system manufacturer certification requirements, refer to Section 20 05 00 – Common Work Results for Mechanical;

.2 For equipment/system start-up requirements, refer to Section 20 05 00 – Common Work Results for Mechanical;

.3 Include for 4 hours of on-site operation demonstration and training session. Training is to be a full review of all components including but not limited to a full operation and maintenance demonstration, with abnormal events.

End of Section

1 General

1.01 Submittals

.1 Submit shop drawings/product data sheets for all products specified in this section except shop fabricated ductwork and fittings.

.2 Include capacity, throw and terminal velocity, noise criteria, and pressure drops with grille and diffuser shop drawing/product data sheet submission.

.3 With shop drawing/product data sheet submission, supply evidence that fire rated duct manufacturer is ULC listed to size requirements shows on drawings.

.4 Submit duct leakage test data prior to ductwork being covered from view.

.5 Submit manufacturer's colour chart(s) for all items for which a finish colour is to be selected.

1.02 Closeout Submittals

.1 Submit proper installation certification from fire rated duct manufacturer as specified in Part 3 of this section.

.2 Submit a site inspection and start-up report from fan filter diffuser manufacturer's representative as specified in Part 3 of this section.

1.03 Maintenance Material Submittals

.1 Supply and hand to Owner at Substantial Performance of the Work, a minimum of 10 identified (with tags) grille/diffuser volume control damper adjustment keys.

1.04 Coordination

.1 Supply reviewed copies of ventilator/curb assembly shop drawings or product data sheets to trade who will cut roof openings for ventilators, and ensure openings are properly sized and located.

1.05 Quality Assurance

.1 Grilles and diffusers are to be tested and performance certified to ANSI/ASHRAE 70, Method of Testing the Performance of Air Outlets and Air Inlets.

2 Products

2.01 Galvanized Steel Ductwork

.1 Galvanized steel sheet is to be hot dipped in accordance with requirements of ASTM A653. G60 galvanizing for bare uncovered duct to be finish painted. G90 for all other galvanizing.

.2 Rectangular

.1 Lock forming grade hot dip galvanized steel, ASTM A653, shop fabricated, minimum #26 gauge.

.3 Round

.1 Factory machine fabricated, spiral, mechanically locked flat seam, single wall duct, fittings and couplings.

.4 Flat Oval

.1 Factory machine fabricated, single wall, 4-ply spiral lock seam duct, fittings and couplings.

2.02 Flexible Metallic Ductwork

.1 Bare

.1 Spirally wound, semi-rigid, self-supporting corrugated aluminum duct with continuous triple lock seams, SMACNA Form "M-UN", CAN/ULC-S110 listed and labelled as a Class 1 Air Duct, constructed of dead soft aluminum strip, and supplied in 3 m (10') lengths.

.2 Insulated

.1 Spirally wound, semi-rigid, self-supporting corrugated aluminum duct with continuous triple lock seams, SMACNA Form "M-I", CAN/ULC-S110 listed and labelled as a Class 1 Air Duct, constructed of dead soft aluminum strip, supplied in 3 m (10') lengths and factory covered with 40 mm (1-½") thick, 12 kg/m3 (0.75 lb/ft³) density fibreglass insulation with a vinyl jacket meeting 25/50 flame spread and smoke developed requirements tested in accordance with CAN/ULC-S102.

2.03 Flexible Connection Material

.1 Waterproof, indoor-outdoor type flexible connection material meeting requirements of NFPA 90A, consisting of woven glass fibre fabric coated on both sides with synthetic rubber.

.2 Manufacturers:

.1 Duro Dyne Canada Inc. "DUROLON";

.2 Dyn Air Inc. "HYPALON".

.3 Waterproof, flameproof, high temperature flexible connection material meeting requirements of NFPA 90A, consisting of a woven glass fibre fabric coated on both sides with silicone rubber.

.4 Manufacturers:

.1 Duro-Dyne Canada Inc. "THERMAFAB";

.2 Dyn Air Inc. "SILICON HI-T".

2.04 Metal Duct System Joint Sealant

.1 ULC listed and labelled, premium grade, grey colour, water base, non-flammable duct sealer, brush, or gun applied, with a CAN/ULC S102 tested maximum flame spread rating of 5 and smoke developed rating of 0.

.2 Manufacturers:

.1 Johns Manville;

.2 Manson Insulation;

.3 Knauf Insulation.

2.05 Acoustic Lining

.1 Minimum 25 mm (1") thick acoustic lining material meeting 25/50 flame spread and smoke developed ratings tested in accordance with CAN/ULC S102, meeting NFPA 90A, ASTM C1071, and ASTM G21 requirements, not supporting microbial growth, flexible for round ducts, board type for rectangular ducts, consisting of a bonded fiberglass mat coated on inside (airside) face with a black fire-resistant coating.

.2 Manufacturers:

.1 Johns Manville;

.2 Manson Insulation;

.3 Knauf Insulation.

2.06 Casing and Plenum Material and Accessories

.1 Unless otherwise specified, casing and plenum material is to be same as connecting duct material.

.2 Accessories such as access doors and drain pans are to be constructed of same material as casing and plenum and are to be in accordance with Chapter 6 of SMACNA HVAC Duct Construction Standards Metal and Flexible.

2.07 Acoustic Plenum Panels

.1 Vibro-Acoustics Ltd. type "AP", 100 mm (4") thick panels with acoustic media meeting NFPA 90A requirements sandwiched between minimum #24 gauge galvanized sheet steel, with airside face perforated, access doors where shown, and with acoustic performance as follows:

Octave Bands, (Hz)	125	250	500	1000	2000	4000
Transmission Loss	21	28	39	50	53	56
Absorption Coefficient	0.7	0.9	.99	.99	0.9	0.9

.2 Acoustic plenum media factory encapsulated in sealed DuPont "Tedlar" polyvinyl fluoride film to ensure no media enters the airstream.

.3 Manufacturers:

.1 Vibro-Acoustics Ltd.;

.2 Kinetics Noise Control Inc.;

.3 Carrier Corp. – Racan;

.4 Haakon Industries;

.5 Price Industries Inc;

.6 Alumavent.

2.08 Plenum Access Doors

.1 Factory fabricated, double wall insulated access doors, sized as indicated on drawings, and constructed of same material as connecting ductwork in accordance with ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible to suit operating pressure of the system.

2.09 Round to Rectangular Duct Connections

.1 Equal to Flexmaster Canada Ltd. galvanized steel, flared, flanged or notched "Spin-On" round duct take-off collars with locking dampers in accordance with ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible.

2.10 Splitter Dampers

.1 Minimum #20 gauge damper blade constructed of same material as duct, reinforced as required to suit blade size, system velocity, and to prevent "chatter", and complete with operating hardware equal to DynAir Inc. #Q-50 "DYN-A-QUAD S-S" quadrant regulator with RW-50 backup washers to prevent leakage, long square bearing pin, and slide pin.

2.11 Air Turning Vanes

.1 For square elbows, multiple-radius turning vanes interconnected with bars, adequately reinforced to suit pressure and velocity of system, constructed of same material as duct they are associated with, and in accordance with ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible.

.2 For short branch ducts at grille and diffuser connections, air extractor type each equipped with a matching bottom operated 90° opposed blade volume control damper, constructed of same material as duct it is associated with and in accordance with requirements and details in ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible.

2.12 Manual Balancing (Volume) Dampers

.1 Flanged and drilled, single or parallel blade (depending on damper size) manual balancing dampers, each constructed of same material as connecting ductwork unless otherwise specified, each designed to maintain internal free area of connecting duct, and each complete with:

.1 hexagonal or square shaft extension through frame;

.2 non-stick, non-corrosive synthetic bearings for rectangular dampers, flange stainless steel bearings for round dampers;

.3 blade stops for single blade dampers, designed to prevent blade from moving more than 90°;

.4 linkage for multiple blade dampers;

.5 locking hand quadrant damper operator with, for insulated ducts 50 mm (2") standoff mounting.

.2 Rectangular Dampers: Nailor Industries Inc. 1800 Series, maximum size 1.2 m x 1.2 m (4' x 4') for a single damper.

.3 Round Dampers: Nailor Industries Inc. model 1890, maximum 600 mm (24") diameter, equipped with a minimum 200 mm (8") deep frame, and blade stiffeners where required.

.4 Multiple Rectangular Damper Section Assembly: Rectangular assembly supplied with the dampers or site constructed, of same material as damper and designed for tight and secure mounting of individual dampers.

.5 Manufacturers:

.1 Nailor Industries Inc.;

.2 T.A. Morrison & Co. Inc. "TAMCO";

.3 NCA Manufacturing Ltd.;

.4 Greenheck Fan Corp.;

.5 Ruskin Co.

2.13 Backdraft Dampers

.1 Nailor Industries Model 1370CB counterbalanced backdraft dampers, vertical or horizontal mounting, 50 mm (2") wide, sized as shown and complete with:

.1 extruded 6063-T5 aluminum frame, 2.3 mm (0.090") nominal wall thickness, with mitred corners;

.2 extruded 6063-T5 aluminum blades, 1.3 mm (0.050") nominal wall thickness on 92 mm (3-5/8") centres, and with extruded PVC blade seals;

.3 corrosion-resistant synthetic bearings;

.4 adjustable plated steel counterweights mounted internally in the airstream;

.5 concealed blade linkage located out of the airstream.

.2 Manufacturers:

.1 Nailor Industries Inc.;

.2 T.A. Morrison & Co. Inc. "TAMCO";

.3 NCA Manufacturing Ltd.;

.4 Greenheck Fan Corp.;

.5 Ruskin Co.

2.14 Combination Fire/Smoke Dampers

.1 Nailor Industries Series 1221, ULC listed to CAN/ULC S112 and CAN/ULC S112.1, meeting requirements of NFPA 80, 90A, 92, 101 and 105, consisting of type A, B, or C fusible link fire dampers as required and a fail-safe, opposed blade, normally closed, motor operated smoke damper complete with factory installed and tested 120 V electric actuator.

.2 ULC 1-1/2 hour fire rated and ULC Class I leakage rated for smoke, and equipped with a 74°C (165°F) ULC classified fusible link that will cause damper to close and lock independent of actuator when duct temperature reaches maximum temperature of damper assembly.

.3 Supply damper with factory installed sleeves of minimum 400 mm (16") length, field verified by contractor dependent on wall thickness. Caulk sleeves to ULC requirements and constructed of 20 gauge for sizes up to 2.1 m (84") wide and 18 gauge for sizes greater than 2.1 m (84") wide.

.4 Dampers in ductwork other than galvanized steel are to be as specified above but constructed of type 316 stainless steel.

.5 Manufacturers:

.1 Nailor Industries Inc.;

.2 Greenheck Fan Corp.;

.3 NCA Manufacturing Ltd.;

.4 Ruskin Co.;

.5 Price Industries (E.H. Price).

2.15 Smoke Dampers

.1 Multi-blade type, fail-safe, dynamic, galvanized steel (unless otherwise specified) smoke dampers, ULC classified to CAN/ULC S112.1, ULC Class I leakage rated for smoke, meeting requirements of NFPA 90A, 92, 101 and 105, normally closed, low pressure drop design, dynamically tested, each complete with jamb and blade seals, linkage concealed in the frame, a steel sleeve to suit the opening, and an electric actuator to automatically close damper upon receiving an external signal, and to automatically open damper when system is reset.

.2 Dampers in ductwork other than galvanized steel are to be as specified above but constructed of type 316 stainless steel.

.3 Manufacturers:

.1 Nailor Industries Inc.;

.2 Greenheck Fan Corp.;

.3 NCA Manufacturing Ltd.;

.4 Ruskin Co.;

.5 Price Industries (E.H Price).

2.16 Roof Duct Supports

.1 Equal to PHP Systems Design Model PHP-D adjustable duct support assemblies sized to suit duct size, each assembly complete with injection moulded recycled plastic and carbon black bases and tubular hot dip galvanized steel framing.

2.17 Duct Access Doors

.1 In accordance with ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible, with sizes suitable in all respects for purpose for which they are provided, and, unless otherwise specified, constructed of same material as duct they are associated with.

2.18 Ductwork Drain Points

.1 Equal to Ductmate Canada Ltd. "Moisture Drain", 20 mm (¾") diameter moisture drains with galvanized sheet metal funnel, and chrome plated brass threaded drain, nut and cap.

2.19 Instrument Test Ports

.1 Equal to Duro-Dyne of Canada Ltd. #IP1 or #IP2 (to suit insulation thickness where applicable) gasketed, leakproof instrument test ports for round or rectangular ducts as required, each complete with a neoprene expansion plug and a plug securing chain.

2.20 Wire Mesh (Birdscreen)

.1 Heavy-gauge galvanized steel or aluminum mesh, 12 mm x 12 mm (½" x ½") secured in a rigid galvanized steel or aluminum framework, sized as indicated on drawings, and constructed so as to be removable.

2.21 Louvres

.1 Price Industries Inc. DE439 or DE635, 100 mm (4") or 150 mm (6") deep (to suit wall thickness) factory assembled stationary, drainable, louvres sized as indicated on drawings, each AMCA water penetration and air performance certified, constructed of welded, extruded, alloy 6063-T5 aluminum with drainable blades, mounting and securing hardware to suit the application, and 12 mm (½") mesh aluminum birdscreen in an aluminum frame.

.2 Acoustical Louvres: Price Industries Inc. Model QA1245 300 mm (12") deep, welded, extruded alloy 3003-H14 aluminum, storm-proof, stationary, drainable acoustical louvers, AMCA water penetration and air performance certified, with high density mineral wool acoustic media secured to blades and protected by perforated aluminum, sound ratings in accordance with ASTM E90 and ASTM E413, and mounting and securing facilities as required.

.3 Louvres are to be factory finished with a finish equal to PPG Industries "Duranar" fluoropolymer powder coating over primer with colour as selected from manufacturer's standard colour range.

.4 Manufacturers:

.1 Price Industries Inc.;

.2 The Airolite Co. LLC;

.3 Construction Specialities;

.4 Nailor Industries Inc.;

.5 Kinetics Noise Control Inc.

.6 Greenheck Fan Corp.

.7 Ventex

2.22 Louvre Blank-Off Panels

.1 Insulated, framed, sandwich construction panels consisting of 40 mm (1-½") thick rigid insulation (meeting NFPA 90A requirements) between minimum #20 gauge galvanized sheet steel with exterior face of panels finished to match finish of exterior wall louvres.

2.23 Brick and Block Vents

.1 Equal to Price Industries Inc. vents constructed of 6063-T5 alloy extruded aluminum, sized as shown, complete with stainless steel fasteners, aluminum rod vertical supports on minimum 300 mm (12") centres, #2 mesh fixed aluminum screen, and all required accessories to suit the application.

.2 Vent(s) to be factory finished with a finish equal to a baked "Kynar 500-XL" colour coat and a clear coat over cleaned and primed metal with colour as selected from manufacturer's standard colour range.

2.24 Grilles and Diffusers

.1 Grilles and diffusers of type, size, capacity, finish, and arrangement as shown on drawings and in accordance with drawing schedule, each equipped with all required mounting and connection accessories to suit mounting location and application.

.2 Manufacturers:

.1 Price Industries Inc.;

.2 Anemostat;

.3 Krueger Division of Air System Components Inc.;

.4 Titus;

.5 Nailor Industries Inc.;

.6 Tuttle & Bailey.

2.25 Intake & Exhaust Wall Box

.1 Equal to Reversomatic SWBLM wall boxes leakproof seamless construction, extruded aluminum grille, sized as shown, complete with stainless steel fasteners, neoprene backdraft damper, and all required accessories to suit the application.

.2 Vent(s) to be factory finished with a finish equal to a baked "Kynar 500-XL" colour coat and a clear coat over cleaned and primed metal with colour as selected from manufacturer's standard colour range.

3 Execution

3.01 Cleanliness Requirements for Handling and Installation of Ductwork

.1 Handle and install ductwork in accordance with CSA Z317.2, Special Requirements for Heating, Ventilation, and Air-Conditioning (HVAC) Systems in Healthcare Facilities and SMACNA's Duct Cleanliness for New Construction Guidelines at the Advanced Level.

.2 Handle and install ductwork in accordance with SMACNA's Duct Cleanliness for New Construction Guidelines at the Advanced Level.

3.02 Fabrication and Installation of Galvanized Steel Ductwork

.1 Provide required ductwork, rectangular, round and/or flat oval. Where rectangular ductwork is shown, round or flat oval ductwork of equivalent cross-sectional area is acceptable.

.2 It is to be understood that all duct dimensions shown on drawings are clear internal dimensions.

.3 Unless otherwise specified, construct and install ductwork in accordance with ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible to suit duct pressure class designation of minimum 500 Pa (2" w.c.) positive or negative as applicable, a minimum velocity of 10 m/s (2000 fpm), and so ductwork does not "drum". Flat surfaces of rectangular ductwork are to be cross-broken. Duct system sealing is to meet ANSI/SMACNA Seal Class A requirements.

.4 Variable air volume ductwork from supply fans to boxes is as above but rectangular duct take-offs are double side straight taper type with a take-off length equal to 0.5 times the branch duct width but minimum 150 mm (6") length, and double taper side is to have an included angle of minimum 60°.

.5 Confirm routing of all ductwork at site and site measure ductwork prior to fabrication. Duct dimensions may be revised to suit site routing and building element requirements, if dimension revisions are reviewed with and approved by the Consultant. Duct routing and/or dimension revisions to suit conditions at site are not grounds for a claim for an extra cost.

.6 Refer to structural drawings. Where ductwork is to be run within or through open web steel joists, ductwork shown on mechanical drawings is schematic only and is to be altered as required to suit steel joist configuration, spacing, panel points, and cross-bridging at no additional cost.

.7 Wherever ductwork is required at locations where sprayed fireproofing is applied to building construction, install ductwork only after fireproofing work is complete and do not compromise fire rating of sprayed fireproofing.

.8 Install (but do not connect) duct system mounted automatic control components supplied as part of the automatic control work.

.9 Where indicated, provide duct connections to fan powered heat transfer equipment with integral coils.

.10 Flange connect ductwork to hot water reheat coils in accordance with requirements of ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible. Coils will be suspended independent of connecting ductwork as part of the heat transfer work.

.11 Support horizontal rectangular ducts inside building in accordance with ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible, but use trapeze hangers with, unless otherwise specified, galvanized steel channels, and galvanized steel hanger rods for exposed ducts and concealed ducts wider than 500 mm (20"). Support hardware constructed of same material as duct for metal duct, and, unless otherwise specified, type 316 stainless steel for non-metal duct. Supports for "heavy" duct such as cementitious core duct is to be suitable in all respects for the application and approved by the Consultant.

.12 Support round and flat oval ducts inside building in accordance with ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible, but, unless otherwise specified, for both uninsulated and

insulated ducts exposed in finished areas, use bands and secure at top of duct to a hanger rod, all similar to Ductmate Canada Ltd. type "BA". If duct is insulated, size strap to suit diameter of insulated duct. Unless otherwise specified, duct support hardware for metal duct is constructed of same material as duct, and for non-metal duct, type 316 stainless steel.

.13 Where flanged duct joints are used, do not locate joints in wall or slab openings, or immediately at wall or slab openings. Do not use flanged joints for exposed uninsulated ducts in finished areas.

.14 Where watertight horizontal ductwork is required, construct ducts without bottom longitudinal seams. Solder or weld joints of bottom and side sheets. Seal all other joints with duct sealer. Slope horizontal duct to hoods, risers, or drain points. Provide drain points. Provide watertight ductwork for:

.1 ductwork outside building or otherwise exposed to the elements;

.2 dishwasher exhaust;

.3 shower exhaust ducts from grilles to duct main or riser;

.4 minimum of 3 m (10') upstream and downstream of duct mounted humidifiers or humidifier manifolds;

.5 fresh air intakes;

.6 wherever else shown.

.15 Leakage Testing:

.1 Ductwork leakage is not to exceed following:

.1 ductwork to 2" W.C. Class, 1% of total air quantity handled by respective fans;

.2 ductwork exceeding 2" W.C. Class, 2% of total air quantity handled by respective fans.

.2 Leakage testing is to be performed by the Testing, Adjusting and Balancing (TAB) agency in accordance with SMACNA HVAC Air Duct Leakage Test Manual and is to be witnessed by the Consultant.

.3 Leakage test following ductwork:

.1 All new supply ductwork.

.4 Be responsible for following:

.1 preparing duct systems for leakage testing prior to installation of external insulation including capping duct runouts and provision of final tap-in for test equipment;

.2 schedule testing with TAB agency in advance, be present for all testing and ensure notice is given to the Consultant so they may witness testing;

.3 resealing and/or replacement of defective ductwork;

.4 bearing all costs associated with retesting ductwork which has failed to pass leakage testing.

.16 Seal all ductwork in accordance with SMACNA Seal Class "A", except for round duct with self-sealing gasketed fittings and couplings which does not require site applied sealant. Apply sealants by brush or gun to cleaned metal surfaces. Where bare ductwork is exposed apply neat uniform lines of sealant. Randomly brushed, sloppy looking sealant applications will be rejected and must be repaired or replaced with a neat application of sealant.

.17 Apply sealants by brush or gun to cleaned metal surfaces. Where bare ductwork is exposed apply neat uniform lines of sealant. Randomly brushed, sloppy looking sealant applications will be rejected and must be repaired or replaced with a neat application of sealant.

.18 Clean exterior exposed (uninsulated) ducts and coat with a heavy full coverage of Bakor #410-02 black metal paint.

.19 Where dissimilar metal ducts are to be connected, isolate ducts by means of flexible duct connection material.

.20 Round exposed ductwork in Gymnasium is to be 2 metal gauges heavier than standard metal gauge for same size duct, and duct hangers are to be pairs of 9.5 mm (⅜") diameter hanger rods secured to 40 mm (1-½") wide #12 gauge galvanized steel split clamps around full circumference of duct at maximum 1.8 m (72") centres. Provide double nuts and lock washers on each hanger rod above and below each clamp.

3.03 Installation of Flexible Ductwork

.1 Provide maximum 3 m (10') long lengths of flexible ductwork for connections between galvanized steel duct mains and branches, and necks of ceiling grilles and diffusers. Do not install flexible ductwork through walls, even if shown on drawings.

.2 At rectangular galvanized steel duct, accurately cut holes and provide flanged or "Spin-in" round flexible duct connection collars. Seal joints with duct sealer.

.3 Install flexible ducts as straight as possible and support in accordance with requirements of ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible, and secure at each end with nylon or stainless steel gear type clamps, and seal joints. Provide long radius duct bends where they are required.

.4 Do not penetrate fire barriers with flexible duct.

3.04 Installation of Acoustic Lining

.1 Provide acoustic lining in ductwork in locations as follows:

.1 wherever shown and/or specified on drawings;

.2 supply ductwork downstream of air terminal boxes for a distance of 2.4 m (8') measured along duct and outward from box in all directions;

.3 all transfer air ducts.

.2 Install lining in accordance with requirements of ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible, however, for all installations regardless of velocity, at leading and trailing edges of duct liner sections, provide galvanized steel nosing channel in accordance with detail entitled Flexible Duct Liner Installation found in the ANSI/SMACNA manual referred to above.

3.05 Installation of Casings and Plenums

.1 Provide required shop or site fabricated casings and plenums. Unless otherwise specified or shown, construct casings and plenums of same material as connecting duct system.

.2 Construct and install casings and plenums in accordance with Chapter 6 of ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible to suit systems' pressure classification. Ensure plenums and casings secured to building structure are gasketed air-tight and equipped with angle reinforcing.

.3 Provide drain pans with accessible trapped drains for fresh air intake plenums, and wherever else shown.

3.06 Installation of Acoustic Panels

.1 Provide acoustic panels for plenums. Integrate acoustic plenums with standard casings and plenums. Install acoustic panels in strict accordance with manufacturer's instructions. Seal panels with acoustic caulking where pipes, ducts or conduit penetrate and make air and watertight.

.2 Provide floor to ceiling high acoustic plenums where shown, each complete with required framing, including framing for access doors and other openings, each structurally designed to resist excessive deflection or bowing, constructed to be air-tight when subjected to a pressure differential of 2.48 kPa (0.36 psi), and designed so any one panel can be removed without dismantling entire plenum.

.3 Provide acoustic type access doors where shown, and provide acoustic caulking at all locations where acoustic plenums abut building walls or slabs, and at all points where pipe, ducts or conduit penetrate acoustic panels.

3.07 Installation of Casing and Plenum Access Doors

.1 Provide access doors into all site or shop fabricated casings and plenums requiring access, and wherever shown.

.2 Construct access doors to open in or out to suit positive and negative pressures of system.

.3 Provide pitot tube openings in access doors where required for system air quantity balancing purposes.

.4 Provide suitably sized, engraved, red-white laminated Lamacoid warning nameplates on access doors into casings and plenums where equipment is located, i.e. fans.

3.08 Installation of Round to Rectangular Duct Connections

.1 Cut round holes in rectangular ducts and provide round to rectangular lock-in fittings with dampers for connection of flexible round ductwork.

3.09 Installation of Splitter Dampers

.1 Provide splitter dampers in supply ductwork at branch duct connections off supply air mains, and wherever else shown and/or specified on drawings. Install splitter dampers so they cannot vibrate and rattle and so damper operation mechanisms are in an easily accessible and operable location. Ensure operators for dampers in insulated ducts are equipped with stand-off mounting brackets.

3.10 Installation of Turning Vanes

.1 Provide turning vanes in ductwork elbows where shown on drawings and wherever else required where, due to site installation routing and duct elbow radius, turning vanes are recommended in accordance with ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible.

.2 Provide volume extractor type turning vanes in short branch supply duct connections off mains to grilles and diffusers where shown and/or specified.

3.11 Installation of Manual Balancing (Volume) Dampers

.1 Provide manual balancing dampers as required to provide a fully balanced system, including but not limited to in all open end ductwork, in all duct mains, and wherever else shown and/or specified.

.2 Install dampers so operating mechanism is accessible and positioned for easy operation, and so dampers cannot move or rattle. Ensure operating mechanisms for dampers in insulated ducts are complete with stand-off mounting brackets.

.3 Where a duct for which a balancing damper is required has dimensions larger than dimensions of maximum size volume damper available, provide multiple dampers bolted together in a properly sized

assembly, or bolted to a heavy-gauge black structural steel angle or channel framework which is properly sized. Seal to prevent air by-pass, and provide connecting linkage.

.4 Confirm exact damper locations with personnel doing air quantity balancing testing work and install dampers to suit. Include for providing 5 additional dampers at no additional cost.

3.12 Installation of Backdraft Dampers

.1 Provide backdraft dampers.

.2 Install and secure dampers so they cannot move or rattle.

3.13 Installation of Combination Fire/Smoke Dampers

.1 Provide combination fire/smoke dampers. Install dampers with retaining angles on all 4 sides of each side of damper, and, where required, connect with ductwork, all in accordance with damper manufacturer's instructions and details, and Code requirements.

.2 Coordinate damper installation with electrical work where electrical connections to damper actuators are specified.

3.14 Installation of Smoke Dampers

.1 Provide smoke dampers. Install dampers with retaining angles on all 4 sides of sleeve on both sides of damper and connect with ductwork in accordance with damper manufacturer's instructions and details, and Code requirements.

.2 Coordinate damper installation with electrical work where electrical connections to damper actuators are specified.

.3 Where size of fire barrier opening requires use of a sectionalized fire damper assembly, provide multiple smoke dampers (sized to CAN/ULC S112) bolted together in a properly sized assembly or bolted to a heavy-gauge black structural steel angle or channel framework.

3.15 Installation of Flexible Connection Material

.1 Provide a minimum of 100 mm (4") of flexible connection material where ducts, plenums, and/or easings connect to fans, and wherever else shown or specified.

.2 Rigidly secure a minimum of 75 mm (3") of duct material (minimum #24 gauge) to each edge of flexible fabric and to fan, duct, plenum, etc., in accordance with ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible. Ensure connections to flexible fabric material are arranged and supported so as to not impose any external forces on the fabric.

3.16 Installation of Roof Mounted Duct Supports

.1 Supply supports for roof mounted ductwork.

.2 Hand adjustable structural supports to roofing trade on roof for installation and flashing into roof construction as part of roofing work. Accurately mark exact locations and spacing of structural supports and supervise installation. Provide properly sized hot dip galvanized structural steel angles between structural supports and secure in place on support studs. Support ductwork on the angles and provide galvanized steel banding to secure ducts to the angles.

.3 Accurately mark location and spacing of roof support assemblies. At each plastic base location, carefully scrape away loose roof ballast (gravel) and all other debris and dirt. Prime existing membrane with a primer which is compatible with existing roofing components. Set bases in adhesive in accordance with manufacturer's installation instructions. Scrape loose ballast back around and on bases. Install framing,

and install ductwork on the cross-members. Secure ductwork to cross-members with galvanized steel banding.

3.17 Installation of Duct Access Doors

.1 Provide access doors in ductwork for access to all components which will or may need maintenance and/or repair, including reheat coils. Install in accordance with requirements of ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible.

.2 Identify access doors provided for fusible link damper maintenance with "FLD" stencil painted or marker type red lettering and ensure doors are properly located for damper maintenance.

.3 When requested, submit a sample of proposed duct access doors for review.

.4 Where sectionalized fusible link dampers and/or balancing dampers are provided in large ducts, provide a plenum type access door to suit, and adequately reinforce ductwork to suit access door installed.

3.18 Installation of Instruments Test Ports

.1 Provide instrument test ports in all main ducts at connections to fans, plenums or casings, in all larger branch duct connections to mains, and wherever else required for proper air quantity balancing and testing.

.2 Locate test ports where recommended by personnel performing air quantity testing and balancing work.

3.19 Installation of Wire Mesh (Birdscreen)

.1 Provide framed, removable wire mesh panels over openings in ducts and/or walls where shown and/or specified on drawings. Rigidly secure in place but ensure panels are removable.

.2 Provide wire mesh panels for open-end return air ducts in ceiling spaces whether shown on drawings or not.

3.20 Installation of Louvres

.1 Provide louvres for wall openings.

.2 Install louvre assemblies and secure in place in accordance with manufacturer's instructions and details.

.3 Confirm exact louvre sizes and finish prior to ordering.

3.21 Installation of Louvre Blank-Off Panels

.1 Provide blank-off panels for inactive portions of exterior wall louvres.

.2 Secure panels in place with non-ferrous hardware so they cannot move or rattle, yet are easily removable.

.3 Confirm exact finish of panels prior to fabrication.

3.22 Installation of Brick and Block Vents

.1 Supply brick or block vents for installation in exterior walls.

.2 Hand assemblies to masonry trade for installation.

.3 Accurately mark exact locations and coordinate installation.

3.23 Installation of Grilles and Diffusers

.1 Provide grilles and diffusers. Wherever possible, grilles and diffusers are to be product of same manufacturer.

.2 Unless otherwise specified connect grilles and diffusers in accordance with requirements of SMACNA HVAC Duct Construction Standards Metal and Flexible.

.3 Exactly locate grilles and diffusers to conform to final architectural reflected ceiling plans and detailed wall elevations, and to conform to final lighting arrangement, ceiling layout, ornamental and other wall treatment.

.4 Equip supply diffusers having a basic 4-way or all round air pattern for operation in 1-, 2-, or 3-way pattern where indicated on drawings.

.5 Provide sheet metal plenums, constructed of same material as connecting duct, for linear grilles and/or diffusers where shown. Construct and install plenums in accordance with requirements of SMACNA HVAC Duct Construction Standards Metal and Flexible. Where individual sections of linear grilles or diffusers are not equipped with a volume control device, equip duct connection collar(s) with volume control device(s).

.6 Where linear type diffusers/grilles are installed in suspended T-bar ceilings, clip diffusers/grilles in place using clip supplied by diffuser/grille manufacturer.

.7 Confirm grille and diffuser finishes prior to ordering.

3.24 Installation of Intake and Exhaust Wall Boxes

.1 Supply brick or block vents for installation in exterior walls.

.2 Hand assemblies to masonry trade for installation.

.3 Accurately mark exact locations and coordinate installation.

3.25 Duct System Protection, Cleaning and Start-Up

.1 Temporarily cover all open ends of ducts during construction.

.2 Remove all dirt and foreign matter from entire duct systems and clean duct system terminals and interior of air handling units prior to operating fans.

.3 Prior to starting any supply air handling system provide 50 mm (2") thick glass fibre construction filters at fan equipment in place of permanent filters.

.4 Provide cheesecloth over duct system inlets and outlets and run system for 24 hours, after which remove cheesecloth and construction filters, and install new permanent filters.

.5 Include all labour for a complete site walk-through with testing and balancing personnel following route of all duct systems to be tested, adjusted and balanced for the purpose of confirming proper position and attitude of dampers, location of pitot tube openings, and any other work affecting testing and balancing procedures. Perform corrective work required as a result of this walk-through.

End of Section

1 General

1.01 Submittals

.1 Submit shop product data sheets for silencers. Include all construction, acoustic and aerodynamic performance data, and details with submission. Acoustical data is to demonstrate that duct systems with silencers will reduce mechanical fan system noise to required levels in occupied spaces.

.2 Submit manufacturer's test data to indicate results of factory tests on the silencers prior to shipment.

.3 Submit a copy of the silencer manufacturer's National Voluntary Laboratory Accreditation Program (NVLAP) accreditation certificate for ASTM E477 test standards.

1.02 Closeout Submittals

.1 Submit an installation certification letter from silencer manufacturer as specified in Part 3 of this section.

1.03 Quality Assurance

.1 Silencer performance must be substantiated by laboratory testing in a duct-to-reverberant room test facility according to ASTM E477, Standard Test Method for Measuring Acoustical and Airflow Performance of Duct Liner Material and Prefabricated Silencers.

.2 Silencer acoustic media and any lining/wrapping material must have a maximum flame spread rating of 25 and a smoke developed rating of 50 when tested in accordance with CAN/ULC S102, Surface Burning Characteristics of Building Materials, and Accessories.

2 Products

2.01 Manufacturers

.1 Vibro-Acoustics Ltd.;

.2 Kinetics Noise Control Vibron Products Group;

.3 Price Industries Inc.

2.02 General Re: Silencers

.1 Silencers are to be factory fabricated by same manufacturer and are to be in accordance with drawing schedule, and tested in accordance with ASTM E477 through National Voluntary Laboratory Accreditation Program (NVLAP) with valid accreditation certificate.

.2 Silencer inlet and outlet dimensions are to be equal to duct sizes shown on drawings. Unless otherwise shown or specified, transitions will not be permitted.

.3 Silencers are to be constructed in accordance with SMACNA HVAC Duct Construction Standards Metal and Flexible, to suit duct system pressure and velocity classification. Unless otherwise specified, casing seams and joints are to be lock-formed and sealed or stitch welded and sealed, and silencers are to be constructed so as not to fail when subjected to an internal static pressure of 3.9 kPa (8" wg).

.4 Perforated steel is to be adequately stiffened to ensure flatness and form, and welds are to be shop painted with zinc rich paint.

.5 Silencers are to be shipped with factory installed end caps.

.6 Galvanized steel is to be in accordance with ASTM A653.

2.03 Outer Casing Materials

.1 Rectangular Straight and Transitional Straight Silencers: Minimum #22 gauge lock forming quality galvanized steel.

.2 Elbow and Transitional Elbow Silencers: Minimum #18 gauge for elbow lock forming quality galvanized steel.

.3 High Transmission Loss (HTL) Rectangular and Elbow Silencers: # 16 or #10 gauge stitch-welded and caulked galvanized steel in accordance with drawing schedule.

.4 Circular Silencers: Lock forming quality galvanized steel with minimum gauges as follows:

.1 300 mm to 660 mm (12" to 26") dia. - #22 gauge;

.2 675 mm to 1.52 m (27" to 60") dia. - #18 gauge;

.3 1.55 m to 2.13 m (61" to 84") dia. - #16 gauge.

2.04 Interior Baffle-Liner-Bullet Material

.1 Minimum #22 gauge lock forming quality galvanized steel.

2.05 Interior Baffle Transition

.1 Transitioning for interior transition silencers is to occur internal to silencer such that height of air passage is uniformly changing with the length of the air passage.

2.06 Acoustic Media Material

.1 Acoustic quality insulation which does not contain any formaldehydes, phenolic resins, or volatile organic compounds that can off-gas, but containing cotton fibres treated with an EPA registered non-toxic borate solution, "flash dried" to actively inhibit the growth of mould, mildew, bacteria, and fungi.

2.07 Acoustic Media Protection Material

.1 Material for lining/wrapping acoustic media to help prevent shedding and erosion, in accordance with drawing schedule, is to be:

.1 Tedlar film material separated from perforated metal liner with a 12 mm (½") thick acoustically transparent spacer;

3 Execution

3.01 Installation of Silencers

.1 Provide silencers. Ensure silencers are installed with airflow arrows in the direction of airflow.

.2 Support each silencer independent of connecting ductwork.

.3 Properly layout ductwork for silencer locations to provide a minimum of 5 diameters of straight duct upstream of silencer and 10 diameters of straight duct downstream of silencer.

.4 Unless otherwise specified, do not install silencers in walls or slabs.

.5 Where cross-talk silencers penetrate partition walls, seal joint between perimeter of silencer and the wall, on both sides of the wall, with proper acoustic caulking.

.6 Seal all silencer connections to ducts with proper fire/smoke rated duct sealer.

.7 When silencer installations are complete, arrange, and pay for silencer manufacturer to examine silencer installations. Perform any corrective work required by manufacturer, then obtain from manufacturer and submit a signed letter certifying proper installation and operation of all silencers.

End of Section

1 General

1.01 Submittals

.1 Submit shop drawings/product data sheets for fans and accessories. Include following:

.1 certified fan performance curves at specified operating point with flow, static pressure and HP clearly plotted;

.2 certified sound power data that conforms to specified levels;

.3 product data sheets for all accessories;

.4 product data sheets for fan motors.

1.02 Closeout Submittals

.1 Submit with delivery of each unit a copy of the factory inspection report, and include a copy of each report with O&M Manual project close-out data.

.2 Submit a site inspection and start-up report from manufacturer's representative as specified in Part 3 of this section.

.3 Supply reviewed copies of fan/curb assembly shop drawings or product data to trade who will cut roof openings for fans, and ensure openings are properly located.

.4 Submit a signed copy of destratification fan manufacturer's 5 year extended parts and labour warranty.

.5 Submit a signed copy of ceiling mounted fan manufacturer's extended 3 year warranty.

.6 Training attendance records.

1.03 Quality Assurance

.1 Fan manufacturers, as applicable, are to be current members of the Air Movement and Control Association International Inc. (AMCA), and fans are to be rated (capacity and sound performance) and certified in accordance with requirements of following standards:

.1 ANSI/AMCA Standard 210, Laboratory Method of Testing Fans for Certified Aerodynamic Performance Rating;

.2 AMCA Standard 211, Product Rating Manual for Fan Air Performance;

.3 ANSI/AMCA Standard 300, Reverberant Room Method for Sound Testing of Fans;

.4 AMCA Standard 311, Product Rating Manual for Fan Sound Performance;

.5 AMCA Standard 99-2408, Operating Limits for Centrifugal Fans.

2 Products

2.01 Centrifugal Inline Fans

.1 Centrifugal, ULC listed, factory run tested rectangular inline fans in accordance with drawing schedule.

.2 Heavy-gauge galvanized steel housing with removable side panels to permit removal of power assembly without disturbing duct connections, universal mounting brackets and hardware including spring vibration

isolators to accommodate horizontal or vertical mounting as required, a flanged inlet panel with inlet venturi, a flanged outlet panel, both with duct connection collars, and galvanized steel wire grid fan inlet/outlet guard(s).

.3 Non-overloading aluminium wheel with backward inclined blades with matching inlet venturi, statically and dynamically balanced as an assembly.

.4 For belt-drive fans only, hot rolled steel shaft, accurately turned, ground, and polished, and sized for a first critical speed of at least 1.25 times maximum rated speed for fan, and heavy-duty, self-aligning pillow block type bearings selected for an AFBMA L-50 minimum average life in excess of 500,000 hours and equipped with lubrication line and fitting, and an adjustable V-belt drive with guard conforming to requirements of Section 20 05 00 – Common Work Results for Mechanical.

.5 TEFC motor conforming to requirements specified in Section 20 05 00 – Common Work Results for Mechanical, mounted out of the airstream, complete with a cover, and factory pre-wired to a NEMA 4 disconnect switch.

.6 For fans as scheduled, factory supplied accessories as follows:

.1 for fans as scheduled, housing insulation (lining), consisting of neoprene spray coated glass fibre semi-rigid insulation meeting NFPA 90A requirements and 25/50 flame spread/smoke developed ratings when tested in accordance with CAN/ULC S102, permanently secured in place with no exposed edges;

.2 for fans as scheduled, a galvanized steel filter box with frame suitable for 25 mm (2") thick disposable panel type filters;

.3 factory secured seismic restraint connection hardware.

.7 Manufacturers:

.1 Twin City Fan and Blower;

.2 Loren Cook Co.;

.3 Greenheck Fan Corp.;

.4 JencoFan;

.5 Carnes Company Inc.

2.02 Roof Mounted Exhaust Fans

.1 Centrifugal, ULC listed, factory run tested roof mounted exhaust fans in accordance with drawing schedule.

.2 Spun aluminium housing with deep venturi inlet, aluminium curb cap with continuously welded corners, pre-punched mounting holes, galvanized steel or aluminium bird screen, and EMT conduit chase to the motor compartment.

.3 Centrifugal, non-overloading aluminum wheel with backward inclined blades matched to inlet venturi, statically and dynamically balanced as an assembly.

.4 For belt-drive fans only, hot rolled steel shaft, accurately turned, ground, and polished, and sized for a first critical speed of at least 1.25 times maximum rated speed for fan, and one-piece grease lubricated pillow block type bearings selected for an AFBMA L-50 minimum average life in excess of 500,000 hours at maximum catalogue operating speed and equipped with a lubrication fitting, and a heavy-gauge galvanized steel adjustable V-belt drive with guard conforming to requirements of Section 20 05 00 – Common Work Results for Mechanical.

.5 Motors are to conform to requirements specified in Section 20 05 00 – Common Work Results for Mechanical, mounted on vibration isolation in a compartment outside of the airstream, and factory pre-wired to a NEMA 4 disconnect switch.

.6 Prefabricated, minimum 300 mm (12") high heavy-duty aluminum roof mounting curb with factory installed wood nailer, 40 mm (1-½") thick insulation, continuously welded seams, and damper tray.

.7 For fans as scheduled, factory supplied accessories as follows:

.1 gravity backdraft damper with #20 gauge galvanized steel frame and #26 gauge aluminum blades with felt edge blade seals;

.2 non-corrosive motorized damper with linkage, end switch, and motor with voltage to match fan motor;

.3 continuous non-corrosive piano type curb hinge to permit access to fan, damper and connecting duct, complete with retaining chain and a security hasp to prevent removal of unit from curb cap and prevent building entry through connecting ductwork;

.4 2-speed switch and 2-speed double winding 1-phase motor in accordance with Section 20 05 00 – Common Work Results for Mechanical;

.8 Manufacturers:

.1 Twin City Fan and Blower;

.2 Loren Cook Co.;

.3 Greenheck Fan Corp.;

.4 JencoFan;

.5 Carnes Company Inc.

2.03 Ceiling Mounted Destratification Fans

.1 Air Pear EC Destratification fan. Premium electrically commutated motor by ebm-papst Patented multi-vane stator and venturi nozzle 3-year parts and workmanship warranty 6 ft. steel leash and anchor point for safety. Conforms to UL-507, CAN/CSA-C22.2 No. 1113. ETL listed in USA and Canada.

.2 BACnet MS/TP card for integration with an existing BACnet system. Individually control speed, on/off and monitor fan status.

.3 Manufacturers:

.1 Airius.

2.04 Ceiling Mounted Fans

.1 ULC listed and labelled ceiling mounted centrifugal, AMCA rated and certified (capacity and sound to AMCA Standards 211 and 311), exhaust fans in accordance with drawing schedule, complete with:

.1 minimum #20 gauge galvanized steel housing equipped with duct connection collar(s), integral spring loaded aluminum backdraft damper, 12 mm (½") thick acoustic insulation meeting 25/50 flame spread/smoke developed ratings when tested in accordance with CAN/ULC S102, multi-position mounting brackets, and an integral CSA certified electrical receptacle in an outlet box for plug-in connection of fan motor;

.2 low RPM, resiliently mounted, direct connected fan wheel and motor assembly with a forward curved, statically and dynamically balanced galvanized steel or calcium carbonate filled polypropylene centrifugal wheel direct connected to a 1-phase motor conforming to requirements specified in Section 20 05 00 – Common Work Results for Mechanical, and equipped with a length of power cord and plug;

.3 for fans as indicated and/or scheduled, a white calcium carbonate exhaust grille;

.4 factory supplied accessories in accordance with drawing schedule, as follows:

.1 rectangular to round duct transitions;

.2 roof cap with backdraft damper and birdscreen;

.3 wall cap with backdraft damper and birdscreen.

.2 Manufacturers:

.1 Twin City Fan and Blower;

.2 Loren Cook Co.;

.3 Greenheck Fan Corp.;

.4 CML Northern Blower;

.5 PennBarry.

3 Execution

3.01 Installation of Centrifugal Inline Fans

.1 Provide inline centrifugal fans.

.2 Secure each fan in place from structure with vibration isolation, independent of connecting ductwork and in accordance with fan manufacturer's instructions.

.3 Brace and secure each unit in accordance with requirements specified in Section 20 05 48.16 – Seismic Controls for Mechanical Systems.

.4 Ensure duct connections are made using flexible connection material.

.5 For equipment/system manufacturer certification requirements, refer to Section 20 05 00 – Common Work Results for Mechanical.

.6 For equipment/system start-up requirements, refer to Section 20 05 00 – Common Work Results for Mechanical.

.7 Include for a 4 hour on-site operation demonstration and training session. Training is to be a full review of all components including but not limited to a full operation and maintenance demonstration, with abnormal events.

3.02 Installation of Roof Mounted Exhaust Fans

.1 Provide roof mounted exhaust fans.

.2 Supply a roof mounting curb with each fan and hand curbs to roofing trade on roof for mounting and flashing into roof construction as part of roofing work. Secure fans in place on curbs.

.3 Install dampers in curb damper tray and secure in place.

.4 For equipment/system manufacturer certification requirements, refer to Section 20 05 00 – Common Work Results for Mechanical.

.5 For equipment/system start-up requirements, refer to Section 20 05 00 – Common Work Results for Mechanical.

.6 Include for a 4 hour on-site operation demonstration and training session. Training is to be a full review of all components including but not limited to a full operation and maintenance demonstration, with abnormal events.

3.03 Installation of Ceiling Destratification Fans

.1 Provide ceiling destratification fans.

.2 Secure each fan in place at the ceiling from structure in accordance with manufacturer's instructions and drawing details. Confirm exact locations prior to roughing-in. Install safety chains and fan blade guards.

.3 Plug each fan motor into an adjacent receptacle.

.4 Supply a fan speed controller for fans as indicated and hand to electrical trade at site for wall mounting and connection to fan motor controllers. Confirm exact speed controller locations prior to installation, and include for identification of each speed controller.

.5 For equipment/system manufacturer certification requirements, refer to Section 20 05 00 – Common Work Results for Mechanical.

.6 For equipment/system start-up requirements, refer to Section 20 05 00 – Common Work Results for Mechanical.

.7 Include for a 1/2 day on-site operation demonstration and training session. Training is to be a full review of all components including but not limited to a full operation and maintenance demonstration, with abnormal events.

3.04 Installation of Ceiling Fans

.1 Provide ceiling exhaust fans.

.2 Secure each ceiling mounted fan housing in place in ceiling space, flush with suspended ceiling.

.3 Secure suspended units in place from structure, level, and plumb, by means of vibration isolation spring hangers and galvanized steel hanger rods.

.4 Plug fan motors into housing receptacles.

.5 Supply exterior wall/roof discharge caps as indicated.

.6 Hand roof caps to roof trade for installation and flashing into roof construction as part of roofing work.

.7 Install wall caps and secure in place. Caulk perimeter of each wall cap in accordance with caulking requirements specified in Division 07.

.8 Connect fan housings and discharges with ductwork.

.9 Brace and secure each unit in accordance with requirements specified in Section 20 05 48.16 – Seismic Controls for Mechanical Systems.

.10 For equipment/system start-up requirements, refer to Section 20 05 00 – Common Work Results for Mechanical.

3.05 Training

.1 Include for a 4 hour on-site operation demonstration and training session. Training is to be a full review of all components including but not limited to a full operation and maintenance demonstration.

End of Section

1 General

1.01 Submittals

.1 Submit shop drawings/product data sheets for air terminals. Include following:

.1 capacity and pressure drop;

.2 sound power data to verify conformance with specified sound power levels;

.3 leakage and dimensions;

.4 mounting details to suit locations shown, indicating methods and hardware to be used;

.5 control components and a control wiring schematic.

.2 Submit with shop drawings/product data, a test report in accordance with ANSI/AMCA 210 requirements and ISO 3741, published test data on DIN (Direct Internal Noise) made by an independent testing agency for 2.5 and 6 m/s (8.2 and 19.7 ft/min) branch velocity or inlet velocity, sound power levels with a minimum inlet pressure of 0.25 kPa (0.036 psi) in accordance with ISO 3741 for the 2nd through 7th octave bands, and confirmation pressure loss through a silencer will not exceed 60% of inlet velocity pressure maximum.

1.02 Closeout Submittals

.1 Submit a site inspection and start-up report from manufacturer's representative as specified in Part 3 of this section.

1.03 Quality Assurance

.1 Air terminals manufacturers are to be current members of Air-Conditioning, Heating and Refrigeration Institute (AHRI), and terminals are to be in accordance with requirements of following standards:

.1 ANSI/AHRI Standard 880, Performance Rating of Air Terminals;

.2 ANSI/AMCA Standard 210, Laboratory Method of Testing Fans for Certified Aerodynamic Performance Rating;

.3 International Organization of Standardization (ISO) Standard 3741, Acoustics-Determination of Sound Power Levels of Noise Sources Using Sound Pressure-Precision Methods for Reverberation Rooms.

2 Products

2.01 Manufacturers

.1 Price Industries Inc.;

.2 Trane;

.3 Titus;

.4 Nailor Industries Inc.;

.5 Krueger Division of Air System Components Inc.

2.02 Variable Air Volume (VAV) Terminal Boxes

.1 Single duct, controller type, pressure independent variable air volume boxes in accordance with drawing schedule, each individually field adjustable to minimum and maximum air volumes, and complete with:

.1 #22 gauge galvanized steel housing, sealed and gasketed, internally lined with 25 mm (1") thick glass fibre duct lining material with a neoprene coating meeting NFPA 90A and 25/50 flame spread/smoke developed ratings when tested in accordance with CAN/ULC S102, and complete with:

.1 exposed cut edges of the liner material factory coated with NFPA 90A and CAN/ULC S102 approved sealant;

.2 50 mm (2") long, round inlet duct connection;

.3 rectangular discharge opening with slip and drive cleat duct connection facilities;

.4 protective galvanized steel shroud for controller and damper actuator.

.2 air valve damper, normally open, galvanized steel blade with peripheral gasket, pivoting in self-lubricating bearings and with air leakage past a closed damper of 2% or less of rated capacity at 750 Pa (3" wc) inlet static pressure;

.3 air flow sensor located at box inlet, complete with gauge taps, multiple pressure sensing ports, and an averaging chamber designed to accurately average the flow across the inlet of box with an accuracy of within 5% with a 90° sheet metal elbow located directly at inlet, and amplify the sensed air flow signal;

.4 digital controller/actuator factory installed, connected and tested control package including a microprocessor based stand-alone digital controller capable of networking with a building automation system, personal computer, or a portable operator interface device, an electronic flow transducer, and an electronic actuator for damper, all calibrated and factory set for maximum and minimum air flow, field adjustable and equipped with gauge taps for balancing with a standard pressure gauge;

.5 for boxes as scheduled, AHRI performance rated and certified, CSA certified electric reheat coils in accordance with drawing schedule, each factory mounted, wired and tested and complete with:

.1 galvanized steel coil frame and cabinet with 20 mm (¾") thick neoprene coated glass fibre insulation meeting NFPA 90A and 25/50 flame spread/smoke developed ratings when tested in accordance with CAN/ULC S102;

.2 hinged access door for electrical enclosure;

.3 low watt density coil consisting of minimum Grade 80/20 nickel-chromium wire elements insulated from frame by floating ceramic bushings;

.4 pre-wired safety devices and controls including:

.1 automatic reset primary thermal cut-out and a manual reset secondary thermal cut-out;

.2 differential pressure switch to shut-down coil upon sensing a no air flow condition;

.3 electronic modulating controller compatible with building controls for proportioned pulsed AC or DC control of heater;

.4 door interlock disconnect switch;

.5 mercury contactors;

.6 Class II, 24 volt AC control transformer as required.

.6 galvanized steel attenuators, lined as per box housings, each factory supplied loose and with a length in accordance with drawing schedule;

.7 wall mounting thermostat with thermometer and guard, supplied with boxes by box manufacturer, suitable in all respects for box it controls and control sequence, and complete with all required installation and connection accessories.

.2 Terminal box to be complete with attenuator or lined discharge duct in place. Maximum sound power levels in decibels and specific static pressure are scheduled on drawings for each size of box.

3 Execution

3.01 Installation of Terminal Boxes

.1 Provide ceiling mounted terminal boxes.

.2 Secure each box in place from structure by means of galvanized steel angles and hanger rods, independent of connecting ductwork.

.3 Coordinate provision of transformers, actuators and controllers with Controls Contractor.

.4 Connect each box with ductwork as indicated. Provide straight inlet duct same size as box inlet and of a length equal to a minimum of 4 duct diameters. Refer to drawing detail. Coordinate final box adjustments and settings with personnel doing system testing and balancing work.

3.02 System Startup

.1 For equipment/system start-up requirements, refer to Section 20 05 00 – Common Work Results for Mechanical.

3.03 Training

.1 Include for a 1/2 day on-site operation demonstration and training session. Training is to be a full review of all components including, but not limited to, a full operation and maintenance demonstration, and setting and adjusting controls.

End of Section

1 General

1.01 Submittals

.1 Submit shop drawings/product data sheets for all products specified in this section.

1.02 Maintenance Material Submittals

.1 Prior to Substantial Performance of the Work, submit a set of spare filters in original identified packaging for each air handling unit requiring filters. Store filters on site where directed by Consultant or Owner.

.2 Prior to Substantial Performance of the Work, submit a spare bottle of red manometer filter gauge oil, with instructions, to Owner for each manometer type gauge installed.

2 Products

2.01 General

.1 Unless otherwise specified or noted, filters are to be synthetic and/or glass fibre disposable media type in accordance with drawing schedule(s).

.2 Minimum Efficiency Reporting Values (MERV) ratings in accordance with ASHRAE Standard 52.2, Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Sizes.

.3 Unless otherwise specified or noted, filters are to be UL/ULC Class 1 in accordance with UL Standard 900, Air Filter Units, ULC S111, Standard Method of Fire Tests for Air Filter Units, and CAN/CGSB 115.10, Disposable Air Filters for Removal of Particulate Matter from Ventilation Systems.

.4 Manufacturers:

.1 AAF International;

.2 Camfil Farr Inc.;

.3 Modern Air Filter Corp.

2.02 Construction Filters

.1 Roll type, disposable, MERV 7 to 9 woven glass fibre media, UL Class 2.

2.03 Inclined Manometer Air Filter Gauge

.1 Dwyer Instruments Inc. Model 250.5-AF inclined tube differential pressure type filter gauge of solid acrylic construction, complete with vent valves for zeroing, built-in level vial, over-pressure safety traps, adjustable mirror polished scale, and 2, 1.5 m (5') lengths of 6.4 mm (¼") dia. tubing, 2 static pressure tips, mounting hardware, and a spare bottle of red gauge oil and instructions.

.2 Each filter gauge is to be complete with contacts suitable for connection into building automation system.

3 Execution

3.01 Installation of Construction Filters

.1 Provide roll type medium efficiency disposable media filter(s) across entire filter bank of each supply air handling unit, either at factory where fan is produced or at site as soon as fan is installed. Secure media in place so it will not be dislodged by fan operation. Replace roll media periodically if it becomes loaded and clogged.

.2 For exhaust systems, secure filter media across exhaust air openings and ductwork to prevent construction dirt and dust from fouling the fan

.3 Leave media in place until fan start-up, at which time remove and dispose of construction media.

3.02 Installation of Filters

.1 Provide required filter media when fan equipment is ready for start-up and performance testing. Provide any required filter framing/racks.

.2 Prior to Substantial Performance of the Work, supply a complete spare set of filter media in original packaging and clearly identified as to the applicable system for each air handling system with filters. Store filters at site where directed by Owner.

3.03 Installation of Inclined Manometer Filter Gauges

.1 Provide an inclined manometer filter gauge for air handling system filter banks.

.2 Secure gauge to filter section casing and install differential pressure tubing and tips. Fill gauges with red oil and adjust as required.

.3 Affix a red arrow to scale so it indicates point on scale where filters are clogged and require replacement.

End of Section

1 General

1.01 Submittals

.1 Submit product data sheets for flue gas vents/air intakes and accessories.

1.02 Coordination

.1 Supply a reviewed shop drawing to appropriate trade to indicate vent size and flashing materials supplied, and accurately locate building openings.

2 Products

2.01 Condensing Appliance Type BH Flue Gas Vents (and Combustion Air Intakes)

.1 Equal to Ipex "System 636" PVC (for vent gas to 65°C (130°F)) or CPVC (for vent gas to 90°C (195°F)) solvent weld vent pipe and fittings, in accordance with CAN/CSA B149.1, certified as type BH vents to ULC S636, Standard for Type BH Gas Venting Systems, suitable for negative or positive venting and complete with an orange warning label to verify compliance with ULC S636, and a moulded cap with screen for vertical termination, or low profile wall termination kit, as applicable.

2.02 Double Wall Stainless Steel Vent for Condensing Equipment

.1 Positive pressure double wall stainless steel flue gas vent with a type 304 outer casing, an AL29-4C inner flue, and a 25 mm (1") annular air space, ULC S636 listed and labelled, complete with prefabricated mated fittings and accessories including a flashing accessory, storm collar counter-flashing piece, and a termination cap.

2.03 Barometric Dampers

.1 Equal to Field Controls UL/ULC listed and CSA certified Type M+MG2, field adjustable, single or double acting barometric damper to suit burner fuel, each complete with a gate which rests on a long, thin, stainless steel knife edge which in turn is supported by self-aligning and self-cleaning bearings, sized to suit the application, approved by equipment manufacturer, and complete with a field thermal switch accessory for dual fuel oil/gas fired burners.

3 Execution

3.01 Installation of Type BH Flue Gas Vents (and Combustion Air Intakes)

.1 Provide type BH flue gas vents and combustion air intakes for condensing appliances.

.2 Support spacing is to be in accordance with flue gas vent manufacturer's instructions. Installation is to be in accordance with gas fired appliance manufacturer's instructions and requirements of CAN/CSA B149.1.

.3 Route piping using shortest route possible to termination point while avoiding interference with other work. Slope vent piping for positive drainage.

.4 Equip termination of vent with a turn-down elbow with open end covered with bronze insect screen. Terminate exhaust vent a minimum of 3 m (10') away from fresh air intakes and operable windows.

.5 Confirm flue gas vent diameter prior to ordering.

3.02 Installation of Flue Gas Vents

.1 Provide ULC listed and labelled flue gas vents for equipment. Confirm flue gas vent diameters prior to ordering.

.2 Secure horizontal sections in place by means of support hardware supplied with vents and conforming to flue diameter, and hanger rods attached to structure. Support spacing is to be in accordance with vent manufacturer's instructions.

.3 Support vertical flue sections inside building at roof level and wherever else required by means of purpose made vertical support accessories supplied by manufacturer.

.4 Hand flashing collars to roofing trade at site on roof for installation and flashing into roof construction. Install counter-flashing pieces over collars.

.5 Equip termination of each chimney with a rain cap. Confirm height requirement for chimney above roof prior to installation, and ensure proper distance from fresh air intakes is maintained.

.6 Provide braided stainless steel aircraft cable guy wires attached to roof anchors and to stainless steel strap anchors on the vents as required and/or shown.

.7 Anchor and restrain vents in accordance with requirements of Section 20 05 48.16 - Seismic Controls for Mechanical Systems.

.8 Provide required accessories, including insulated thimbles at building wall penetrations, barometric damper(s), cleanout(s), fire stops, and expansion joints where shown and/or required.

.9 Locate and install barometric dampers in accordance with manufacturer's instructions and field adjust to suit operating conditions.

End of Section

1 General

1.01 Section Includes

.1 Wall Hung Condensing Hot Water Boilers.

1.02 Submittals

.1 Submit shop drawings/product data sheets for boilers, including accessories, and all required wiring schematics. Include boiler flue product data sheets with the submission.

1.03 Closeout Submittals

.1 Submit manufacturer's 8 year extended warranty for the heat exchanger, and 2 year extended warranty for all other boiler components.

.2 Supply complete spare charge of calcium carbonate chips for each acid neutralizing assembly.

.3 Submit, prior to Substantial Performance of the Work, start-up or test data specified in Part 3 of this section.

.4 Submit boiler manufacturer/supplier start-up and installation certification letters as specified in Part 3 of this section.

.5 Training attendance records.

1.04 Quality Assurance

.1 Boilers and installation of boilers are to be in accordance with requirements of following:

.1 all applicable Provincial Codes and Standards;

.2 CSA B51, Boiler, Pressure Vessel, and Pressure Piping Code;

.3 CAN/CSA B149.1, Natural Gas and Propane Installation Codes;

.4 CAN1-3.1, Industrial and Commercial Gas-Fired Package Boilers.

.2 Boiler installation tradesmen are to be journeyman tradesmen licensed to install boiler equipment.

2 Products

2.01 Wall Hung Condensing Hot Water Boilers

.1 Viessmann Manufacturing Co. "Vitodens 200-W" fully condensing, wall hung, zero clearance, factory assembled hot water boilers in accordance with drawing schedule.

.2 Performance requirements are as follows:

.1 boilers and burners, CSA certified and ULC listed and labelled as one unit, have a CRN, and comply with Provincial regulations;

.2 NOx emissions, maximum 8.9 ppm and in accordance with Canadian Council of Ministers of the Environment Initiative N306, PN 1286, and Provincial guidelines;

.3 95.2% boiler annual fuel efficiency;

.4 420 kPa (60 psi) boiler operating pressure rating.

.3 Each boiler complete with an enamelled steel accessible enclosure, and following construction features:

.1 high alloy (SA240 316Ti) stainless steel radial design coil type heat exchanger with defined gaps between coils for efficient heat transfer;

.2 factory calibrated, self-adjusting, fully modulating, stainless steel cylinder type burner capable of operating at altitudes of up to 3000 m (10,000') adjusting automatically to either natural gas or propane, and with a 3:1 turndown ratio, in accordance with CAN/CSA B149.1 or .2 as applicable, complete with variable speed DC blower for positive flue discharge, designed to return to the low fire position prior to ignition and to remain in the low fire position during ignition and until main flame has been proven and complete with:

.1 automatic electric spark ignition, and 100% safety shut-down ionization flame detector to monitor flame to prevent primary fuel valves from opening until flame has been established;

.2 microprocessor-based combustion manager to regulate gas butterfly valve, control ignition and safety shut-down, and display sequence of operation, safety lock-out error messages and codes, and information, service, and operating parameters;

.3 gas piping train with ball type shut-off valve, main gas pressure regulator, low gas pressure switch, double main gas valves, secondary gas pressure regulator, ball type shut-off valve, and gas valve, controlled through combustion manager to start or stop burner excessive pressure or temperature, low gas pressure, or low water condition.

.4 Boiler trim is to include the following:

.1 integral flow switch and an ASME rated factory sized and set relief valve;

.2 adjustable automatic reset high limit control and a manual rest high limit control in accordance with ASME Section IV;

.3 boiler manufacturer supplied, site installed low loss header to decouple high flow rate systems and ensure low return boiler water temperatures at all times, factory insulated with insulation and jacket conforming to requirements specified in Section 20 07 00 - Mechanical Systems Insulation, and equipped with NPT pipe connections, air vent, and drain valve;

.4 boiler manufacturer supplied, site installed distribution manifold with supply and return pipe connections, factory insulated with insulation and jacket conforming to requirements specified in Section 20 07 00 - Mechanical Systems Insulation.

.5 Multi-function, self-diagnostic, outdoor reset, weather responsive, digital controls with menu-driven programmable unit factory installed on each boiler, capable of communicating via KM-BUS protocol to a "Vitocontrol-S WB2B" distribution manifold mounted cascade control with temperatures sensor, accepting remote 0 to 10 volt input, boiler sequencing and firing rate, indoor/outdoor reset and user interface with graphic output. Boiler control is to self-adjust to varying operating environments and have priority for both electrical and fuel savings in its self-learning, self-adaption logic, and is to include fault code and alarm indication. Self-diagnostic cascade control is to operate up to 4 boilers and, where applicable, be capable of interface to building automation system.

.6 Boiler flue gas venting supplied with each boiler by boiler manufacturer for boiler operation under Category IV positive vent pressure conditions for room air dependent operation. Venting is to be complete with required installation and termination accessories, is to feature condensate disposal, and is to have zero clearance to combustibles.

.7 Condensate acid neutralizer equal to JJM Boiler Works or Condensate Neutralizer condensate acid neutralizing PVC tube sized to suit boiler condensate discharge, supplied with boilers, filled with 12 mm

(½") and 20 mm (¾") aggregate calcium carbonate and complete with floor mounting galvanized steel strut clamps, threaded PVC inlet and outlet fittings, and a spare charge of calcium.

3 Execution

3.01 Installation

.1 Provide wall mounted condensing boilers.

.2 Conform to requirements of CAN/CSA B149.1 or .2 as applicable.

.3 Secure each boiler in place, level and plumb, on wall bracket assemblies supplied with boilers.

.4 Connect each boiler with a distribution manifold, cascade control, and other accessories supplied loose. Follow boiler manufacturer's instructions when installing accessories supplied loose. Provide pressure gauges and thermometers in boiler water supply and return piping.

.5 Install condensate acid neutralizers adjacent to boilers and connect with piping from boilers to neutralizers and from neutralizers to drain in accordance with manufacturer's directions and drawing requirements.

.6 Install control components shipped loose with boilers. Perform required control wiring in conduit to connect control components. Follow boiler manufacturer's control wiring schematics and conduit and conductor installation requirements specified as part of the electrical work.

3.02 System Startup

.1 For equipment/system manufacturer certification requirements, refer to Section 20 05 00 – Common Work Results for Mechanical.

.2 For equipment/system start-up requirements, refer to Section 20 05 00 – Common Work Results for Mechanical.

3.03 Closeout Activities

.1 Include for a one day on-site boiler plant operation demonstration and training session. Training is to be a full review of all components including but not limited to a full boiler internal inspection, construction details, burner operation, maintenance, flame characteristics, and adjustments, gas train maintenance, boiler normal operation, abnormal events, normal shut-down, emergency shut-down, and setting up controls.

End of Section

1 General

1.01 Submittals

.1 Submit shop drawings/product data sheets for heat exchangers, including accessories.

1.02 Closeout Submittals

.1 Submit with delivery of each unit a copy of the factory inspection report, and include a copy of each report with O&M Manual project closeout data.

.2 Submit a site inspection and start-up report from manufacturer's representative as specified in Part 3 of this section.

.3 Training attendance records.

1.03 Quality Assurance

.1 Heat exchanger equipment is to be stamped with a Canadian Registration Number (CRN).

.2 Heat exchangers and accessories are to be in accordance with following:

.1 CSA B51, Boiler, Pressure Vessel, and Pressure Piping Code;

.2 ASME Boiler and Pressure Vessel Code;

.3 governing Provincial and/or Municipal Codes and Regulations.

2 Products

2.01 Plate Type Heat Exchangers

.1 Vertical plate type heat exchangers in accordance with drawing schedule, 1035 kPa (150 psi) working pressure rated, factory pressure tested and complete with:

.1 electro-galvanized carbon steel frames with baked epoxy enamel finish, same end ANSI 150 flanged connections, a fixed end panel and a removable end panel, and molybdenum greased electro-galvanized steel bolts protected by means of sleeves;

.2 type 316 stainless steel plates, fully supported and steered by upper and lower carrying bars to prevent misalignment in both vertical and horizontal directions, space between ports not feeding channels, and channels vented to atmosphere;

.3 one-piece snap-on nitrile rubber gaskets moulded in a groove around heat transfer area and plate portholes, and continually supported along inner and outer edges;

.4 heat exchangers for domestic water service shall be 316L stainless steel double wall construction and suitable in every respect for potable water applications;

.2 Manufacturers:

.1 S. A. Armstrong Ltd.;

.2 Alfa Laval Inc.;

.3 Baltimore Aircoil of Canada Inc.;

.4 Tranter Heat Exchangers (Canada) Ltd.;

.5 APV an SPX Brand;

.6 Danfoss Inc;

.7 GEA Canada Inc.;

.8 Taco (Canada) Ltd.

.9 Flo-Fab Inc.

3 Execution

3.01 Installation of Plate Type Heat Exchangers

.1 Provide plate type heat exchangers.

.2 Secure each heat exchanger in place, level, and plumb, on a concrete housekeeping pad.

.3 Connect with piping in accordance with drawing detail.

.4 When installation is complete and piping has been permanently filled, start-up each heat exchanger, check and test all safeties and operating controls, and set controls to design conditions.

3.02 System Startup

.1 For equipment/system manufacturer certification requirements, refer to Section 20 05 00 – Common Work Results for Mechanical.

.2 For equipment/system start-up requirements, refer to Section 20 05 00 – Common Work Results for Mechanical.

3.03 Training

.1 Include for a one half day on-site operation demonstration and training session. Training is to be a full review of all components including but not limited to a full operation and maintenance demonstration, with abnormal events.

End of Section

1 General

1.01 Submittals

.1 Submit shop drawings/product data sheets for all air handling units. Include following:

.1 computer generated and certified fan performance curves;

.2 computer generated psychometric chart for each cooling coil;

.3 certified sound power data for discharge, radiated, and return positions by octave band;

.4 hardware for section-to-section site connections as applicable;

.5 dimensioned layouts;

.6 product data sheets for fan motors.

.2 Submit manufacturer's colour chart to indicate standard colour range of paint finishes. Supply 4 L (3.5 qt) of touch-up paint with each air handling unit.

1.02 Closeout Submittals

.1 Submit with delivery of each unit a copy of factory inspection report, and include a copy of each report with O&M Manual project close-out data.

.2 Submit a site inspection and start-up report from manufacturer's representative as specified in Part 3 of this section.

.3 Training attendance records.

1.03 Maintenance Material Submittals

.1 Submit spare air filters as specified in Part 2 of this section.

1.04 Coordination

.1 Supply reviewed copies of air handling unit/curb assembly shop drawings or product data sheets to trade who will cut roof openings for ductwork, and ensure openings are properly sized and located.

1.05 Quality Assurance

.1 Roof mounted modular air handling equipment is to be rated (capacity, performance, efficiency and sound) and certified in accordance with requirements of following American National Standards Institute/Air-Conditioning, Heating and Refrigeration Institute Standards, and Air Movement and Control Association International Inc. Standards:

.1 AHRI 410, Forced-Circulation Air-Cooling and Air-Heating Coils;

.2 ANSI/AHRI 430, Performance Rating of Central Station Air-Handling Units;

.3 AMCA Standard 211, Product Rating Manual for Fan Air Performance;

.4 AMCA Standard 99-2408, Operating Limits for Centrifugal Fans.

.2 Indoor modular air handling equipment is also to be in accordance with requirements of following Codes, Standards, and Regulations:

.1 CAN/CSA C22.2 No. 236/UL 1995, Heating and Cooling Units;

.2 ANSI/ASHRAE/IES 90.1, Energy Standard for Buildings Except Low Rise Residential Buildings;

.3 CSA or ETL certification and labelling for all electrical components;

.4 governing local Codes and Regulations.

2 Products

2.01 Manufacturers

.1 Trane Canada Inc.;

.2 Daikin;

.3 Johnson Controls York.

2.02 Roof Modular Air Handling Units

.1 GENERAL

.1 Each unit shall be specifically designed for outdoor rooftop application and include a weatherproof cabinet. Each unit shall be completely factory assembled and shipped in one piece. Packaged units shall be shipped fully charged with R-410 Refrigerant and oil.

.2 The unit shall undergo a complete factory run test prior to shipment. The factory test shall include a refrigeration circuit run test, a unit control system operations checkout, a unit refrigerant leak test and a final unit inspection.

.3 All units shall have decals and tags to indicate caution areas and aid unit service. Unit nameplates shall be fixed to the main control panel door.

.4 Electrical wiring diagrams shall be attached to the control panels. Installation, operating and maintenance bulletins and start-up forms shall be supplied with each unit.

.5 Performance: All scheduled EER, IEER, capacities and face areas are minimum accepted values.

.6 All scheduled amps, kW, and HP are maximum accepted values that allow scheduled capacity to be met.

.7 Warranty: The manufacturer shall provide 12-month parts only warranty. Defective parts shall be repaired or replaced during the warranty period at no charge. The warranty period shall commence at startup or six months after shipment, whichever occurs first.

.2 CASING

.1 Panel construction shall be double-wall construction for all panels. All floor panels shall have a solid galvanized steel inner liner on the air stream side of the unit to protect insulation during service and maintenance. Insulation shall be a minimum of 2" thick with an R-value of 13.0, and shall be 2 part injected foam. Panel design shall include no exposed insulation edges. Unit cabinet shall be designed to operate at total static pressures up to 5.0 inches w.g.

.2 Exterior surfaces shall be constructed of pre-painted galvanized steel for aesthetics and long term durability. Paint finish to include a base primer with a high quality, polyester resin topcoat of a neutral beige color. Finished panel surfaces to withstand a minimum 1000-hour salt spray test in accordance with ASTM B117 standard for salt spray resistance.

.3 Service doors shall be provided on the fan section, filter section, control panel section, and heating vestibule in order to provide user access to unit components. All service access doors

shall be mounted on multiple, stainless steel hinges and shall be secured by a latch system. Removable service panels secured by multiple mechanical fasteners are not acceptable.

.4 The unit base shall overhang the roof curb for positive water runoff and shall seat on the roof curb gasket to provide a positive, weathertight seal. Lifting brackets shall be provided on the unit base to accept cable or chain hooks for rigging the equipment.

.3 FILTERS

.1 The filter section shall be provided with a 2 inch MERV-8 prefilter and a 4" inch cartridge MERV-14 final filter.

.4 OUTDOOR / RETURN AIR SECTION

.1 Unit shall be provided with an outdoor air economizer section. The economizer section shall include outdoor, return, and exhaust air dampers. The economizer operation shall be fully integral to the mechanical cooling and allow up to 100% of mechanical cooling if needed to maintain the cooling discharge air temperature. The outdoor air hood shall be factory installed and constructed from galvanized steel finished with the same durable paint finish as the main unit. The hood shall include moisture eliminator filters to drain water away from the entering air stream. The outside and return air dampers shall be sized to handle 100% of the supply air volume. The dampers shall be parallel blade design. Damper blades shall be gasketed with side seals to provide an air leakage rate of 1.5 cfm / square foot of damper area at 1" differential pressure in according with testing defined in AMCA 500. A barometric exhaust damper shall be provided to exhaust air out of the back of the unit. A bird screen shall be provided to prevent infiltration of rain and foreign materials. Exhaust damper blades shall be lined with vinyl gasketing on contact edges.

.2 Control of the dampers shall be by a factory installed direct coupled actuator. Damper actuator shall be of the modulating, spring return type. A comparative enthalpy control shall be provided to sense and compare enthalpy in both the outdoor and return air streams to determine if outdoor air is suitable for "free" cooling. If outdoor air is suitable for "free" cooling, the outdoor air dampers shall modulate in response to the unit's temperature control system.

.5 SUPPLY FAN

.1 Where noted on drawings, Supply, Return and Exhaust Fans shall be configured in an array with a minimum number fans specified in the schedule for each unit.

.2 All Fans shall be dynamically balanced as an assembly in planes as per DIN / ISO 21940 to balancing grade G 6.3 or better or provide Spring isolation for each fan.

.3 All fans shall be provided with totally enclosed maintenance-free ball bearings and permanent lubrication. Bearings shall be selected for a minimum life in excess of 350,000 hrs (L50) at selected operating point.

.4 ECM Supply and Exhuast Fans

.5 All fans shall be a single width, single inlet (SWSI) airfoil centrifugal fan. The fan wheel shall be Class II construction with aluminum fan blades that are continuously welded to the hub plate and end rim. The fan shall be a direct drive fan mounted to the motor shaft. Belts and sheaves are not acceptable due to the additional maintenance.

.6 The fan motor shall be a totally enclosed electrically commutated motor or factory mounted VFD that is speed controlled by the rooftop unit controller. The motor shall include thermal overload protection and protect the motor in the case of excessive motor temperatures. The motor shall have phase failure protection and prevent the motor from operation in the event of a loss of phase. Motors shall be premium efficiency.

.6 COOLING COIL

.1 The indoor coil section shall be installed in a draw through configuration, upstream of the supply air fan. The coil section shall be complete with a factory piped cooling coil and a sloped drain pan.

.2 The direct expansion (DX) cooling coils shall be fabricated of seamless high efficiency copper tubing that is mechanically expanded into high efficiency aluminum plate fins. Coils shall be a multi-row, staggered tube design with a minimum of 4 rows. All cooling coils shall have two independent refrigerant circuits and shall use an interlaced coil circuiting that keeps the full coil face active at all load conditions. All coils shall be factory leak tested with high pressure air under water.

.3 Each refrigeration circuit shall be equipped with a thermostatic expansion valve for control refrigerant flow control.

.4 The refrigerant suction lines shall be fully insulated from the expansion valves to the compressors

.5 The distributor tubes shall be sleeved or coated to provide longevity and protection from leaks.

.6 The drain pan shall be stainless steel and designed to comply with ASHRAE- 62.1 double sloped requirements drain pan shall be provided with the cooling coil. The drain pan shall extend beyond the leaving side of the coil and underneath the cooling coil connections. The drain pan shall have a minimum slope of 1/8" per foot to provide positive draining. The drain pan shall be connected to a threaded drain connection extending through the unit base. Units with stacked cooling coils shall be provided with a secondary drain pan piped to the primary drain pan.

.7 Insulation under the drain pan should be a closed cell structure to prevent moisture from wicking under the drain pan. Fiberglass is not allowed.

.7 CONDENSING SECTION

.1 All Units shall provide the Energy Efficiency specified EER and IEER per the schedule equipment or higher.

.2 Condenser fans shall be direct drive, axial type designed for low tip speed and vertical air discharge. Fan blades shall be constructed of steel and riveted to a steel center hub. Condenser fan motors shall be heavy-duty, inherently protected, three-phase, non-reversing type with permanently lubricated ball bearing and integral rain shield.

.3 Condenser coils shall be an all aluminum design, and mounted on polymer brackets, to minimize di-electric corrosion. The aluminum tube shall be a micro channel design with high efficiency aluminum fins. Fins shall be brazed to the tubing for a direct bond. Each condenser coil shall be factory leak tested with high-pressure air under water.

.4 Condenser coils shall be protected from incidental contact to coil fins by a coil guard. Coil guard shall be constructed of cross wire welded steel with PVC coating

.5 Head Pressure Control

.1 Units shall have positive head pressure control by SpeedTrol™ condenser fan speed modulation to provide cooling operation to ambient temperatures down to 0° F. Fan speed control shall be field adjustable.

.6 Each unit shall have multiple, heavy-duty scroll compressors. Each compressor shall be complete with gauge ports, crankcase heater, sight-glass, anti-slug protection, motor overload protection and a time delay to prevent short cycling and simultaneous starting of compressors following a power failure. Compressors shall be isolated with resilient rubber isolators to decrease noise transmission

.7 Each unit shall have two independent refrigeration circuits for redundancy. Each circuit shall be complete with a low pressure control, filter-drier, liquid moisture indicator/sight-glass, thermal expansion valve, and a manual reset high pressure safety switch. The thermal expansion valve shall be capable of modulation from 100% to 25% of its rated capacity. Sight-glasses shall be accessible for viewing without disrupting unit operation. Each circuit shall be dehydrated and factory charged with Refrigerant 410A and oil.

.8 Each unit shall have at least 4 compressor stages of cooling capacity control for better part load control as required by ASHRAE 90.1-2013.

.9 For RTU-2,4: The unit shall have scroll compressors. One of the compressors shall be an inverter compressor providing proportional control. The unit controller shall control the speed of the compressor to maintain the discharge air temperature. The inverter compressor shall have a separate oil pump and low oil safety protection.

.10 For RTU-1,3: Hot gas bypass control shall be factory installed on both refrigerant circuits. Hot gas bypass control shall include a modulating hot gas bypass control valve, solenoid valve, all associated piping and be automatically operated by the units microprocessor control

.8 MODULATING HOT GAS REHEAT

.1 Unit shall be equipped with a fully modulating hot gas reheat coil with hot gas coming from the unit condenser

.2 Hot gas reheat coil shall be a Microchannel design. The aluminum tube shall be a micro channel design with high efficiency aluminum fins. Fins shall be brazed to the tubing for a direct bond. The capacity of the reheat coil shall allow for a 20°F temperature rise at all operating conditions.

.3 The modulating hot gas reheat systems shall allow for independent control of the cooling coil leaving air temperature and the reheat coil leaving air temperature. The cooling coil and reheat coil leaving air temperature set points shall be adjustable through the unit controller. During the dehumidification cycle the unit shall be capable of 100% of the cooling capacity. The hot gas reheat coil shall provide discharge temperature control within +/- 2°F.

.4 Each coil shall be factory leak tested with high-pressure air under water.

.5 Dehumidification operation with Hot gas reheat shall use direct air temperature feedback from the leaving face of the evaporator coil for controlling the compressor cooling capacity and the reheat will be fully modulate to maintain the leaving/supply air temperature set point. The leaving/supply air temperature set point can be reset based on outside, space, and return temperature or humidity.

.9 GAS HEATING SECTION

.1 The gas furnace design shall be factory installed downstream of the supply air fan in the heat section.

.2 The heat exchanger shall include a 439 grade Stainless steel. Aluminized steel heat exchangers are not acceptable. The heat exchanger design shall collect condensate in a collection point and have a condensate drain.

.3 The furnace will be supplied with a modulating induced draft burner. The burner shall be controlled for low fire start. The burner shall be capable of continuous modulation between 10% and 100% (10:1 control) of rated capacity.

.4 The burner shall be specifically designed to burn natural gas and shall include a micro-processor based flame safeguard control, combustion air proving switch, pre-purge timer and spark ignition.

Status and alarm codes are available at the unit controller via a network connection and are available for BAS integration.

.5 Provide with a 15 year gas heat exchanger warranty

.10 ENERGY RECOVERY WHEEL SECTION

.1 The rooftop unit shall be provided with an AHRI certified rotary wheel air-to-air heat exchanger in a cassette frame complete with seals, drive motor and drive belt. The energy recovery wheel shall be an integral part of the rooftop unit with unitary construction and does not require field assembly. Bolt-on energy recovery units that require field assembly and section to section gasketing and sealing are not acceptable.

.2 The wheel capacity, air pressure drop and effectiveness shall be AHRI certified per AHRI Standard 1060. Thermal performance shall be certified by the manufacturer in accordance with ASHRAE Standard 84, Method of Testing Air-to-Air Heat Exchangers and AHRI Standard 1060, Rating Air-to-Air Heat Exchangers For Energy Recovery Ventilation Equipment.

.3 The unit shall have 2" Merv 7 filters for the outdoor air before the wheel to help keep the wheel clean and reduce maintenance. Filter access shall be by a hinged access door with ¼ turn latches.

.4 The matrix design shall have channels to reduce cross contamination between the outdoor air and the exhaust air. The layers shall be effectively captured in aluminum and stainless steel segment frames that provide a rigid and self-supporting matrix. All diameter and perimeter seals shall be provided as part of the cassette assembly and shall be factory set. Drive belt(s) of stretch urethane shall be provided for wheel rim drive without the need for external tensioners or adjustment.

.5 The total energy recovery wheel shall be coated with silica gel desiccant permanently bonded without the use of binders or adhesives, which may degrade desiccant performance. The substrate shall be lightweight polymer and shall not degrade nor require additional coatings for application in marine or coastal environments. Coated segments shall be washable with detergent or alkaline coil cleaner and water. Desiccant shall not dissolve nor deliquesce in the presence of water or high humidity.

.6 Wheels shall be provided with removable energy transfer matrix. Wheel frame construction shall be a welded hub, spoke and rim assembly of stainless, plated and/or coated steel and shall be self-supporting without matrix segments in place. Segments shall be removable without the use of tools to facilitate maintenance and cleaning.

.7 Wheel bearings shall be selected to provide an L-10 life in excess of 400,000 hours. Rim shall be continuous rolled stainless steel. Wheels shall be connected to the shaft by means of taper lock hubs.

.8 The control of the energy recovery wheel shall be an integral part of the rooftop unit's DDC controller. The DDC controller shall have visibility of the outdoor air temperature, leaving wheel temperature, return air temperature, and exhaust air temperature. These temperatures shall be displayed at the rooftop units DDC controller LCD display. All of these temperatures shall be made available through the BACnet interface.

.9 The rooftop unit DDC controller shall provide frost control for the energy recovery wheel. When a frost condition is encountered the unit controller shall slow down the wheel.

.11 ELECTRICAL

.1 Each unit shall be wired and tested at the factory before shipment. Wiring shall comply with CSA standards. All wiring shall be number coded per the electrical wiring diagrams. All electrical components shall be labeled according to the electrical diagram and be CSA recognized.

.2 A terminal block shall be provided for the main power connection and a terminal board shall be provided for the low voltage control wiring. Knockouts shall be provided in the bottom of the main control panel for field wiring entrance. Branch short circuit protection, 115-volt control circuit transformer and fuse, system switches, and a high temperature sensor shall also be provided with the unit.

.3 Each compressor and condenser fan motor shall be furnished with contactors and internal thermal overload protection. Supply fan motors shall be supplied with external overload protection.

.4 Unit shall include a 115V receptacle to be field wired and powered by separate connection.

.5 Provide a disconnect switch to cut power to the entire unit before the control panel can be opened.

.12 CONTROLS FOR APPLIED ROOFTOP

.1 Refer to drawing control diagrams and sequences. Control system components required for installation within air handling unit modules are provided with air handling unit with identified wiring terminated in identified junction boxes on outside of module casings for site connections as part of automatic control work and electrical work. Unless otherwise specified all air handling unit control components are to be of same manufacturer as building automatic control system component manufacturer.

.13 ROOF CURB

.1 A prefabricated heavy gauge galvanized steel, mounting curb shall be provided for field assembly on the roof decking prior to unit shipment. The roof curb shall be a full perimeter type with complete perimeter support of the air handling section and condensing section. The curb shall be a minimum of (24") high and include a nominal 2"×4" wood nailing strip. Gasket shall be provided for field mounting between the unit base and roof curb. The roof curb shall be approved by the National Roofing Contractors Association.

.2 Where shown on drawings Roof curb shall be provided with horizontal duct connections as shown on the plans. Curb shall be air tight and fully insulated with 2" 1 1/2 lb density fiberglass insulation with a galvanized perf metal internal liner.

.14 STARTUP SERVICE AND WARRANTY

.1 Manufacturer shall furnish a factory trained service technician to perform the unit startup. Manufacturer shall provide instruction to the owner's personnel on the operation and maintenance of the unit. Factory technician to provide copy of start up log to owner and to demonstrate operation and maintenance to owners' representative. The warranty period shall commence at the date of initial startup and shall continue for a period of one (1) year not to exceed eighteen (18) months from shipment. Manufacturer's warranty shall include all parts and labour to install parts.

3 Execution

3.01 Installation of Outdoor Modular Air Handling Units

.1 Provide outdoor modular air handling units on roof.

.2 Provide required rigging and hoisting/moving equipment required to move units to required locations. Perform rigging/hoisting/moving in accordance with unit manufacturer's directions and details.

.3 Site assemble units shipped in sections in strict accordance with unit manufacturer's instructions.

.4 Locate curbs on roof where required for installation and flashing into roof construction as part of roofing work of Division 07. Secure units in place, level, and plumb, on gasketing material.

.5 Remove fan base hold-down clamps and other shipping restraints and protective packaging.

.6 Carefully coordinate installation of each unit with other trades making connections to unit, in particular, control connections.

.7 For equipment/system start-up requirements, refer to Section 20 05 00 – Common Work Results for Mechanical.

.8 For equipment/system manufacturer certification, refer to Section 20 05 00 – Common Work Results for Mechanical. Submit a copy of the letter prior to Substantial Performance.

3.02 Closeout Activities

.1 Include for a one half day on-site operation demonstration and training session. Training is to be a full review of all components including but not limited to a full operation and maintenance demonstration, with abnormal events.

End of Section

1 General

1.01 Related Requirements

.1 Section 23 23 00 – Refrigerant Piping.

1.02 Submittals

.1 Submit shop drawings/product data sheets, complete with control components, and piping and wiring schematics.

1.03 Closeout Submittals

.1 Submit a start-up and certification letter from equipment supplier as specified in Part 3 of this section.

.2 Prepare and submit a schematic layout of refrigerant piping showing all piping components required for satisfactory operation and maintenance of the system(s), including but not limited to pipe sizes, charging valve, isolating valves, sight glasses, strainers, driers, traps, etc. Schematic diagram must be reviewed with and approved by air conditioning equipment supplier prior to submittal to the Consultant.

1.04 Quality Assurance

.1 Split system air conditioning equipment and installation of equipment are to be in accordance with requirements of following:

.1 all applicable Provincial Codes and Standards;

.2 ANSI/AHRI Standard 210/240, Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment.

.2 Split system air conditioning system installation tradesmen are to be journeyman refrigeration mechanics.

2 Products

2.01 Split System Air Conditioning Equipment

.1 Factory assembled and tested, package type equipment consisting of an indoor evaporator unit and an exterior condensing unit in accordance with drawing schedule, CSA or ETL listed and labelled, AHRI rated and certified and with a minimum system efficiency of 13 SEER.

.2 Wall mounting evaporator assembly consisting of a white moulded high-strength plastic cabinet with front access panel, a motorized horizontal vane to automatically direct air flow in a horizontal and downward direction and which closes when fan operation is stopped, motorized vertical vanes controlled remotely, and a mounting plate supplied loose. Evaporator complete with:

.1 double inlet, forward curve fan(s) direct driven by a single 4-speed motor;

.2 removable and washable return air filter;

.3 factory pressure tested multi-angled coil of non-ferrous construction with aluminium fins, copper tubes with silver alloy solder joints, and an insulated condensate drain pan sloped to a drain connection for positive drainage.

.3 Factory run tested, weatherproof condensing unit equipped with a control board to interface with indoor unit and perform all necessary operation functions. Pre-charge unit with R-410a refrigerant for a minimum of 21 m (70') of refrigerant tubing. Unit is to be capable of operation at -18°C (0°F) without additional low ambient controls, and capable of a height difference between condensing unit and evaporator of 30 m (100'). Each condensing unit complete with:

.1 galvanized steel plate cabinet with an electrostatically applied thermally fused polyester powder finish, and an ABS plastic fan grille;

.2 draw-through direct driven balanced fan with horizontal air discharge, mounted in front of coil, arranged to pull air across coil, and equipped with a raised fan guard;

.3 "L" shaped coil with copper tubes and aluminium fins, factory pressure tested, complete with an integral metal guard and refrigerant flow controlled by a linear expansion valve metering orifice controlled by a microprocessor controlled step motor;

.4 vibration isolated DC rotary compressor driven by an inverter circuit to dynamically control compressor speed to match room load, complete with an accumulator, high pressure safety switch, and circuitry to permit a minimal amount of current to be applied to motor to maintain enough heat during off cycle to prevent liquid from accumulating.

.4 System controls consisting of a microprocessor in each indoor and outdoor unit, and an indoor wall mounted controller site connected to indoor evaporator unit. System is to be capable of automatic restart after power interruption, and have self-diagnostics ability and indication of total compressor run time, and following:

.1 Indoor unit microprocessor is capable of monitoring return air temperature and evaporator coil temperature, receiving and processing commands from wall mounted controller, providing emergency operation, and controlling outdoor unit through its microprocessor and interface board;

.2 controller is complete with an integral temperature sensor, able to perform input and output functions necessary to operate system, and equipped with following:

.1 large DOT liquid crystal display to indicate diagnostic codes for both indoor and outdoor units, compressor run time, a weekly timer with up to 8 pattern settings per day, set temperature, room temperature, refrigerant piping temperatures, compressor operating conditions, and linear expansion valve opening pulses, sub-cooling and discharge super heat;

.2 On/Off button, Increase/Decrease Set Temperature buttons, a Cool/Dry/Fan mode selector, a Timer Menu button, a Timer On/Off button, Set Time buttons, a Fan Speed selector, a Vane Position selector, a Louvre Swing button, a Ventilation button, a Test Run button, and a Check Mode button.

.5 Suitable anchoring connection hardware factory installed on equipment to suit requirements of Section 20 05 48.16 – Seismic Controls for Mechanical Systems.

2.02 Manufacturers

.1 Mitsubishi Electric Sales Canada Inc.;

.2 LG Electronics Canada Inc.;

.3 Panasonic Canada Inc.;

.4 Fujitsu General America Inc.

3 Execution

3.01 Installation

.1 Provide split system air conditioning equipment consisting of an exterior condensing unit and an indoor evaporator.

.2 Secure condensing unit in place, level and plumb, on vibration isolation pads on a concrete housekeeping pad.

.3 Secure condensing unit in place, level and plumb, on vibration isolation pads on pressure treated wooden sleepers as indicated.

.4 Anchor equipment in accordance with requirements specified in Section 20 05 48.16 – Seismic Controls for Mechanical Systems. Provide flexible connections in all piping connections to equipment.

.5 Mount indoor evaporator unit. Confirm exact location prior to roughing-in.

.6 Connect condensing unit and indoor evaporator with refrigerant piping in accordance with piping shop drawing schematic. Refer to Section 23 23 00 - Refrigerant Piping. Provide any required additional refrigerant.

.7 Install loose control components and perform required control wiring (except building automation system connections) between condensing unit and evaporator in conduit in accordance with manufacturer's control wiring schematic and wiring standards of electrical work.

3.02 System Startup

.1 For equipment/system manufacturer certification requirements, refer to Section 20 05 00 – Common Work Results for Mechanical.

.2 For equipment/system start-up requirements, refer to Section 20 05 00 – Common Work Results for Mechanical.

3.03 Training

.1 Include for 4 hours of on-site operation demonstration and training session. Training is to be a full review of all components including, but not limited to, a full operation and maintenance demonstration, with control set-up and abnormal events.

End of Section

1 General

1.01 Related Requirements

.1 Section 23 21 00 – Hydronic Piping and Pumps.

1.02 Submittals

.1 Submit shop drawings/product data sheets for radiation units, including accessories, and any required control wiring schematics.

1.03 Closeout Submittals

.1 Submit a site inspection and start-up report from manufacturer's representative as specified in Part 3 of this section.

2 Products

2.01 Fin-Tube Type Direction Radiation

.1 Hot water fin-tube type direct radiation units with capacities/lengths as indicated on the drawings. Heating capacities and element lengths indicated are based on 82.2°C (180°F) average entering water temperature at a velocity of 0.0762 m/s (0.25 ft/sec) with an 11.1°C (20°F) temperature drop through the element, and 21.1°C (70°F) entering air temperature.

.2 Baseboard radiation complete with:

.1 heating elements: seamless copper tubes mechanically expanded into collars integral with continuous plate type aluminum fins;

.2 enclosure: one-piece #18 gauge cold rolled steel front louvred panel with a factory prime coat finish, #10 gauge galvanized steel support brackets, and all required enclosure accessories (including valve boxes) to suit mounting arrangements shown.

.3 Convector radiators complete with:

.1 heating elements consisting of seamless copper tubes mechanically expanded into collars integral with continuous plate type aluminum fins and into machined openings in cast iron headers, and equipped with steel protective plates which extend full length on both sides of each element;

.2 enclosure, as indicated on drawings, consisting of minimum #20 gauge steel back and end panels, minimum #18 gauge steel, removable, reinforced front panels with integral formed grilles, minimum #18 gauge steel top panels, rounded exposed edges and corners, and element support clips or legs fastened to enclosure and adjustable for element pitch.

.4 Wall-fin convectors complete with:

.1 steel heating elements consisting of minimum 32 mm (1-¼") IPS steel tubes mechanically expanded into and permanently bonded to 110 mm (4-½") square steel plate fins, and factory coated with a black finish;

.2 copper-aluminum elements consisting of minimum 32 mm (1-¼") IPS seamless copper tubing mechanically expanded into and permanently bonded to 110 mm (4-½") square plate type aluminum fins;

.3 enclosures, as indicated on drawings, each removable and constructed of #16 gauge cold rolled steel, factory cleaned, phosphatized and finished with primer, and equipped with stamped grilles,

flush slip joint enclosure to enclosure joints where required, access doors for valve access, and any required enclosure trim such as column to column extension pieces, column enclosures, etc.;

.4 continuous minimum #20 gauge steel top support wall guard strip prime coat painted as for enclosure and arranged to maintain the top back edge of enclosure 20 mm (¾") from face of wall, enclosure supports with enclosure locks constructed and finished as for wall strip and designed to hook onto top strip, and steel element support cradles which attach to slots in wall guard strip;

.5 for radiation units as indicated, fully adjustable, plate type, knob operated control dampers located behind front grille and integral with front panel of enclosure.

.5 Manufacturers:

.1 Modine Manufacturing Co.;

.2 Rosemex Inc.;

.3 Slant/Fin Ltd.;

.4 Engineered Air.

3 Execution

3.01 Installation

.1 Provide fin-tube type direct radiation units.

.2 Secure enclosure brackets in place at maximum 900 mm (35") centres and install element supports or cradles. Slope elements to ensure proper water circulating and to eliminate air. Ensure enclosures are level and plumb. Provide required enclosure accessories.

.3 Connect elements with piping. Provide radiator type valves in piping at each element or group of series connected elements, shut-off type in supply piping, balancing type in return piping. Unless otherwise noted or specified, locate valves and accessories inside enclosures or behind trim, and ensure valves are accessible.

.4 Where 2 or more heating elements are connected in series, join elements with piping the full size of the element tubes or use piping sized to supply pipe size and connect elements with eccentric fittings.

.5 Equip each element or group of series connected elements with a manual air vent installed in an accessible location.

.6 Provide proper height, cleaned and prime coat painted, flanged steel pipe supports for free-standing radiation units. Size inside diameter of supports to suit diameter of heating piping which is to extend through the supports to the elements. Secure supports to floor over floor openings.

End of Section

1 General

1.01 Section Includes

.1 Hot water unit heaters and cabinet unit heaters.

1.02 Related Requirements

.1 Section 23 21 00 – Hydronic Piping and Pumps.

1.03 Submittals

.1 Submit shop drawings/product data sheets for motorized heaters, including accessories.

1.04 Closeout Submittals

.1 Submit a site start-up report from manufacturer's representative as specified in Part 3 of this section.

.2 Training attendance records.

2 Products

2.01 Unit Heaters

.1 CSA certified hot water unit heaters in accordance with drawing schedule, each complete with:

.1 for vertical unit casing, top and bottom heavy-gauge circular steel plates, top plate equipped with a depression for motor and an opening for motor cooling air as well as threaded hanger rod connections, bottom plate equipped with a die-formed fan venturi and a bolt-on adjustable air deflector, both plates bolted together with a circular heating coil in between;

.2 for horizontal unit casing, minimum #20 gauge die-formed steel front and back casing halves with formed ribs and rounded corners, both halves secured together top and bottom with screws and equipped with threaded hanger rod connections in the top, a formed fan venturi with bolt-on wire grid guard in the back, and a rectangular formed discharge opening with adjustable horizontal and vertical air deflectors in the front;

.3 factory applied casing finish, consisting of electrostatically applied baked powder epoxy on cleaned and primed casing surfaces;

.4 factory leak tested heating coil, consisting of minimum 16 mm (5/8") OD seamless copper tubing mechanically expanded into and permanently bonded to continuous plate type aluminum fins, and equipped with screwed steel supply and return piping connections and silver braced tube joints;

.5 continuous duty TEFC motor conforming to requirements specified in Section 20 05 00 – Common Work Results for Mechanical, direct connected to a balanced propeller type fan wheel with aluminum blades secured to a steel hub;

.2 Manufacturers:

.1 Armstrong-Hunt Inc.;

.2 Trane;

.3 Engineered Air.

.4 Modine Manufacturing Co.;

.5 Rosemex Inc.;

.6 Sigma

2.02 Cabinet Unit Heaters

.1 CSA certified hot water cabinet unit heaters in accordance with drawing schedule, each complete with:

.1 cabinet, of welded fabrication, constructed from one-piece top and sides, and one-piece partition panels and backsheet, both die-formed from single sheets of minimum #18 gauge insulated furniture grade steel and complete with minimum 825 mm (32-½") space at each end for piping and wiring, stamped grilles where required, and, for surface floor and wall mounted cabinets, key lock access doors for access to valves and speed controls;

.2 #16 gauge removable front panel with tamperproof fasteners, stamped grille where required, and insulation applied to the inside face;

.3 for all exposed cabinet surfaces, a baked enamel prime coat finish applied to cleaned metal surfaces;

.4 factory leak tested heating coil, consisting of seamless copper tubing mechanically expanded into and permanently bonded to continuous plate type aluminum fins, and equipped with screwed steel supply and return piping connections and silver brazed tube joints;

.5 removable galvanized steel fan board with centrifugal forward curved, formed aluminum fan wheel(s) with galvanized steel housings, direct connected to a continuous duty, three-speed, permanent split capacitor motor conforming to requirements specified in Section 20 05 00 – Common Work Results for Mechanical;

.6 for cabinets where indicated, duct connection collars;

.7 permanent, cleanable aluminum mesh filter;

.8 seismic restraint connection hardware factory secured to each unit as required.

.2 Manufacturers:

.1 Armstrong-Hunt Inc.;

.2 Engineered Air.

.3 Trane;

.4 Modine Manufacturing Co.;

.5 Rosemex Inc.;

.6 Sigma

3 Execution

3.01 Installation of Motorized Heaters

.1 Provide motorized heaters.

.2 Secure unit heaters in place at proper height by means of hanger rods attached to structure. Ensure heaters are level and plumb. Confirm exact locations prior to roughing-in.

.3 Carefully coordinate installation of cabinet heaters with trades constructing building surfaces in or on which heaters are located. Confirm exact locations prior to roughing-in.

.4 Connect with piping in accordance with drawing detail.

3.02 System Startup

.1 For equipment/system start-up requirements, refer to Section 20 05 00 – Common Work Results for Mechanical.

3.03 Closeout Activities

.1 Include for a 4 hour on-site heater operation demonstration and training session. Training is to be a full review of all components including but not limited to construction details, operation, and maintenance.

End of Section

1 General

1.01 Related Requirements

.1 Section 23 21 00 – Hydronic Piping and Pumps.

1.02 Submittals

.1 Submit shop drawings/product data sheets for radiant heating units, including accessories, and any required control wiring schematics.

1.03 Closeout Submittals

.1 Submit a site inspection and start-up report from manufacturer's representative as specified in Part 3 of this section.

2 Products

2.01 Linear Radiant Ceiling Panels

.1 Continuous linear radiant ceiling panels sized and arranged as shown and scheduled on drawings, complete with:

.1 extruded aluminum panels with aluminum saddles to secure 12 mm (½") diameter type "L" copper piping, non-hardening heat conductive paste between piping and panels, and a white finish factory applied to face of each panel;

.2 cross channel braces in quantities as recommended by panel manufacturer to suit panel length, and end and centre clips;

.3 all required type "L" copper piping return bends and connection fittings.

.2 Manufacturers

.1 Adair Industries "Airtex";

.2 Rosemex Inc;

.3 TWA Panel Systems Inc.;

.4 Sigma Corp.

3 Execution

3.01 Installation

.1 Provide linear radiant ceiling panels. Install cross channel braces, end and centre clips in accordance with panel manufacturer's details.

.2 Secure panels in place on T-bars and/or wall channel moulding provided as part of suspended ceiling system work, and provide ceiling hanger wire at 1200 mm (48") centres between structure and cross channel braces.

.3 Interconnect radiant panels by means of 12 mm dia. (1/2") soft copper tubing or connection accessories supplied with panels, as required. Ensure heating piping system has been flushed and cleaned prior to connecting radiant panels.

.4 Personnel handling unprotected panels are to wear clean white gloves to avoid soiling panel face finish.

.5 When installation of the panels is complete, cover the top of active panels with manufacture's recommended thickness of insulation or a minimum of 50 mm (2") foil face batt insulation, whichever is greater.

End of Section

1 General

1.01 Related Requirements

.1 Section 23 21 00 – Hydronic Piping and Pumps.

1.02 Submittals

.1 Submit shop drawings and/or product data sheets for following:

.1 cross-linked polyethylene (PEX) floor heating grid tubing, fittings and accessories, manifold assembly, control components and controls;

.2 copies of system manufacturer's loop layout design printouts indicating water flows and temperatures, floor profiles with floor covering(s), and heating outputs;

.3 certified tubing and piping layout and schematic for each system zone;

.4 certified power wiring schematic and a certified control wiring schematic with sequence of operation for each system zone;

.5 letter from system component manufacturer stating system components proposed meet all requirements of the Specification.

1.03 Closeout Submittals

.1 Submit, prior to Substantial Performance of the Work, start-up or test data specified in Part 3 of this section.

.2 Submit letters of installation certification from system manufacturer's representative as specified in Part 3 of this section.

.3 Training attendance records.

1.04 Quality Assurance

.1 Radiant floor heating system is to be installed by journeyman tradesmen with a minimum of 3 years successful installation of PEX radiant floor system components supplied by manufacturer of components.

.2 Prior to installation of system components, meet on-site with system component manufacturer's representative and trades whose work is related to successful installation of system(s) to confirm floor areas involved are ready for tubing installation.

1.05 Warranty

.1 Submit, at Substantial Performance of the Work, a non-prorated transferable repair or replacement warranty in name of Owner, issued by and signed by system component manufacturer covering materials against failure due to defects in material and/or workmanship as follows:

.1 PEX tubing, 25 years;

.2 manifold assemblies, 5 years;

.3 controls and electrical components, 2 years.

2 Products

2.01 Basis of Design

.1 Basis of design Radiant floor heating is provided by Klimatrol Environmental Systems Inc. consisting of ANURAV PRE-ASSEMBLED Cabinets and Rehau Piping.

2.02 PEX Piping Manufacturers

.1 Uponor Inc.;

.2 Watts Radiant Inc.;

.3 Rehau Inc.

2.03 System Materials

.1 Uponor Inc. radiant floor heating system components as follows:

.1 cross-linked polyethylene (PEX) tubing to CAN/CSA B137.5, ASTM F876 and F877, and SDR-9 requirements with an oxygen barrier in accordance with German Standard DIN 4726, flame spread and smoke developed ratings in accordance with CAN/ULC S102 and ASTM E84, supplied in coils, and with characteristics and accessories as follows:

.1 Plastic Pipe Institute certified temperature and pressure ratings of 550 kPa at 93°C (80 psi at 200°F), 690 kPa at 82°C (100 psi at 180°F), and 1100 kPa at 23°C (160 psi at 74°F);

.2 where required, "ProPEX" cold expansion type fittings in accordance with ASTM F877, CAN/CSA B137.5, and ASTM F1960, each consisting of a barbed adapter with an o-ring and an applicable sized PEX ring;

.3 minimum bend radius of 6 times the tubing OD, with factory supplied bend supports required for tubing with a bend radius less than 6 times the tubing OD;

.4 all required installation and connection accessories to suit floor construction, all in accordance with tubing manufacturer's instructions and factory supplied with tubing.

.2 Package type copper or brass supply and return manifold assembly to suit number of heating zones, factory assembled and equipped with wall mounting brackets and following:

.1 main supply and return full flow ball type isolating valves, zone pipe connection couplings, and fill/drain valves for both supply and return manifolds;

.2 supply manifold automatic air vent, and zone on/off valves with 24 volt AC actuators to suit control system;

.3 return manifold pressure balancing by-pass valve, and zone balancing valves and flow rate indicators;

.4 combination pressure gauge and thermometer for each manifold, and individual zone return piping thermometers for accurate visual zone balancing by zone temperature drops;

.5 all other required fittings and connection accessories.

.3 Controls in accordance with drawing control diagram and sequence.

3 Execution

3.01 Installation

.1 Provide hydronic radiant floor heating zones and piping manifold assemblies. System installation is to be in strict accordance with manufacturer's instructions.

.2 Piping is to be as follows:

.1 for pipe inside building and aboveground, Schedule 40 black steel, screwed, ASTM A53, Grade B, ERW, or Type "K" hard temper copper with forged copper solder type fittings and 95% tin / 5% Antimony solder joints, all in accordance with Section 23 21 00 – Hydronic Piping and Pumps.

.2 for floor grid piping, PEX pipe installed in continuous lengths with all required support and installation accessories.

.3 Provide a strainer in piping to manifold supply header and clean strainer screen when system balancing is to commence.

.4 Ensure grid tubing has been successfully pressure tested prior to concealment. Be present when covering is being placed over grid tubing to ensure integrity of tubing is not compromised during placement of remainder of floor construction.

.5 Where tubing and/or piping penetrates fire rated construction, carefully coordinate with firestopping work specified in Division 07.

.6 Where tubing and/or piping penetrates fire rated construction, provide firestopping in accordance with requirements specified in Section 20 05 17 – Sleeves and Sleeve Seals for Mechanical Piping.

.7 Prior to system flow balancing, ensure all air is purged from system and system operates successfully at design temperatures and pressure for a minimum of 2 days. Supply system manufacturer's software for final balancing flow adjustment settings.

3.02 System Startup

.1 For equipment/system start-up requirements, refer to Section 20 05 00 – Common Work Results for Mechanical.

.2 For equipment/system manufacturer certification requirements, refer to Section 20 05 00 – Common Work Results for Mechanical. Ensure system manufacturer inspects grid tubing installation prior to concealment and certifies each zone correct in writing. Submit a copy of each certification letter prior to Substantial Performance of the Work.

3.03 Training

.1 Include for 4 hours of on-site training for 2 groups of 6 people. Training is to be a full review of all components including but not limited to a full operation and maintenance demonstration, with abnormal events.

End of Section

1 General

1.01 Submittals

.1 Submit shop drawings/product data sheets for following:

.1 all control system components;

.2 identified schematic control diagrams with component identification, catalogue numbers, and sequence of operation for all systems;

.3 certified wiring diagrams for all systems.

.2 Submit following samples for review:

.1 control damper section with linkage, operator, and certified flow and leakage data;

.2 wall mounting control system flow diagram as specified in Part 2 of this Section;

.3 each type of thermostat to be used, each identified as to intended use.

1.02 Closeout Submittals

.1 Submit a site inspection and start-up report from manufacturer's representative as specified in Part 3 of this Section.

.2 Submit written confirmation from control component manufacturer that site installation personnel are qualified and experienced in installation of components, and have parts and service availability on a 24/7 basis.

1.03 Quality Assurance

.1 Control systems are to be installed by control component manufacturer or by licensed personnel authorized by control component manufacturer. Submit written confirmation from control component manufacturer.

.2 Control wiring work is to be performed by licensed journeyman electricians, or under direct daily supervision of journeyman electricians.

2 Products

2.01 Automatic Control Valves and Operators

.1 Each control valve must be suitable in all respects for the application, including system pressure, and must have design output and flow rates with maximum pressure drops as follows:

.1 Two-Position: Line size or size using a pressure differential of 1 psi.

.2 Two-Way Modulating: 3 psid or twice the load pressure drop, whichever is more.

.3 Three-Way Modulating: Twice the load pressure drop, but not more than 5 psid.

.2 Body and trim materials selected in accordance with specification for globe valves, ball valves, or high performance butterfly valves, and in accordance with manufacturer's recommendations for design conditions and service.

.3 Size control valves for pressure drops and heating and cooling loads as scheduled with same pressure rating as globe valves under same service and pressure conditions.

.4 Size valves for two port and three port, two position service;

.1 line size,

.2 ball valves, sizes NPS 1 ½ and smaller,

.3 butterfly valves, sizes NPS 2 and larger.

.5 For two port and three port modulating service;

.1 use globe valves for CV rating 160 and smaller,

.2 use butterfly valves for CV rating above 160.

.6 Select butterfly valves based on CV rating at 70° rotation

.7 Hydronic system valves;

.1 two position service;

.1 straight through two port type, single seated, with replaceable disc or ball,

.2 quick opening linear or equal percentage flow characteristics.

.2 modulating service;

.1 straight through two port type, single seated,

.2 equal percentage flow characteristics.

.3 modulating diverting service; three port mixing valves,

.1 linear for each port to give constant total flow or,

.2 equal percentage flow characteristics with 25% valve authority (valve pressure drop equal to 33% pressure drop through load at full flow).

.4 actuator and trim selected for close-off pressure ratings as follows;

.1 two-way modulating or two position service; 150% of pump shut off head.

.2 three-way modulating service; 300% of pressure differential between ports A and B at design flow or 100% of pump shut off head.

.3 shut off head to be based on maximum rpm when pump is fitted with VFD

.5 sized as follows;

.1 for two-position service; line size.

.2 for two-way modulating service unless otherwise shown; pressure drop at design flow equal to greatest of;

.1 200% of pressure drop through heat exchanger,

.2 100% of pressure drop through coil,

.3 50% of pressure difference between supply and return mains, or

.4 35 kPa (5 psi).

.3 for three-way modulating service; pressure drop equal to smaller of;

.1 twice pressure drop through coil or heat exchanger, or

.2 35 kPa (5 psi).

.4 for valves for radiation, terminal units and reheat coils;

.1 pressure drop of 7 kPa (1 psig)

.6 failed position on isolation from control signal as follows;

.1 Heating water and glycol zone valves; normally open.

.2 Heating coil valves in AHU; normally open.

.3 Chilled water control valves; normally closed.

.4 Chilled water differential pressure by-pass control valves; normally open.

.5 Hot water and glycol differential pressure by-pass control valves; normally closed.

.8 Valve actuators for service other than radiation, radiant panel and reheat coil valve applications;

.1 sized and selected in accordance with manufacturer's specifications,

.2 electric/electronic for two position, or proportional control action, coupled to valves with linkage,

.3 electronic interface control board, solid state drive, reversible motor, oil immersed gear train,

.4 electronic overload or digital rotation sensing circuitry to protect damper operator through entire range of rotation,

.5 span and zero travel adjustment,

.6 position feedback signal on actuators used for proportional control,

.7 provision for manual positioning of valve when actuator is not powered,

.8 spring return mechanism to return valve to "normal" position on power failure (i.e. Normally Open (NO), or Normally Closed (NC)),

.9 control signals:

.1 0 to 10VDC or 0 to 20 ma,

.2 modulate damper position with 2 to 10VDC or 4 to 20 ma input signal operating range when in proportional service.

.3 input type and range as suitable for interfacing to output of BAS controller

.10 feedback signals:

.1 two independent adjustable travel limit switches and wiring to BAS for indication of valve position.

.11 general purpose, drip proof NEMA 2 die-cast housing with corrosion resistant steel cover for indoor applications, watertight NEMA 4 enclosure for outdoor use,

.12 electric actuators suitable for operation down to -35°C where installed outdoors.

.9 Valve actuators for service on radiation, radiant panel, and reheat coil valve applications;

.1 output shaft driven by gear train mechanism.

.2 reversible motor with automatic load limit,

.3 input type and range as suitable for interfacing to output of BAS controllers,

.4 adjustable span and offset travel,

.5 position feedback signal on actuators used for proportional control,

.6 general purpose, dustproof, die-cast aluminum housing,

.7 actuator rotation limit.

.10 Chilled water "energy valves";

.1 Belimo Energy Valve, pressure independent complete with Power Control and Belimo Delta T Manage logic built in to monitor coil performance and optimize the available energy of the coil by maintaining Delta T, standard analog signal and feedback wiring and connection to the BAS via BACnet MS/TP and built-in web server for visualization of the valves' operation in real time.

2.02 Control Dampers and Operators

.1 T. A. Morrison & Co. Inc. "TAMCO" 100 mm (4') deep, flanged, AMCA low leakage certified aluminium dampers. Dampers for modulating and mixing applications are to be parallel blade type. Dampers for open-shut service are to be opposed blade type. Maximum blade length is to be 1 m (4'). Dampers greater than 2 sections wide are to be complete with a jackshaft. Each damper is to be complete with:

.1 extruded 6063T5 aluminum frame and airfoil blades, each with an integral slot to receive a gasket;

.2 extruded TPE frame gaskets and extruded EPDM blade gaskets;

.3 slip-proof aluminium and corrosion resistant plated steel linkage of a metal thickness to prevent warping or bending during damper operation, concealed in frame, equipped with seal-sealing and self-lubricating bearings consisting of a Celcon inner bearing fixed on hexagonal blade pin and rotating in a polycarbonate outer bearing inserted in frame.

.2 For standard damper(s), Series 1000 as above.

.3 For insulated damper(s), Series 9000 as above but with all 4 sides of frame insulated with polystyrene, and blades thermally broken and insulated with expanded polyurethane foam.

.4 For stainless steel dampers, as above but constructed of type 316 stainless steel and equipped with Teflon blade bearings.

.5 Each damper motor is to be shaft mounted, spring return, fail safe in the normally open or normally closed position, sized to control damper against maximum pressure or dynamic closing pressure, whichever is greater, to suit sizes of dampers involved, and to provide sufficient force to maintain damper rated leakage characteristics. Each operator is to be complete with a damper position indicator, and external adjustable stops to limit length of stroke in either direction, and is to be mounted on a corrosion resistant adjustable bracket. Operating arms are to have double yoke linkages and double set screws for fastening to damper shaft. Operators for dampers to be connected to building fire alarm system or to freeze protection devices are to be equipped with additional relays to permit dampers to respond and go to required position in less than 15 seconds upon receipt of a signal. Operator enclosures are to be suitable in all respects for environment in which they are located.

.6 Electric damper operators are to be equal to Belimo EF Series 24 volt or 120 volt AC spring return, direct coupled electric motor operators for either modulating or 2-position control as required. Each operator is to be overload protected and complete with an enclosure to suit the mounting location.

2.03 Local Control Panels

.1 NEMA 1 (NEMA 2 in sprinklered areas) wall mounting, enamelled steel barriered enclosures sized to suit the application with 20% spare capacity, a perforated sub-panel, numbered terminal strips for all low and line voltage wiring, hinged door, and slotted flush latch.

2.04 Control System Components

.1 Components specified below are required for control of equipment and systems in accordance with drawing control diagrams and sequences of operation. Not all required components may be specified.

.2 Sensor/transmitter input devices must be suitable in all respects for the application and mounting location. Devices are as follows:

.1 unless otherwise specified, temperature sensors are to be resistance type, either 2-wire 1000 ohm nickel RTD or 2-wire 1000 ohm platinum RTD with accuracy (includes errors associated with sensor, lead wire, and A to D conversion), equipped with type 316 stainless steel thermowells for pipe mounting applications, as follows:

.1 chilled water, room temperature, and duct temperature points, ±1°C (±0.5°F);

.2 all other points, ±0.75°C (±1.3°F).

.2 room temperature sensors constructed to be selected in accordance with the following classifications:

.1 Type 1: Space temperature sensor (private/non-public areas);

.1 for measurement of space temperature only as shown on the floor plans and/or as described in the Sequence of Operation;

.2 set-point adjustment shall be accessible through the cover;

.3 sensor operating temperature range from 4°C to 60°C (40°F to 140°F);

.4 surface mounted plastic mono-chromatic guard with surface mounting plate and wall anchors;

.5 mono-chromatic guard secured to mounting plate by screws;

.2 Type 2: Space temperature sensor (public areas or secure areas);

.1 for measurement of space temperature of space temperature only in areas subject to vandalism as shown on the floor plans and/or as described in the Sequence of Operation;

.2 sensor operating temperature range from 4°C to 60°C (40°F to 140°F);

.3 stainless steel flat plate surface type with sensor epoxy-bonded to back of cover plate;

.4 tamperproof/secure concealed fasteners;

.5 set-point adjustment is to be concealed behind the cover.

.3 Type 3: Adjustable space temperature sensor with display (Private Areas, Office areas);

.1 for measurement and adjustment of space temperature as shown on the floor plans and/or as described in the Sequence of Operation;

.2 digital set point operating temperature adjustment range from 4°C to 60°C (40°F to 140°F);

.3 surface mounted plastic mono-chromatic guard with surface mounting plate and wall anchors;

.4 mono-chromatic guard secured to mounting plate by screws;

.5 on/off button to allow occupant override feature;

.6 three-digit LED digital temperature display with 0.2° display resolution;

.7 5% to 95% relative humidity, non-condensing;

.8 minimum/maximum limit set point values adjustable from the BAS operator interface and controller.

.9 set-point adjustment is to be accessible through the cover.

.3 outside air sensors designed and constructed for an ambient temperature of -25°C to 60°C (-13°F to 140°F) and 5% to 95% relative humidity, non-condensing, complete with a NEMA 3R enclosure, solar shield, a weatherproof seal at all wall penetrations, and a perforated plate surrounding sensor element where exposed to wind velocity pressure;

.4 insertion duct mounting sensors type with lock nut and mounting plate, designed to mount in an electrical box (weather-proof with gasket and cover where outside) through a hole in duct;

.5 for ducts greater than 1.2 m (4') or for ducts where air temperature stratification occurs, averaging type sensors with multiple sensing points, and for plenums for applications such as mixed air temperature measurement to account for air turbulence and/or stratification, an averaging string of sensors with capillary supports on the sides of duct/plenum;

.6 Where both temperature and humidity are shown to be measured at same location or in same airstream, use of single measuring unit is permitted provided that features and performance of both temperature sensor and humidity sensor are in accordance with requirements of this specification.

.3 factory solid-state relative humidity sensors with an element that resists contamination, weather-proof with a NEMA 3R enclosure for outside air applications, supplied with a type 304 stainless steel probe with mounting bracket and hardware for duct mounting, each complete with a factory calibrated humidity transmitter which is accurate (including lead loss and analog to digital conversion) to 3% between 25°C to 60°C (-13°F to 140°F) and 5% to 95% relative humidity, non-condensing and complete with non-interactive span and zero adjustments, and a 2-wire isolated loop powered, 4-20 mA, 0 to 100% linear proportional output;

.4 carbon dioxide sensors for air quality control purposes having a maximum 20 second response time, suitable for operating conditions from 0°C to 50°C (32°F to 122°F) and 0 to 100% RH non-condensing, complete with a calibration kit (to be handed to Owner) and characteristics as follows:

.1 measurement range: 0 to 2000 ppm;

.2 accuracy: ±100 ppm;

.3 repeatability: ±20 ppm;

.4 drift: ±100 ppm per year;

.5 output signal: 0 to 10 VDC proportional over the 0 to 2000 ppm range.

.5 Pressure transmitters are to be constructed to withstand 100% pressure over-range without damage and to hold calibrated accuracy when subject to a momentary 40% over-range input. Pressure transmitters are to transmit a 0 to 5 VDC, 0 to 10 VDC, or 4 to 20 mA output signal. Differential pressure transmitters used for flow measurement are to be sized to the flow sensing device and supplied with a tee fitting and shut-off valves in the high and low sensing pick-up lines to allow permanent ease of use connection for balancing, etc. Transmitter housing is to suit mounting location. Standalone pressure transmitters are to be mounted in a minimum NEMA 1 (NEMA 2 in sprinklered area) by-pass valve assembly panel with high and low connections piped and valved, air bleed units, by-pass valves, and compression fittings. Transmitters are to be as follows:

.1 low differential water pressure, 0 to 5 kPa (0 to 20" wc): equal to Setra or Mamac industrial quality transmitter capable of transmitting a linear 4 to 20 mA output signal in response to variation of flow meter differential pressure or water pressure sensing points, each complete with non-interactive zero and span adjustments adjustable from outside the cover, and performance as follows:

.1 maintain accuracy up to 20 to 1 ratio turndown;

.2 reference accuracy: +0.2% of full scale.

.2 medium to high differential water pressure, over 5 kPa (20" wc): equal to Setra or Mamac transmitters as specified above for low pressure transmitters but with a pressure range of from 2.5 kPa (10" wc) to 2070 kPa (300 psi), a reference accuracy of ±1% of full span (includes non-linearity, hysteresis, and repeatability);

.3 building differential air pressure: equal to Setra or Johnson Controls Inc. industrial quality transmitter with a range suitable for the application, capable of transmitting a linear 4 to 20 mA output in response to variation of differential pressure or air pressure sensing points, each complete with non-interactive zero and span adjustments adjustable from outside the cover, and performance as follows:

.1 maintain accuracy up to 20 to 1 ratio turndown;

.2 reference accuracy: +0.2% of full span.

.4 low differential air pressure, 0 to 1.25 kPa (0" to 5" wc): equal to Setra or Johnson Controls Inc. industrial quality transmitter with a range suitable for the application, capable of transmitting a linear 4 to 20 mA output signal in response to variation of differential pressure or air pressure sensing points, each complete with non-interactive zero and span adjustments adjustable from outside the cover, and performance as follows:

.1 maintain accuracy up to 20 to 1 ratio turndown;

.2 reference accuracy: +0.2% of full span.

.5 medium differential air pressure, over 1.5 kPa (5" wc): equal to Setra or Johnson Controls Inc. transmitters as specified above for low pressure air transmitters but performance requirements as follows:

.1 zero and span: (c/o F.S./Deg. F); .04% including linearity, hysteresis, and repeatability;

.2 accuracy: 1% F.S. (best straight line); static pressure effect: 0.5% F. S.;

.3 thermal effects: less than +0.33 F.S./°F over 40°F to 100°F (calibrated at 70°F).

.6 Air and water flow monitoring stations and probes are to be Air Monitor Corp., Tek-Air Systems Inc., Ebtron, or Dietrich Standard products as follows:

.1 Fan Inlet Air Flow Measuring Station: At fan inlet and near exit of inlet sound trap, air flow traverse probes are to continuously monitor fan air volume and system velocity pressure, and traverse probes are to be as follows:

.1 each probe is to be of a dual manifold, cylindrical, anodized type 3003 extruded aluminium construction probe with sensors located along the stagnation plane of approaching air flow, and the static pressure manifold is to incorporate dual offset static tops on opposing sides of averaging manifold so as to be insensitive to flow angle variations for as much as ±20° in approaching air stream;

.2 each probe is not to introduce a measurable pressure drop, nor is sound level within duct to be amplified by its singular or multiple presence in air stream, and each probe is to contain multiple static and total pressure sensors places at equal distances along its length in accordance with ASHRAE Standards for duct traversing.

.2 Single Probe Air Flow Measuring Sensor: Duct mounting hot wire anemometer type which utilizes 2 temperature sensors, one is a heater element temperature sensor and the other is to measure downstream temperature, with temperature differential related directly to air flow velocity. Sensor insertion length is to be adjustable up to 200 mm (8"), and transmitter is to produce a 4 to 20 mA or 0 to 10 VDC signal linear to air velocity.

.3 Duct Flow Measuring Stations: #14 gauge galvanized steel casing with duct connection flanges of a size to mate with connecting ductwork, and complete with an air directionalizer and a 98% free area parallel cell 20 mm (¾") honeycomb profile suppressor across entering air stream to equalize velocity profile and eliminate turbulent and rotational flow from the air stream prior to measuring point, mechanically fastened to casing so as to withstand velocities of up to 1828 m (6000') per minute. Additional requirements as follows:

.1 total pressure measurement side (high side) is to be designed and spaced to requirements of Industrial Ventilation Manual, 16th Edition, page 9-5, and self-averaging manifolding is to be constructed of brass and copper components;

.2 static pressure sensing probes (low side) is to be bullet-nose shaped, per detailed radius, as illustrated in Industrial Ventilation Manual referred to above, page 9-5;

.3 main take-off point from both total pressure and static pressure manifolds is to be symmetrical, and manifolds are to terminate with external ports for connection to control tubing;

.4 each station is to be equipped with a label on casing indicating unit model number, size, area, and specified air flow capacity;

.5 each station is to have a self-generated sound rating of less than NC 40, and sound level within duct is not to be amplified nor is additional sound to be generated.

.4 Static Pressure Traverse Probe: Duct mounting, complete with multiple static pressure sensors located along exterior surface of cylindrical probe.

.5 Shielded Static Air Probe: Indoor type or outdoor type as required, each with multiple sensing ports, an impulse suppression chamber, and air flow shielding.

.6 Water Flow Monitoring: Equal to Onicon microprocessor-based electromagnetic water flow meters with an accuracy of 0.25%.

.7 Power (amps) monitoring is to be performed by a combination of a current transformer and a current transducer with transformer sized to reduce full amperage of monitored circuit to a maximum 5 ampere signal which will be converted to a 4 to 20 mA DDC compatible circuit for use by building automation system. Current transformer and current transducer are as follows:

.1 equal to Veris Industries split core current transformer with an operating frequency of from 50 to 400 Hz, 0.6 Kv class, 10 Kv BIL insulation, and 5 ampere secondary;

.2 equal to Veris Industries current to voltage or current to mA transducer with an accuracy of ±5%, a minimum load resistance of 30 kOhm, an input of 0 to 20 amperes and an output of 4 to 20 mA, and a 24 VDC regulated power supply.

.8 Duct mounting smoke detectors supplied as part of electrical work for mounting as part of control system work.

.9 Double contact switches to monitor equipment status and safety conditions, and generate alarms when a failure or abnormal condition occurs. Status and safety switches are to be as follows:

.1 current sensing switches: equal to Veris Industries self-powered dry contact output switches for sensing run status of motor loads, each calibrated to indicate a positive run status only when motor is operating under load, and each consisting of a current transformer, a solid-state current sensing circuit, adjustable trip point, solid-state switch, SPDT relay, and a LED to indicate on or off status;

.2 air filter status switches: equal to Johnson Controls Inc. or Cleveland Controls automatic reset type differential pressure switches, each complete with SPDT contacts rated for 2 amperes at 120 VAC, a scale range and differential pressure adjustment appropriate for the service, and an installation kit which includes static pressure taps, tubing, fittings, and air filters;

.3 air flow switches: equal to Johnson Controls Inc. or Cleveland Controls pressure flow switches, bellows actuated mercury switch or snap-acting micro-switch type with an appropriate scale range and pressure adjustment;

.4 air pressure safety switches: equal to Johnson Controls Inc. or Cleveland Controls manual reset switches, each complete with SPDT contacts rated for 2 amperes at 120 VAC and an appropriate scale range and pressure adjustment;

.5 water flow switches: equal to Johnson Controls Inc. Model P74;

.6 low temperature limit switches: manual reset type equal to Johnson Controls Inc. Model A70, each complete with DPST snap acting contacts rated for 16 amperes at 120 VAC, a minimum 4.5 m (15') sensing element for mounting horizontally across duct/plenum with sensing reaction from coldest 450 mm (18") section of element, and where sensing element does not provide full coverage of air stream, additional switches are to be supplied as required.

.10 Control relays as follows:

.1 control pilot relays: equal to Johnson Controls Inc. or Lectro modular plug-in design with snap-mount mounting bases, retaining springs or clips, DPDT, 3 PDT or 4 PDT as required for the application, with contacts rated for 10 amperes at 120 VAC;

.2 lighting control relays: latching type with integral status contacts rated for 20 amperes at 120 VAC, each complete with a split low voltage coil that moves the voltage contact armature to On or Off latched position, each controlled by a pulsed tri-state output (preferred) or pulsed paired binary outputs, and each designed so power outages will not result in a change-of-state and so multiple same state commands will simply maintain commanded state.

.11 Electronic signal isolation transducers equal to Advanced Control Technologies for installation whenever an analog output signal from building automation system is to be connected to an external control system as an input (i.e. equipment control panel), or is to receive as an input signal from a remote system, and to provide ground plane isolation between systems.

.12 Each manual override station is to be complete with contacts rated minimum 1 ampere at 24 VAC and is to provide following:

.1 integral H-O-A switch to override controlled device pilot relay;

.2 status input to building automation system to indicate whenever switch is not in the Auto position;

.3 status LED to illuminate whenever output is On;

.4 override LED to illuminate whenever H-O-A switch is in either the Hand or Off position.

.13 Electronic transducers equal to Johnson Controls Inc. transducers with an output of from 3 to 15 psig, an input of from 4 to 20 mA or 10 VDC, manual output adjustment, a pressure gauge, and an external replaceable supply air filter.

.14 Thermostats:

.1 Wall mounting adjustable set-point thermostats, each suitable in all respects for equipment (and operating sequence) they are provided for, equipped with a thermometer, a cover and any required mounting and connection accessories.

.2 Line voltage thermostats are to be 115 volt.

.3 Low voltage thermostats are to be 24 volt electronic type.

.4 Set-point adjustment for thermostats in public spaces is to be concealed behind cover. Set-point adjustment for other thermostats is to be accessible through cover.

.5 Covers are to be removable, tamper-proof covers with temperature set-point and thermometer displays.

.6 Guards for thermostats are to be clear, ventilated acrylic covers with allen key locking hardware.

.15 Humidistats:

.1 Direct or reverse acting (to suit system), proportional type, adjustable humidity controllers, each corrosion resistant, suitable in all respects for the application and complete with a nylon element, replaceable cartridge type air filter, internally adjustable limit stops for maximum and minimum settings, a cover, and required mounting and connection accessories.

.2 Electric humidistats are to be line voltage (115 volt), or 24 volt electronic type.

.3 Wall mounting humidistats are to be complete with a tamper-proof display type cover.

.4 Duct mounting humidistats are to be complete with a display type cover, duct sampling chamber with 300 mm (12") long extruded pick-up tube for duct mounting, a moulded mounting base, and a ventilated cover.

.16 Hardware to permit building automation system control and monitoring of input/output points in accordance with Section 25 05 02 - Building Automation System, points schedule, and drawing control diagrams and operation sequences. All such hardware is to be suitable in all respects for interface with the building automation system.

2.05 System Wiring Materials

.1 System wiring, conduit, boxes, and similar materials are to be in accordance with requirements specified in appropriate Section(s) of Electrical Work specification.

3 Execution

3.01 General Re: Installation of Controls

.1 Provide complete systems of control and instrumentation to control and supervise building equipment and systems in accordance with this Section and drawings.

.2 Control systems are to generally be as indicated on drawing control diagrams and are to have all the elements therein indicated or implied.

.3 Control diagrams show only the principal components controlling the equipment and systems. Supplement each control system with all relays, transformers, sensors, etc., required to enable each system to perform as specified and to permit proper operation and supervision.

.4 Brace and secure control system equipment in accordance with requirements specified in Section 20 05 48.16 - Seismic Controls for Mechanical Systems.

3.02 Supply of Control Air Dampers and Operators

.1 Unless otherwise specified, supply required control dampers. Hand dampers to sheet metal trade at site in location where they are required for installation as part of sheet metal work. Ensure each damper is correctly located and mounted.

.2 Unless otherwise specified or scheduled, insulated dampers to be provided for all outdoor air intake and exhaust air applications.

.3 Provide linkage and operators for dampers. Wherever possible locate damper operators so they are accessible from outside duct, plenum, and equipment casings. Bracket mount operators on ducts or plenums clear of insulation where applicable.

.4 Where sequence operation is indicated, or where multiple operators drive a series of dampers, provide pilot positioners to couple their action.

.5 Ensure dampers located in ductwork other than galvanized steel are constructed of type 316 stainless steel.

3.03 Supply of Automatic Control Valves and Operators

.1 Unless otherwise specified, supply required automatic control valves. Hand valves to appropriate piping trades at site in locations they are required for installation as part of piping work. Ensure each valve is properly located and installed.

.2 Provide an operator for each valve.

3.04 Installation of Thermostats

.1 Unless otherwise noted, provide required thermostats.

.2 Provide a ventilated clear acrylic cover for each thermostat located in finished areas, and a wire type guard for each thermostat located in unfinished areas and in areas such as mechanical rooms where thermostat is subject to damage.

.3 Unless otherwise indicated, mount room thermostats 1.5 m (5 ft.) above finished floor level. Thermostats intended to be used by building occupants in a barrier-free path of travel to be mounted at 1.2m. Confirm exact location of all thermostats prior to roughing-in.

.4 Provide stand-off mounting and an insulated sub-base for thermostats on outside walls.

.5 Perform control wiring associated with installation of electric or electric-electronic thermostats.

3.05 Installation of Control System Components

.1 Provide required control system components and related hardware. Refer to drawing control diagrams and sequences.

.2 Where components are pipe, duct, or equipment mounted supply components at proper time, coordinate installation with appropriate trade, and ensure components are properly located and mounted.

3.06 Control Wiring

.1 Perform required control wiring work for control systems except:

.1 power wiring connections to equipment and panels, except as noted below;

.2 control wiring associated with mechanical plant equipment and systems whose control is not part of work specified in this Section;

.3 starter interlock wiring.

.2 Except as specified below, install wiring in conduit. Unless otherwise specified, final 600 mm (2') connections to sensors and transmitters, and wherever conduit extends across flexible duct connections is to be liquid-tight flexible conduit.

.3 Control wiring in ceiling spaces and wall cavities may be plenum rated cable installed without conduit but neatly harnessed, secured, and identified.

.4 Wiring work is to be in accordance with certified wiring schematics and instructions, and wiring standards specified in appropriate Sections of Electrical Work Specification.

3.07 Installation of Control Air Compressor Set and Dryer

.1 Provide a duplex air compressor set. Secure set in place on vibration isolation on a concrete housekeeping pad. Install flexible piping connections supplied with set and connect with required piping, including drain piping extended and terminated at nearest drain.

.2 Wall mount power and control panel(s) adjacent to equipment. Connect compressor set panel pressure switch with copper tubing to compressor set.

3.08 Identification and Labelling of Equipment and Circuits

.1 Refer to identification requirements specified in Section 20 05 00 – Common Work Results for Mechanical.

.2 Identify equipment as follows:

.1 enclosures and components: engraved laminated nameplates with wording listed and approved prior to manufacture of nameplates;

.2 wiring: numbered sleeves or plastic rings at both ends of conductor, with numbering corresponding to conductor identification on shop drawings and "as-built" record drawings.

3.09 Testing, Adjusting, Certification, Start-Up, and Training

.1 When control work is complete, check installation of components and wiring connections, make any required adjustments, and coordinate adjustments with personnel doing HVAC testing, adjusting and balancing work.

.2 For equipment/system manufacturer certification requirements, refer to Section 20 05 00 – Common Work Results for Mechanical.

.3 For equipment/system start-up requirements, refer to Section 20 05 00 – Common Work Results for Mechanical.

.4 Include for 2 full, 8 hour days on-site operation demonstration and training sessions. Training is to be a full review of all components including but not limited to a full operation and maintenance demonstration, with abnormal events.

.5 Include for 2 follow-up site training and troubleshooting visits, one 6 months after Substantial Completion and other at end of warranty period, both when arranged by Owner and for a full, 8 hour day to provide additional system training as required, and to demonstrate troubleshooting procedures.

End OF Section

1 General

1.01 Abbreviations and Definitions

.1 Abbreviations used in this Specification are as follows:

.1 BAS building automation system;

.2 DDC direct digital controls;

.3 LAN local area network;

.4 PC personal computer.

1.02 Submittals

.1 Submit shop drawings/product data sheets for BAS components. As a minimum, submit the following:

.1 BAS network architecture, including modes and interconnections;

.2 systems schematics, sequences, and flow diagrams;

.3 points schedule for each point in BAS, including point type, object name, expanded ID, display units, controller type, and address;

.4 samples of graphic display screen types and associated menus;

.5 detailed Bill of Materials for each system or application, identifying quantities, part numbers, descriptions, and optional features;

.6 control damper schedule including a separate line for each damper and a column for each of damper attributes including code number, fail position, damper type, damper operator, duct size, damper size, mounting and actuator type;

.7 control valve schedules including a separate line for each valve and a column for valves as for control dampers;

.8 room schedule including a separate line for each HVAC terminal unit indicating type, location and address;

.9 details of BAS interfaces and connections to other systems;

.10 product data sheets or marked catalogue pages including part number, photograph and description for BAS hardware and software.

1.03 Closeout Submittals

.1 Submit a site inspection and start-up report from manufacturer's representative as specified in Part 3 of this Section.

.2 Record "as-built" drawings are to include:

.1 schematic outline of BAS for quick reference of overall system scope;

.2 adequate record of work as installed, including locations and routing of system wiring.

.3 O&M Manual is to include:

.1 hardware specification manual which gives a functional description of hardware components;

.2 operator's manual which outlines concise instructions for operation of system and an explanation and recovery route for system alarms;

.3 engineering manual which outlines and defines system set-up, definition and application;

.4 data manual which indicates applications data programmed into system;

.5 system software documentation.

1.04 Description of the Building Automation System

.1 Building automation system is to consist of a modular, BACnet protocol, open architecture system incorporating direct digital control and monitoring of equipment and systems and consisting of all hardware and software required for complete, functional DDC control system. BAS is to be accessible through standard personal computers within building through a wireless application protocol device, or remotely through Internet by means of a standard web browser.

.2 BAS is to be field expandable, with a distributed architectural design to eliminate dependence upon any single device for alarm reporting and control execution. Failure of any single component or network connection is not to interrupt execution of control strategies at other operational devices. BAS is to maintain all settings and overrides through a system re-boot, and is to incorporate, as a minimum, following integrated features, functions and services:

.1 graphic user interface for accessing and viewing BAS information, commanding points, changing setpoints, responding to alarms, programming time-of-day schedules;

.2 operator information, alarm management, and control features;

.3 enterprise-level information and control access;

.4 information management including monitoring, transmission, archiving, retrieval, and reporting functions;

.5 diagnostic monitoring and reporting of BAS functions;

.6 off-site monitoring and management access;

.7 energy management;

.8 standard applications for terminal HVAC systems.

.3 BAS is to include, but not be limited to, following:

.1 personal computer based server for networking and integrating all hardware components into a single BAS;

.2 personal computer based operator work station with colour monitor for colour graphic displays, and a colour printer;

.3 portable operator's terminal;

.4 network of standalone network automation engine(s);

.5 network of field equipment controllers;

.6 input/output modules;

.7 local display devices;

.8 distributed user interfaces;

.9 network processing, data storage and communication equipment;

.10 all other components required for a complete and operating BAS.

1.05 Quality Assurance

.1 BAS hardware and software is to be installed by experienced personnel employed and trained by manufacturer/supplier of field equipment controllers. System wiring is to be installed by journeyman electricians or under direct on-site supervision of journeyman electricians.

2 Products

2.01 General Re: Building Automation System

.1 Control system components (field devices) other than those specified in this Section are generally specified in Section 25 05 01 - Automatic Control Systems. Components factory installed with equipment or supplied with equipment are specified in mechanical work Sections with equipment.

.2 BAS specified in this Section is an expandable DDC building automation system in accordance with drawing control diagrams and sequences, and points lists.

.3 Manufacturers:

.1 Trane Controls (Contact: Tejas Sawant, tejas.sawant@tranetechnologies.com, 613-853-4254)

2.02 BAS Architecture

.1 BAS is to be based industry standard Ethernet TCP/IP communications protocol. Where used, LAN controller cards are to be standard "off-the-shelf" products available through normal PC vendor channels. BAS is to be capable of operating at a communication speed of 100 Mbps, with full peer-to-peer network communication. BAS is to be compatible with other enterprise-wide networks, and where indicated, BAS is to be connected to the enterprise network and share resources with it by way of standard networking devices and practices.

.2 Network automation engines are to provide supervisory control over control network and are to support BACnet Standard MS/TP bus communication protocol (ASHRAE SSPC-135, Clause 9). Control networks are to provide either a "peer-to-peer", master-slave, or supervised token passing communications and are to operate at a minimum communication speed of 9600 baud. DDC controllers are to reside on control network.

.3 BAS is to include appropriate hardware and software to allow BACnet bi-directional data communications between BAS and building equipment/system control panels. BAS is to receive, react to, and return information from connected equipment and systems. Data required by application is to be mapped into automation engine's data base and is to be transparent to operator. Point inputs and outputs from building equipment/system control panels is to have real-time interoperability with BAS software features such as control software, energy management, custom process programming, alarm management, historical data and trend analysis, totalization, and local area network communications.

2.03 Dedicated Web Based User Interface

.1 User interface is to be web based and is to operate on a personal computer for command entry, information management, network alarm management, and database management functions. Real-time control functions including scheduling, history collection, and alarming are to be resident in appropriate components of BAS network to facilitate greater fault tolerance, availability and reliability.

.2 Architecture of personal computer is to be implemented to conform to industry standards such that it can accommodate applications provided with BAS and mechanical systems and equipment, including but not limited to Microsoft Office Applications. Specifically, it must conform to following interface standards:

.1 Microsoft Internet Explorer (or other standard browser) for user interface functions;

.2 Microsoft Office Professional for creations, modification and maintenance of reports, and sequencing other necessary building management functions;

.3 Microsoft Outlook or other email program for supplemental alarm functionality and communication of system events, and reports;

.4 required network operating system for exchange of data and network functions such as printing of reports, trends, and specific system summaries.

.3 Personal computer server or operator workstation is to be configured at minimum as follows:

.1 memory: 8 GB;

.2 processor: Intel;

.3 hard drive: 500 GB free hard drive;

.4 graphics card: 1 GB DDR3;

.5 ports: 1 HMDI, 2 serial, one parallel, and 2 USB-C ports;

.6 keyboard: 101 keyboard and 2-button mouse;

.7 monitors: 23" LCD monitor with 1920 x 1080 resolution;

.8 LAN communications: 10/100/1000 network card.

.4 Operating System Software: Windows 7 Professional 64-bit Microsoft SQL 2008 Server and SQL 2008 Server Express are automatically installed by EBI. Where user interface is not provided via browser, PC is to be equipped with a complete workstation software package including any software or hardware keys, and package is to include original installation discs and licenses for all software, device drivers, peripherals, and software registration cards which are to be handed to Owner.

.5 Printer is to be at minimum equal to Hewlet Packard "DeskJet" colour printer with a speed of 600 DPI black and 300 DPI colour, and 64 K input print buffer.

2.04 Distributed Web Based User Interface

.1 Features and functions of dedicated web based user interface described above are to be available on any computer connected directly or via a wide area or virtual private network to BAS network, which conforms to the following specifications:

.1 software is to run on Microsoft Internet Explorer (8.0 or higher) browser;

.2 minimum hardware requirements are:

.1 2 GB RAM;

.2 2.0 GHz clock speed Pentium 4 microprocessor;

.3 120.0 GB hard drive;

.4 keyboard with 83 keys minimum;

.5 SVGA 1024 x 768 resolution display with 64K colours and 16 bit colour depth;

.6 mouse or other pointing feature.

2.05 Remote Access Via Smart Phone and/or Tablet Devices

.1 Available with an operator interface designed for use on various modern smart phone devices with network connectivity with the follow features:

.1 Mobile user interface operating over standard TCP network connection, performing well down to standard mobile 3G speeds, and optimized to ensure very high performance across different network topologies.

.2 Solution written with HTML5 web standards and browser agnostic, not deploying or using ActiveX controls, nor requiring installation of Java Runtime engine.

.3 Mobile solution incorporating full scope of responsibilities of BAS operators for remote mobile users, allowing them to view or control points within their assigned facility locations.

.4 Without alternation, mobile user interface operable within any standard internet browser from a normal personal computer.

.2 Along with optimized smart phone user interface, a dedicated tablet access user interface, optionally providing full operator workstation functionality, on a tablet style device. Tablet interface is to support standard operator workstation features including full operator scope of responsibility, and operable using commercial off-the-shelf technology.

2.06 User Interface Application Components

.1 Integrated browser based client application is to be used as user operator interface program. System is to employ an event-driven rather than a device polling methodology to dynamically capture and present new data to user. Additional features are as follows:

.1 inputs, outputs, set-points, and other parameters as defined in Part 3 of this Section, shown on drawings, or required as part of system software are to be displayed for operator viewing and modification from operator interface software;

.2 user interface software is to provide help menus and instructions for each operation and/or application;

.3 system is to support customization of user interface configuration and a home page for each operator;

.4 system is to support user preferences in alarm, trend, display, and applications screen presentations;

.5 controller software operating parameters are to be displayed for operator to view/modify from user interface, and these parameters are to include set-points, alarm limits, time delays, PID tuning constants, run times, point statistics, schedules, etc.;

.6 operator interface is to incorporate comprehensive support for functions including but not limited to following:

.1 user access for selective information retrieval and control command execution;

.2 monitoring and reporting;

.3 alarm, non-normal, and return to normal condition annunciation;

.4 selective operator override and other control actions;

.5 information archiving, manipulation, formatting, display and reporting;

.6 BAS internal performance supervision and diagnostics;

.7 on-line access to help menus;

.8 on-line access to current BAS as-built records and documentation;

.9 means for controlling, re-programming, and re-configuration of the BAS operation and for the manipulation of the BAS database information in compliance with applicable Codes and Regulations for individual BAS applications.

.7 system is to support a list of application programs configured by users that are called up by the Tools Menu, hyperlinks within graphic displays, and key sequences;

.8 operation of control system is to be independent of user interface, which is to be used for operator communication only.

.2 System is to have a minimum of 5 levels of nesting, and the capability of displaying multiple navigation trees to aid operator in navigating throughout all systems and points connected, adding custom trees, defining any logical grouping of points and arranging them on a tree in any order, and nesting groups within other groups. Navigation trees are to be "dockable" to other displays such as graphics, meaning trees will appear as part of display but can be detached and then minimized to Windows task bar or closed altogether, however, a simple keystroke will reattach navigation to primary display of user interface.

.3 Alarms are to be routed directly from network automation engines to PC's and servers, and it is to be possible for specific alarms from specific points to be routed to specific PC's and servers. BAS is to annunciate diagnostic alarms indicating system failures and non-normal operating conditions, annunciate application alarms as required by points lists and sequences, and as a minimum, permit 4 categories of alarm sounds customizable through user defined wav files. Alarm management segment of user interface is to provide, as a minimum, following alarm functions:

.1 log, date, and time of alarm occurrence;

.2 generate a "pop-up" window or populate a dedicate section of screen with audible alarm to inform a user that an alarm has been received;

.3 permit a user with the appropriate security level to acknowledge, temporarily silence, or discard an alarm;

.4 provide an audit trail on PC hard drive for alarms by recording user acknowledgement, deletion or disabling of an alarm, name of the user, alarm, action taken, and time/date of alarm;

.5 facilitate ability to direct alarms to an email address or alphanumeric pager, in addition to pop-up window described above;

.6 any attribute of any object in system may be designated to report an alarm.

.4 Reports and summaries are to be generated and directed to user interface displays with subsequent assignment to printers or discs. Summaries and reports are to be accessible via standard user interface functions, and selection of a single menu item, tool bar item, or tool bar button is to print any displayed report or summary. System is to permit creation of custom reports and queries via a standard web services XML (Extensible Mark-up Language) interface and commercial of-the-shelf software such as Microsoft Access, Microsoft Excel, or Crystal Reports. As a minimum, BAS is to provide following reports and summaries:

.1 all points in BAS;

.2 all points in each BAS application;

.3 all points in a specific controller;

.4 all points in a user-defined group of points;

.5 all points currently in alarm;

.6 all points locked out;

.7 all BAS schedules;

.8 all user defined and adjustable variables, schedules, interlocks, etc.

.5 Graphical display for time-of-day scheduling and override scheduling of building operations is to be provided, with weekly schedules for each group of equipment with a specific time use schedule, and it is to be possible to define one or more exception schedules for each schedule including reference to calendars, with monthly calendars provided to permit simplified scheduling of holidays and special days for a minimum of 5 years in advance, user selected with the pointing device or keyboard. Changes to schedules made from user interface are to directly modify network automation engine schedule database. Selection of a single menu item or tool bar button is to print any displayed schedule. As a minimum, following functions are to be provided:

.1 weekly schedules;

.2 exception schedules;

.3 monthly calendars;

.4 global schedules.

.6 BAS Is to be complete with multiple-level password access protection to permit user/manager to user interface control and display, database manipulation capabilities deemed appropriate for each user, based on an assigned password. Password access protection features are to include:

.1 each user is to have a user name (24 characters minimum), a password (12 characters minimum), and access levels;

.2 each user may change his or her password at any time;

.3 when editing or entering passwords, system is not to echo actual characters for display on monitor;

.4 minimum of 500 unique password is to be supported;

.5 operators are to be able to perform only those commands available for their respective passwords, and display of menu selections is to be limited to only those items defined for access level assigned to password of each user;

.6 BAS is to automatically generate a report of log-on/log-off and system activity for each user, and any action that results in a change in operation or configuration of control system is to be recorded, including acknowledgement and deletion of alarms;

.7 minimum of 5 levels of access is to be supported individually or in any combination of following:

.1 Level 1 – view data;

.2 Level 2 – command;

.3 Level 3 – operator overrides;

.4 Level 4 – database modification;

.5 Level 5 – database configuration;

.6 Level 6 – all privileges including password add/modify.

.7 User interface is to be equipped with screen management capabilities that allows user to activate, close, and simultaneously manipulate a minimum of 4 active display windows plus a network of user defined navigation trees.

.8 Graphics application program is to be an integral part of user interface and is to include a create/edit function and a runtime function, and system architecture is to support a number of graphic documents (graphic definition files) limited only by memory and computing resources to be generated and executed. Graphics are to be capable of displaying and providing animation based on real-time data that is acquired, derived, or entered. Additional features include following:

.1 maximum of 16 graphic applications are to be able to be executed at any one time on a user interface or workstation with 4 visible to user, and each graphic application is to capable of following functions:

.1 all graphics are to be fully scalable;

.2 graphics are to support a maintained aspect ratio;

.3 multiple fonts are to be supported;

.4 unique background is to be assigned on a per graphic basis;

.5 colour of animations and values on displays is to indicate status of object attribute.

.2 it is to be possible to change values (set-points) and states in system controlled equipment by using drop-down windows accessible via pointing device;

.3 graphic editing tool is to be provided to permit creation and editing of graphic files, and graphic editor is to be capable of performing/defining animations, defining runtime binding, and:

.1 in general, facilitate creation and positioning of point objects by dragging from tool bars or drop-downs and positioning where required;

.2 be capable of adding additional content to any graphic by importing backgrounds in the SVG, BMP, or JPG file formats.

.4 many graphic displays representing part of building and various building components are exact duplicates, with exception that various variables are bound to different field values, consequently, it is to be possible to bind value of a graphic display to aliases, as opposed to physical field tags.

.9 Trend and change of value data is to be stored within the automation engines or server and uploaded to a dedicated trend database or exported in a selectable data format via a data export utility. Uploads to a dedicated database are to occur based on one of user-defined interval, manual command, or when trend buffers are full. Exports are to be as requested by user or on a time scheduled basis. System is to be equipped with a configurable data storage sub-system for collection of historical data which can be stored in either Microsoft Access or SQL database format. Each automation engine is to store, trend, and point history data for analog and digital inputs and outputs as follows:

.1 any point, physical or calculated, may be designated for trending, and methods of collection are to be defined time interval or a change of value;

.2 each automation engine or server is to capable of storing multiple samples for each physical point and software variable based on available memory, including an individual sample time/date stamp, and points may be assigned to multiple history trends with different collection parameters.

.10 Trend viewing utility with access to data points and capability of defining trend study displays to include multiple trends is to be provided, and is to include:

.1 capability of retrieving any historical database point for use in displays and reports by specifying point name and associated trend name;

.2 displays which are able to be single or stacked graphs with on-line selectable display characteristics such as ranging, colour, and plot style;

.3 display magnitude (zoom capability) and units selectable by operator at any time without reconfiguration of processing or collection of data;

.4 display magnitude is to be automatically scaled to show full graphic resolution of data being displayed;

.5 trend studies are to be capable of calculating and displaying calculated variables including highest value, lowest value, and time based;

.6 display is to support user's ability to change colours, sample sizes, and types of markers.

.11 BAS is to be equipped with a database manager that separates database monitoring and management functions by supporting 2 separate windows. Database secure access is to be accomplished using standard SQL authentication including ability to access data for use outside of BAS application. Additional features are as follows:

.1 database management function is to include summarized information on trend, alarm, event, and audit for backup, purge, and restore database management functions;

.2 database manager is to support 4 tabs as follows:

.1 statistics, which is to display database server information and trend, alarm (event), and audit information on BAS database;

.2 maintenance, which is to be an easy method of purging records from BAS server trend, alarm (event), and audit databases by supporting separate screens for creating a backup prior to purging, selecting database, and allowing for retention of a selected number of day's data;

.3 backup, which is to provide means to create a database backup file and select a storage location;

.4 restore, which is to provide a restricted means of restoring a database by requiring user to log into an Expert Mode in order to view Restore screen.

.3 status bar is to appear at bottom of BAS database manager tabs and is to indicate information on current display activity with icons as follows:

.1 Ready;

.2 Purging Record From Database;

.3 Action Failed;

.4 Refreshing Statistics;

.5 Restoring Database;

.6 Shrinking A Database;

.7 Backing-Up A Database;

.8 Resetting Internet Information Services;

.9 Shutting Down BAS Deice Manager;

.10 Action Successful.

.4 database manager monitoring functions are to be accessed through Monitoring Settings window and are to continuously read database information once user has logged in;

.5 system is to advise user via task bar icons and email messages when a database value has exceeded a warning or alarm limit;

.6 Monitoring Settings window is to have following sections:

.1 General: allow user to set and review scan intervals and start times;

.2 Email: allow user to create and review email and telephone text messages to be delivered when a warning or alarm is generated;

.3 Warning: allow user to define warning limit parameters, set reminder frequency, and link email message;

.4 Alarm: allow user to define alarm limit parameters, set reminder frequency, and link email message;

.5 Database Login: protect system from unauthorized database manipulation by creating a read access and write access for each trend, alarm (event), and audit databases as well as an Expert Mode required to restore a database.

.7 Monitoring Settings taskbars to display following informational icons:

.1 Normal: indicates by colour and size that databases are within their limits;

.2 Warning: indicates by colour and size that one or more databases have exceeded their warning limit;

.3 Alarm: which indicates by colour and size that one or more databases have exceeded their alarm limit.

.8 BAS is to indicate via taskbar icons and email messages when a database value has exceeded a warning or alarm limit;

.12 BAS is to be equipped with a demand limiting and load rolling program for purpose of limiting peak energy usage and reducing overall energy consumption. Program is to support both Sliding Window and Fixed Window methods of predicting demand. Additional features are as follows:

.1 system is to support 3 levels of sensitivity in Sliding Window demand calculations for fine tuning the system, as follows:

.1 Low Setting: sheds loads later and over shortest period of time and maximizes period of time equipment is on;

.2 Medium Setting: sheds loads earlier over a period of time greater than Low Setting, and increases time equipment is on and decreases probability of exceeding "Tariff Target";

.3 High Setting: sheds loads earlier and over a longer period of time than Medium Setting to minimize probability of exceeding "Tariff Target".

.2 system is to have both a Shed Mode and a Monitor Only Mode of operation, as follows:

.1 when Shed Mode is engaged, system is to actively control demand;

.2 when Monitor Mode is engaged, system is to simulate shedding action but will not take any action.

.3 Demand Limiting Program is to monitor energy consumption rate and compare it to a user defined "Tariff Target", and maintain consumption below target by selectively shedding loads based on a user defined strategy;

.4 Demand Limiting Program is to be capable of supporting a minimum of 10 separate load priorities, with each load user assigned, and a minimum of 12 separate "Tariff Targets" defining maximum allowed average power usage during current interval;

.5 system is to support a maximum shed time for each load as determined by user, and system is to restore load before maximum shed time has expired;

.6 system is to support a minimum shed time for each load as determined by user, and system is not to restore load before minimum shed time has expired;

.7 system is to support a minimum release time for each load as determined by user, and system is not to shed load until it has been off for minimum release time;

.8 system is to support three user defined options if meter does not function properly, as follows:

.1 shedding – currently shed loads will be released as their maximum shed time expires;

.2 maintain current shed rate – system will use demand limiting shed rate that was present when meter began to function improperly;

.3 use unreliable meter shed rate – system is to control to a user defined unreliable shed rate target.

.9 Load Rolling Program is to sum the loads currently shed and compare sum to a user defined load rolling target, and system is to maintain consumption below target by selectively shedding loads based on a user defined load priority;

.10 Load Rolling Program is to be capable of supporting a minimum of 10 separate load priorities with each load user defined to a load priority;

.11 Load Rolling Program is to be capable of supporting a minimum of 12 separate "Tariff Targets" defining amount of energy by which demand must be reduced;

.12 system is to equip user with a Load Tab that displays all demand limiting and load rolling parameters for any selected load;

.13 system is to be complete with a Load Summary that displays all loads associated with demand limiting and load rolling program, and status icons for each load are to indicate:

.1 Load Is Offline;

.2 Load Is Disabled;

.3 Load Is Shed;

.4 Load Is Locked;

.5 Load Is In Comfort Override.

.14 Load Summary is to include a load summary runtime view listing following load conditions:

.1 Load Priority;

.2 Shed Strategy;

.3 Load Rating;

.4 Present Value;

.5 Ineligible Status;

.6 Active Timer;

.7 Time Remaining;

.8 Last Shed time.

2.07 Network Automation Engines

.1 Network automation engines are to be ULC listed and labelled, BACnet Testing Labs (BTL) certified and labelled, fully user programmable supervisory controllers to monitor a network of a minimum of 100 distributed application-specific controllers for a global strategy and direction and to communicate on a peer-to-peer basis with other network automation engines.

.2 Each network automation engine is to have ability to deliver a web based user interface as specified above, and computers connected physically or virtually to automation network are to have access to web-based user interface. Additional characteristics/requirements are as follows:

.1 web-based user interface software is to be imbedded in each network automation engine;

.2 each network automation engine is to support a minimum of 4 concurrent users;

.3 user is to be capable of accessing all system data through one network automation engine;

.4 remote users connected to network through an internet service provider or by telephone dial-up are also to have total system access through one network automation engine;

.5 each network automation engine is to be capable of generating web-based user interface graphics, and this capability is to be imbedded in network automation engine;

.6 user interface is to support following functions using a standard version of Microsoft Internet Explorer:

.1 configuration;

.2 commissioning;

.3 data archiving;

.4 monitoring;

.5 commanding;

.6 system diagnostics.

.7 each network automation engine is to permit temporary use of portable devices without interrupting normal operation of permanently connected modems.

.3 Each network automation engine is to be a multi-tasking, multi-user, microprocessor-based real time digital control processor sized to meet requirements of system with a minimum word size of 32 bits, and standard operating systems.

.4 Each network automation engine is to have sufficient memory to support its own operating system, databases, and control programs to provide supervisory control for control level devices.

.5 Each network automation engine is to include an integrated, hardware based real time clock.

.6 Each network automation engine is to be equipped with LED indicators to identify following conditions:

.1 Power, On/Off;

.2 Ethernet Traffic, Ethernet Traffic/No Ethernet Traffic;

.3 Ethernet Connection Speed, 10 Mbps/100 Mbps;

.4 FC Bus A, Normal Communications/No Field Communications;

.5 FC Bus B, Normal Communications/No Field Communications;

.6 Peer Communication, Data Traffic Between Network Automation Engines;

.7 Run, NAE Running/NAE in Start-up/NAE Shutting Down/Software Not Running;

.8 Battery Fault, Battery Defective/Data Protection Battery Not Installed;

.9 24 VAC, 24 VAC Present/Loss of 24 VAC;

.10 Fault, General Fault;

.11 Modem RX, NAE Modem Receiving Data;

.12 Modem TX, NAE Modem Transmitting Data.

.7 Each network automation engine is to be equipped with ports for operation of operator input/output devices such as industry standard computers, modems, and portable operator's terminals. Ports are to be as follows:

.1 2 USB ports;

.2 2 URS-232 serial data communication ports;

.3 2 RS-485 ports;

.4 one Ethernet port.

.8 Each network automation engine is to continually perform self-diagnostics, communications diagnostics, and diagnostics of all pane components, and transmit both local and remote annunciation of any detected component failure, low battery condition, and repeated failures to establish communication.

.9 In event of loss of normal power each network automation engine is to continue to operate for a user adjustable period of up to 10 minutes after which there is to be an orderly shut-down of all programs to prevent loss of database or operating system software, and:

.1 during a loss of normal power, control sequences are to go to normal system shutdown conditions, and critical configuration data is to be saved into Flash memory;

.2 upon restoration of normal power and after a minimum off-time delay, controller is to automatically resume full operation through a normal soft-start sequence without manual intervention.

2.08 Field Equipment Controllers

.1 Each field equipment controller is to be a fully user programmable BACnet Testing Labs (BTL) certified and labelled digital controller that communicates via BACnet MS/TP protocol. Each controller is to be housed in a plenum rated plastic housing with removable base to permit pre-wiring of analog and binary input/output field points without controller in place.

.2 Each controller is to employ a finite state control engine to eliminate unnecessary conflicts between control functions at crossover points in their operational sequences, and is to be factory programmed with a continuous adaptive tuning algorithm that sense changes in physical environment and continually adjusts loop tuning parameters appropriately.

.3 Each field equipment controller is to:

.1 include troubleshooting LED's to identify following conditions:

.1 Power On;

.2 Power Off;

.3 Download or Start-Up In Progress-Not Ready For Normal Operation;

.4 No Faults;

.5 Device Fault;

.6 Field Controller Bus-Normal Data Transmission;

.7 Field Controller Bus-No Data Transmission;

.8 Field Controller Bus-No Communication;

.9 Sensor Actuator Bus-Normal Data Transmission;

.10 Sensor Actuator Bus-No Data Transmission;

.11 Sensor Actuator Bus-No Communication.

.2 support universal inputs, configured to monitor any of following:

.1 analog input, voltage mode;

.2 analog output, current mode;

.3 analog input, resistive mode;

.4 binary input, dry contact maintained mode;

.5 binary input, pulse counter mode.

.3 support binary inputs configured to monitor either of following:

.1 dry contact maintained mode;

.2 pulse counter mode.

.4 support analog outputs configured to output either of following:

.1 analog output, voltage mode;

.2 analog output, current mode.

.5 support binary outputs, 24 VAC Triac;

.6 support configurable outputs capable of following:

.1 analog output, voltage mode;

.2 binary output mode.

.7 have ability to reside on a master-slave/token-passing field controller bus supporting BACnet standard protocol as follows:

.1 support communications, including input/output communications between field controllers and network automation engines;

.2 support a minimum of one hundred input/output modules and field equipment controllers in any combination;

.3 operate at a maximum distance of 4560 m (15,000') between field controller and furthest connected device.

.8 have ability to monitor and control a network of sensors and actuators over a master-slave/token-passing sensor-actuator bus supporting BACnet standard protocol as follows:

.1 bus is to support a minimum of ten devices per trunk;

.2 bus is to operate at a maximum distance of 365 m (1200') between field controller and furthest connected device.

.9 capability of executing complex control sequences involving direct wired input/output points as well as input and output devices communicating over field controller bus or sensor-actuator bus;

.10 support, but not limited to, following:

.1 hot water, chilled water/central plant applications;

.2 custom air handling units for special applications;

.3 terminal units;

.4 special programs as required for systems control.

.11 support a password protected local controller LCD back-lit display with 6 key keypad as an integral part of field controller or as a remote device communicating over sensor-actuator bus to permit user to view monitored points without logging into system, and to view and change set-points, modes of operation, and parameters.

2.09 Input/Output Modules

.1 Input/output modules to facilitate additional inputs and outputs for use in field equipment controllers are to be similar to field equipment controllers but less display and with a minimum of 4 and a maximum of 17 points.

2.10 System Configuration Tools

.1 System configuration tool is a software package supplied with BAS to enable a computer platform to be used as a stand-alone engineering configuration tool for a network automation engine and to permit programming of field equipment controllers. Configuration tool is to provide an archive database for configuration and application data and is to have same look and feel at user interface regardless of whether configuration is being done online or offline. Additional features and characteristics are as follows:

.1 tool is to include:

.1 basic system navigation tree for connected networks;

.2 integration of system enabled devices;

.3 customized user navigation tress;

.4 point naming operator parameter setting;

.5 graphic diagram configuration;

.6 alarm and event message routing;

.7 graphical logic connector tool for custom programming;

.8 downloading, uploading, and archiving databases.

.2 tool is to have capability to automatically discover field devices on connected buses and networks;

.3 tool is to be capable of configuring from a library of standard applications, simulating to verify applications, and commissioning field equipment controllers and field devices;

.4 tool is to be complete with a Bluetooth Wireless Technology wireless access point to enable a wireless enabled portable computer to make a temporary Ethernet connection to automation network.

.2 Bluetooth Wireless Technology converter is to provide temporary wireless connection between sensor-actuator bus or field-controller bus and a wireless enabled portable computer. Converter is to be powered through a connection to either sensor-actuator bus or the field-controller bus and is to support downloading and troubleshooting field equipment controllers and field devices from portable computer over wireless connection. Converter is to be complete with LED indicators for following conditions:

.1 Power: On/Off;

.2 Fault: Fault/No Fault;

.3 SA/FC Bus: Bus Activity/No Bus Activity;

.4 Bluetooth: Bluetooth Communication Established/Bluetooth Communication Not Established.

2.11 Wiring Materials

.1 System wiring, conduit, boxes, and similar materials are to be in accordance with requirements specified in Division 26 – Electrical.

3 Execution

3.01 General Re: Installation of the BAS

.1 Provide a complete building automation system in accordance with requirements of this Section of the Specification, Section 25 05 01 - Automatic Control Systems, drawings, and the input/output points list(s).

.2 Unless otherwise specified, perform BAS work in accordance with system manufacturer's instructions.

3.02 Installation of Direct Digital Control System Components

.1 Provide required direct digital control hardware, software, accessories, and wiring for a complete BAS. Refer to drawing control diagrams and sequences, points list(s), and Section 25 05 01 - Automatic Control Systems.

.2 Provide operator workstation in a location as directed by the Owner.

.3 DDC work is to be performed by skilled technicians, properly trained and are qualified for this work.

.4 Materials and equipment used are to be standard components, regularly manufactured for this and/or other systems, and not custom designed especially for this project. Systems and components are to have been thoroughly tested and proven in actual use.

.5 System is to be modular, permitting expansion by adding hardware and software without changes in communication or processing equipment.

.6 Provide new communications bus as required complete with required ancillaries. Connect and extend existing communications bus.

.7 Provide 1 supervisory controller (SC) per cabinet fan (air handler). Provide necessary field equipment controllers (FEC).

.8 Provide necessary quantity of SC to accomplish requirements of this specification, and to minimize number of mechanical systems that would be inoperative in event of a FEC failure. A maximum of 2 major mechanical systems are to be controlled by 1 FEC.

.9 Surface wall mount SC and FEC control units in Mechanical Rooms ensuring they are not mounted on vibrating surfaces, and connect to 15A-1P circuit breakers dedicated for control system applications, in branch panel circuit boards in adjacent spaces. Power wiring from control units to circuit breakers is to be the responsibility of the controls contractor. Wiring is to be in conduit and conduit and wiring are to be in accordance with standards and requirements of Division 26 – Electrical. Refer to electrical drawings for locations of branch circuit panelboards with dedicated circuits for controls system applications.

.10 Indicate via number, and systems controlled by SC and FEC. Indicate via a lamacoid label mounted inside panel the identification number of electrical panel supplying power to SC and FEC.

.11 Submit schedule(s) of input/output points to Consultant for review. Directly connect each SC and FEC to point devices in accordance with control diagrams and schedule of miscellaneous control points as shown on drawings. Sensor wires for each analogue input are to be No. 18 AWG twisted-shielded cable. Other types of wire required are to be as recommended by system supplier.

.12 Provide required sensors, remote devices, etc., and required interface accessories. Mount duct and/or plenum sensors half-way across duct or plenum.

.13 Differential pressure sensor used to provide space pressurization control through regulation of return air quantities must be mounted with snubbers on indoor pressure leg to prevent sudden fluctuations caused by door openings, etc. Mount outdoor air ports in locations that minimize effects of abnormal surface flow conditions and wind gusts.

.14 Supply and turn over to Consultant prior to application for a Certificate of Substantial Performance of the Work, reports to be used in assisting Owner in defining and debugging DDC programs. These reports are to consist, as a minimum, of following:

.1 process control language (PCL) logs;

.2 control loop logs;

.3 PCL master point.

.15 Submit Point Data Input forms to Consultant that Owner will fill out with DDC system supplier's assistance. Input this point data into the system.

.16 Contacts will be supplied as part of mechanical work or electrical work for alarm and status points for systems and equipment other than building environmental systems and equipment. Connect to DDC system in accordance with point schedule.

3.03 Implementation of Energy Management Programs

.1 Implement energy management programs indicated for building equipment and systems.

.2 Ensure energy management program adjustable parameters are accessible to and adjustable by building operations personnel at operator's workstation.

.3 Configure energy management programs so they may be enabled/disabled on an individual basis for each system to which they apply.

3.04 Control Wiring

.1 Perform required control wiring work for control systems except:

.1 power wiring connections to equipment and panels, except as noted below;

.2 control wiring associated with mechanical plant equipment and systems whose control is not part of work specified in this Section;

.3 starter interlock wiring.

.2 Except as specified below, install wiring in conduit. Unless otherwise specified, final 600 mm (2') connections to sensors and transmitters, and wherever conduit extends across flexible duct connections is to be liquid-tight flexible conduit.

.3 Control wiring in ceiling spaces and wall cavities may be plenum rated cable installed without conduit but neatly harnessed, secured, and identified.

.4 Wiring work is to be in accordance with BAS manufacturer's certified wiring schematics and instructions, and wiring standards specified in electrical work Division of this Specification.

3.05 Identification and Labelling of Equipment and Circuits

.1 Refer to Section 20 05 00 – Common Work Results for Mechanical.

.2 Identify BAS equipment as follows:

.1 enclosures: engraved laminated nameplates with lettering such as BAS Panel CP2, or BAS Relays, or BAS E/P Transformers, with all wording listed and approved prior to manufacture of nameplates;

.2 panel points: a weather-proof input/output layout sheet for each controller with the name of each point connected to controller, and associated wire labelling information;

.3 wiring: numbered sleeves or plastic rings at both ends of conductor, with numbering corresponding to conductor identification on shop drawings and "as-built" record drawings;

.4 interface components: a weather-proof layout sheet clearly illustrating/identifying purpose of each component within enclosure such that an operator or service technician can quickly identify exact use of each relay, transducer, contactor, etc., with each sheet fastened securely to back of enclosure door.

3.06 System Startup

.1 For equipment/system manufacturer certification requirements, refer to Section 20 05 00 – Common Work Results for Mechanical.

.2 For equipment/system start-up requirements, refer to Section 20 05 00 – Common Work Results for Mechanical.

3.07 Closeout Activities

.1 Include for demonstration and training sessions for each of 2 groups of Owner's operating and maintenance personnel as follows:

.1 3 full, 8 hour day orientation sessions at system manufacturer's office to educate personnel on BAS architecture, hardware, and software, with an overview of BAS operation and capabilities including but not limited to operational programmes, equipment functions (both individually and as part of a total integrated system), BAS commands, advisories, alarms, and appropriate operator intervention required in responding to BAS operation;

.2 2 full, 8 hour day sessions at site using BAS for a "hands-on" demonstration of BAS functions and features with instruction regarding chronological flow of information from field devices, contacts and sensors to operator's workstation, an overview of communications network describing interplay between initiating devices, field hardware panels, systems communications, and their importance within operating BAS, and alarm indications and appropriate responses;

.3 2 full, 8 hour day seasonal (summer-winter) site sessions to perform additional instruction regarding seasonal changes and how they affect BAS.

.2 Include for 2 follow-up site training and troubleshooting visits, one 6 months after Substantial Completion and other at end of warranty period, both when arranged by Owner and for a full day to provide additional system training as required.

End of Section

1 General

1.01 Section Includes

.1 Common requirements for electrical work.

.2 Mounting heights for electrical equipment and devices.

1.02 Related Requirements

.1 Provisions of this section apply to all sections of Division 26, Division 27, Division 28, and sections related to electrical utilities in Division 33.

.2 Document 00 64 01 – Request for Electronic M&E Files Form.

.3 Section 07 62 00 – Flashing and Sheet Metal.

.4 Section 07 85 00 – Firestopping and Smoke Seals.

.5 Section 08 31 00 – Access Doors and Panels.

.6 Section 09 91 00 – Painting.

.7 This section is to be read in conjunction with Division 00 documents, and Division 01 specification sections, which take precedence as described in CCDC 2-2020.

.1 General Conditions.

.2 Supplementary General Conditions.

.3 General Requirements.

1.03 Intent

.1 Include all material, labour, equipment, and plant construction as necessary to make a complete installation as shown and specified hereinafter.

.2 Leave complete systems ready for continuous and efficient satisfactory operation.

.3 Discipline and Trade Jurisdiction

.1 In accordance with CCDC 2-2020 GC 1.1.9: Neither the organization of the Specifications nor the arrangement of Drawings shall control the Contractor in dividing the work among Subcontractors and Suppliers.

.2 MasterFormat's organizational structure used in a project manual does not imply how the work is assigned to various design disciplines, trades, or subcontractors. MasterFormat is not intended to determine which particular elements of the project manual are prepared by a particular discipline. Similarly, it is not intended to determine what particular work required by the project manual is the responsibility of a particular trade. A particular discipline or trade is likely to be responsible for subjects from multiple Divisions, as well as from multiple Subgroups.

1.04 Drawings and Specifications

.1 The drawings and specifications are complementary each to the other and what is called for by one to be binding as if called for by both. Should any discrepancy appear between the drawings and specifications, which leaves the Contractor in doubt as to the true intent and meaning of plans and specifications, a ruling is to be obtained from the Consultant in writing before submitting Bid. If this is not done, the maximum, the most expensive alternate or option will be provided in base tender bid.

.2 All drawings and all Divisions of these specifications shall be considered as a whole, and work of this Division shown anywhere therein shall be furnished under this Division.

.3 Drawings are diagrammatic and indicate the general arrangement of equipment and pathways. Most direct routing of conductors and wiring is not assured. Exact requirements are governed by architectural, structural, and mechanical conditions of the job. Consult all other drawings in preparation of the bid. Extra lengths of wiring or addition of pull and junction boxes, etc. necessitated by such conditions are to be included in the bid. Check all information and report and apparent discrepancies before submitting the bid.

.4 Contractor shall determine the exact locations of equipment and rough-ins, and the exact routing of pathways so as to best fit the layout of the job. Plan, coordinate, and establish exact locations and routing of services with affected trades prior to installation such that services clear each other, as well as other obstructions.

.5 Determine final locations of major work within ceiling spaces based on the largest equipment first.

.6 Unless otherwise shown or specified, conceal work in finished areas, and conceal work in partially finished and/or unfinished areas to extent made possible by the area construction. Install services as high as possible to conserve headroom and/or ceiling space. Notify Consultant where headroom or ceiling space appears to be inadequate prior to installation of the work.

.7 Scaling off the drawings will not be sufficient or accurate for determining these locations. Where job conditions require reasonable changes in indicated arrangement and locations, such changes shall be made at no additional cost to the Owner.

.8 Because of the scale of the drawings, certain basic items, such as junction boxes, pull boxes, conduit fittings, etc. may not be shown, but where such items are required by other sections of the specifications of where there are required for proper installation of the work, such items are to be furnished and installed.

.9 Before ordering any conduit, cable tray, conductors, wireways, raceway bus duct, fittings, etc., verify all pertinent dimensions at the job site and be responsible for their accuracy.

.10 If obvious ambiguities or omissions are noticed when tendering refer same to the Consultant for a ruling and obtain the ruling in writing in the form of an Addendum. Claims for extras for ambiguities or omission of items brought to the attention of the Consultant after the award of a contract which, due to the nature of the ambiguity or omission, should have been brought to the attention of the Consultant during the tendering period, will not be allowed.

.11 The drawings are performance drawings, diagrammatic, and show locations for apparatus and materials. The drawings are intended to convey the scope of work and do not intend to show Architectural and Structural details. The locations shown are approximate, and may be altered, when approved by the Consultant, to meet requirements of the material and/or apparatus, other equipment and systems being installed, and of the building. Do not scale drawings.

.12 Control devices, equipment requiring maintenance, junction boxes, and similar products, particularly such products located above suspended ceilings must be located for easy access for servicing and/or removal. Products which do not meet this location requirement are to be relocated to an accessible location at no additional cost.

.13 Be responsible for making necessary changes, at no additional cost, to accommodate structural and building conditions that were foreseeable by a review of existing conditions or a review of drawings prepared by other disciplines.

.14 Where drawings indicate that acoustic tile ceiling is being suspended below existing plaster ceilings, coordinate the design of framework used to support this suspended ceiling, lighting, diffusers, and other

components that are mounted within or through ceiling. Do not mount devices to suspended ceilings. Secure and mount to ceiling slab above. Seal ceiling openings to maintain required fire rating.

.15 Provide any fitting, offset, transformation, etc., required to suit architectural and structural details but not shown.

1.05 Work Restrictions

.1 Refer to Section 01 11 00.

.2 Existing buildings:

.1 Examine the existing building, the site and surrounding areas and by fully informed as to the conditions and limitations under which the work has to be executed. Claims for additional costs will not be entertained with respect to conditions which could reasonably been ascertained by an inspection prior to Tender closing.

.2 All work in the existing building, other than minor works required to permit construction of the new addition, is to be performed in such a manner as to not disrupt the building operations.

.3 All systems are to be kept in full operation during normal building hours.

.4 Note that any noise generating works that disrupt the building operation shall be coordinated accordingly and carried out after/before normal operating hours.

.5 Cut, modify, or extend as necessary or as directed by the Consultant, the existing material or equipment to be reused or relocated to suit work under this contract.

.6 Existing materials and equipment which are to be used in new work shall be repaired and refinished as necessary. Provide additional new materials and components as required to facilitate reinstallation of such existing materials and equipment.

.7 Co-ordinate with the Owner, and refer to General Conditions.

.8 Do work in existing areas to best suit available space and not interfere with or obstruct use of existing facilities.

.9 Where disruptions of existing services are required, coordinate shut down with the Owner's operating staff and do the work at a time and in a manner mutually acceptable. Carefully schedule disruptions to keep "down time" to a minimum.

.3 Do all cutting, patching and making good to leave in a finished condition and to make the several parts of the Work come together properly. Co-ordinate work to keep cutting and patching to a minimum.

.4 Quality of workmanship and materials used in patching, making good and refinishing of existing construction and/or compartments shall be of a standard equal to that specified for new construction and if not specified, equal to or exceeding that of original existing work.

.5 Prior to cutting openings, examine wall, floor and ceiling construction for buried electrical cables and pipes; and take adequate protection. Conduct cable locating tests to locate buried cables in existing work.

1.06 Allowances

.1 Cash allowances are to be carried as indicated in Section 01 21 00 for the items indicated, each including all equipment, wiring material, labour, incidentals, profit, overhead, taxes, etc.

1.07 Substitution Procedures

.1 Refer to Section 01 60 00 and General Provisions of the Contract.

.2 Additionally, "Approved equal" shall be defined as an alternate approved by the Consultant.

.3 If during the tender bid process, the bidding contractor wishes to substitute the specified equipment for an "Approved equal", the bidding contractor must submit shop drawings to the Consultant before the tender close for approval. If no substitution request is made, the as-specified equipment is that to be provided.

.4 Where several manufacturers' names are given, the first named manufacturer constitutes the basis for job design and establishes the equipment quality required to be used in this contract.

.5 This contractor, at his option, may use equipment as manufactured by any of the listed manufacturers. This Contractor is responsible to ensure that all items submitted by these other manufacturers meets are requirements of the drawings and specification and fits in the allocated space. The final determination of a product being equivalent is to be determined by the Consultant when a catalog number is not listed, or listed in part.

.6 Any material, article or equipment of other unnamed manufacturers which will adequately perform the services and duties imposed by the design and is of a quality equal to or better than the material, article or equipment identified by the drawings and specifications may be used if approval is secured in writing from the Consultant as described in the General Provisions of the Contract for Submittals. The Contractor bears full responsibility for the unnamed manufacturers' equipment adequately meeting the intent of the design. The Owner or the Consultant may reject manufacture at time of shop drawing submittal.

.7 In addition to manufacturer's products base specified or named as acceptable, other manufacturers of products may be proposed as substitutions to the Consultant for review and consideration for acceptance, listing in each case a corresponding credit for each substitution proposed. However, base Bid Price on products base specified or named as acceptable. Certify in writing to the Consultant that proposed substitution meets space, power, design, energy consumption, and other requirements of base specified or acceptable product. It is understood that there will be no increase in Contract Price by reason of any changes to associated equipment, mechanically, electrically, structurally or architecturally, required by acceptance of proposed substitution. Consultant has sole discretion in accepting any such proposed substitution of product. Indicate any proposed substitutions in areas provided on Bid Form. Do not order such products until they are accepted in writing by the Consultant.

1.08 Contract Modification Procedures

.1 When submitting quotations in response to changes in the contract, quotations for electrical work are to include a breakdown of all material, including material unit rates, and labour units as indicated in the NECA Manual of Labor Units (MLU).

1.09 Coordination

.1 Refer to Section 01 31 00.

.2 Coordinate work with other trades to avoid conflict and to provide correct rough-in and connection for equipment furnished under other trades that require electrical connection. Inform Contractors of other trades of the required access to and clearances around electrical equipment to maintain serviceability and code compliance.

.3 Verify equipment dimensions and requirements with provision specified under this Section. Check actual job conditions before fabricating work. Report necessary changes in time to prevent needless work. Changes or additions subject to additional compensation, which are made without written authorization and an agreed price, shall be at Contractor's risk and expense.

.4 Read specifications and drawings of other trades and conform with their requirements before proceeding with any work specified in this Division related to other trades. Co-operate with all other trades on the job, so that all equipment can be satisfactorily installed, and so that no delay is caused to any other trades.

.5 Coordinate utility service outages with the owner. Obtain permission from Owner at least 24 hours before partially or completely disabling system. Minimize outage duration.

.6 Co-ordinate work with all trades to ensure a proper and complete installation. Notify all trades concerned of the requirement for openings, sleeves, insets and other hardware necessary for the installation and, where work is to be integrated with the work of other trades or is to be installed in close proximity with the work of other trades, carefully co-ordinate the work prior to installation.

.7 Working Detail Drawings

.1 The contractor is to prepare working detail drawings supplementary to the contract drawings, when deemed necessary by the Consultant, for all areas where a multiplicity of materials and or apparatus occur, or where the work due to architectural and structural considerations involves special study and treatment. Such drawings may be prepared jointly by all trades affected, or by the one trade most affected with due regard for and approval of the other trades, all as the Consultant will direct in each instance. Such drawings must be reviewed by the Consultant before the affected work is installed.

.2 Carry out all alterations in the arrangement of work which has been installed without proper study and approval, even if in accordance with the contract documents, in order to make such work come within the finished lines of walls, floors and ceilings, or to allow the installation of other work, without additional cost. In addition, make any alterations necessary in other work required by such alterations, without additional cost.

1.10 Submittal Procedures

.1 Refer to Section 01 33 00.

.2 Before delivery to site of any item of equipment, submit shop drawings complete with all data, pre-checked and stamped accordingly, for review by the Consultant. Indicate project name on each brochure or sheet, make reference to the number and title of the appropriate specification section, type identifier such panelboard ID or luminaire type as indicated on appropriate schedule, and provide adequate space to accommodate the Consultant's review stamp(s).

.3 Verify field measurements and affected adjacent Work are coordinated, including passageway clearances for movement of equipment into location.

.4 Submit shop drawings to the Consultant in electronic (PDF) format, as coordinated after award of contract. Where submittals are derived from digital originals, do not print and rescan documents; submittals made as such will be immediately rejected.

.5 Submit a schedule of shop drawings within one week after award of contract. Group submittals by specification division as appropriate.

.6 Shop Drawings

.1 Submit for review, properly identified shop drawings showing in detail the design and construction of all equipment and materials as requested in sections of the specification governed by this Section.

.2 Obtain and comply with the manufacturer's installation instructions.

.3 Endorse each shop drawing copy "CERTIFIED TO BE IN ACCORDANCE WITH ALL REQUIREMENTS", stamp each copy with your company name, date each copy with the submittal date, and sign each copy. Shop drawings which are received and are not endorsed, dated and signed will be returned for re-submittal.

.4 The Consultant will stamp shop drawings as follows:

.1 Reviewed ( )

.2 Reviewed as Modified ( )

.3 Revise and Re-Submit ( )

.4 Not Reviewed ( )

.5 If "REVIEWED" is checked-off, the shop drawing is satisfactory. If "REVIEWED AS MODIFIED" is checked-off, the shop drawing is satisfactory subject to requirements of remarks put on shop drawing copies. If "REVISE AND RE-SUBMIT" is checked-off, the shop drawing is entirely unsatisfactory and must be revised in accordance with comments written on shop drawing copies and resubmitted. If "NOT REVIEWED" is checked-off, the shop drawing is in error of submission, not applicable for this project.

.6 This review by the Consultant is for the sole purpose of ascertaining conformance with the general design concept. This review shall not mean that the Consultant approved the detail design inherent in the shop drawings, responsibility for which shall remain with the Contractor, and such review shall not relieve the Contractor of responsibility for errors or omissions in the shop drawings or of responsibility for meeting all requirements of the contract documents. Be responsible for dimensions to be confirmed and correlated at the job site, for information that pertains solely to fabrication processes or to techniques of construction and installation, and for co-ordination of the work as well as compliance with codes and inspection authorities such as CSA, etc.

.7 Confirm layouts of major electrical equipment rooms with the dimensions of as-procured equipment, and submit a layout sketch to the Consultant showing the major equipment and required clear spaces. The contractor may, at their option, revise the layout of the major electrical equipment rooms, but take responsibility for these new layouts and meeting the requirements of the local electrical utilities. Capture final room layouts on as-built drawings.

1.11 Safety Requirements

.1 Refer to Section 01 35 25.

.2 Be responsible for the safety of workers and the equipment on the project in accordance with all applicable safety legislation passed by Federal, Provincial, and local authorities governing construction safety. The more stringent regulations prevail.

1.12 Regulatory Requirements

.1 Refer to Section 01 40 00.

.2 Codes and Standards

.1 Ontario Electrical Safety Code including all bulletins and amendments.

.2 Ontario Building Code and its referenced standards.

.3 Applicable CSA and ULC standards.

.4 All work shall be in accordance with Owner's Design Guidelines.

.3 Permits and Fees

.1 Obtain and pay for all permits and fees required for the execution and inspection of the electrical work and pay all charges incidental to such permits. Submit to Electrical Inspection Department and Supply authority necessary number of drawings and specifications for examination and

approval prior to commencement of work. Arrange and pay for any special inspection of equipment specified if and when required.

.2 Apply, pay and obtain all permits as required for the electrical work.

.3 Upon substantial completion of your work, supply and turn over to the Consultant all required inspection certificates from governing authorities to certify that the work as installed conforms to the rules and regulations of the governing authorities.

.4 Patents

.1 Pay all royalties and licence fees, and defend all suits or claims for infringement of any patent rights, and save the Owner, Architect, Project Manager and Consultants harmless of loss or annoyance on account of suit, or claims of any kind for violation or infringement of any letters patent or patent rights, by this Subcontractor or anyone directly or indirectly employed by him or by reason of the use by him or them of any part, machine, manufacture or composition of matter on the work, in violation or infringement or such letters patent or rights.

1.13 References

.1 CSA Group

.1 CSA C22.1-18, Canadian Electrical Code, Part 1 (24th Edition), Safety Standard for Electrical Installations.

.2 CSA C235:19, Preferred voltage levels for AC Systems up to 50 000 V.

.3 Do underground systems in accordance with CSA C22.3 No. 7-15, Underground systems, except where specified otherwise.

.4 Ontario Electrical Safety Code (27th edition/2018), and all bulletins.

.2 Electrical and Electronic Manufacturer's Association of Canada (EEMAC)

.1 EEMAC 2Y-1-1958, Light Gray Colour for Indoor Switch Gear.

.3 Health Canada / Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

.4 Electrical utility requirements and local applicable codes and regulations.

.5 Institute of Electrical and Electronics (IEEE)/National Electrical Safety Code Product Line (NESC)

.1 IEEE SP1122-2000, The Authoritative Dictionary of IEEE Standards Terms, 7th Edition.

.6 2012 Ontario Building Code.

1.14 Definitions

.1 Electrical and electronic terms: unless otherwise specified or indicated, terms used in these specifications, and on drawings, are those defined by IEEE SP1122.

1.15 Quality Assurance

.1 Refer to Section 01 40 00.

.2 The specifications contained herein are set forth as the minimum acceptable requirements. This does not relieve the Contractor from executing other quality assurance measures to obtain a complete operating system within the scope of this project.

.3 Ensure that all workmanship, all materials employed, all required equipment and the manner and method of installation conforms to accepted construction and engineering practices, and that each piece of equipment is in satisfactory working condition to satisfactorily perform its functional operation.

.4 Provide quality assurance tests and operational check on all components of the electrical distribution system, all lighting fixtures, and communication systems.

.5 Only first class workmanship will be accepted, not only in regards to durability, efficiency and safety, but also in regards to neatness of detail. Present a neat and clean appearance on completion to the satisfaction of the Consultant. Any unsatisfactory workmanship will be replaced at no extra cost.

.6 Conform to the best practices applicable to this type of work. Install all equipment and systems in accordance with the manufacturer's recommendations, but consistent with the General Requirements of this specification. Electrical Contractor will be held responsible for all damage to the work of his own or any other trade, resulting from the execution of his work. Store all electrical equipment and materials in dry locations.

.7 Provide foreman in charge of this work at all times.

.8 The contractor shall be fully liable to provide and maintain in force during the life of this Contract, such insurance, including Public Liability Insurance, Product Liability Insurance, Auto Liability Insurance, Worker's Compensation, and Employer's Liability Insurance.

.9 Governing Federal, Provincial and Municipal codes and regulations will be considered minimum standards for the work and where these are at variance with the drawings and specification, the more stringent ruling will apply.

.10 Where any code, regulation, bylaw, or standard is quoted it shall mean the current edition including all revisions or amendments at the time of the tender.

.11 In case of conflict, the codes and regulations take precedence over the Contract Documents. In no instance reduce the standard or scope of work or intent established by the drawings and specifications by applying any of the codes referred to herein.

1.16 Quality Control

.1 Refer to Section 01 40 00.

.2 Provide a full time Superintendent to oversee and coordinate all sub-trades in these divisions.

1.17 Temporary Utilities

.1 Refer to Section 01 50 00.

.2 Do not use any of the permanent facility systems during construction except as may be specified, or unless written approval is obtained from the Consultant.

.3 The use of permanent facilities for temporary construction service will not affect in any way the commencement day of the warranty period.

.4 Temporary heating during the construction period will be provided as described in Division 01.

1.18 Temporary Facilities and Controls

.1 Refer to Section 01 50 00.

.2 Prior to start of each work period in occupied area, install temporary protection to prevent damage to any personal property or furnishing. Coordinate with Owner's representative if any furniture must be relocated to facilitate work.

.3 Take necessary steps to ensure that required firefighting apparatus is accessible at all times. Flammable materials shall be kept in suitable places outside the building.

1.19 Product Requirements

.1 Refer to Section 01 60 00.

.2 The design, manufacture and testing of electrical equipment and materials shall conform to or exceed the latest applicable CSA, IEEE, and ANSI standards.

.3 All materials must be new and be ULC or CSA listed. Any materials not covered by the aforementioned listing standards shall be tested and approved by an independent testing laboratory, Technical inspection Services, or other government agency.

.4 Materials and equipment are specifically described and named in this Specification in order to establish a standard of material and workmanship.

.5 Materials required for performance of work shall be new and the best of their respective kinds and of uniform pattern throughout work.

.6 Materials shall be of Canadian manufacture where obtainable. Materials of foreign manufacture, unless specified, shall be approved before being used.

.7 Equipment items shall be standard products of approved manufacture. Identical units of equipment shall be of same manufacture. In any unit of equipment, identical component parts shall be of same manufacture, but the various component parts comprising the unit need not be of one manufacture.

.8 Chemical and physical properties of materials and design performance characteristics and methods of construction and installation of items of equipment, specified herein, shall be in accordance with latest issue of applicable Standards or Authorities when such are either mentioned herein, or have jurisdiction over such materials or items of equipment.

.9 Materials shall bear approval labels as required by Code and/or Inspection Authorities.

.10 Install materials in strict accordance with manufacturer's recommendations.

.11 Include items of material and equipment not specifically noted on Drawings or mentioned in Specification but which are necessary to make a complete and operating installation.

.12 Remove materials, condemned as not approved for use, from job site and deliver and install suitable approved materials in their place.

.13 Unless otherwise noted, equipment and material specifications in Sections of the Specification governed by this Section are based on products of a manufacturer selected by the Consultant for the purpose of setting a standard of quality, size, performance, capacity, appearance and serviceability.

.14 In most instances the names of acceptable manufacturers are also stated for materials and equipment, and you may base your tender price on equipment and materials produced by either the specified manufacturer or a manufacturer listed as acceptable.

.15 For any items of equipment, material, or for any system where acceptable manufacturers are not stated, you must provide only the equipment, material or system specified.

.16 If materials or equipment manufactured and/or supplied by a manufacturer named as acceptable are used in lieu of products of the manufacturer specified, be responsible for ensuring that the substituted material or equipment is equivalent in size, performance and operating characteristics to the specified materials or equipment, and it shall be understood that <u>all</u> costs for larger starters, additional space, larger power feeders, and changes to associated or adjacent work required as a result of providing materials and equipment named as acceptable in lieu of the specified product will be borne by Contractor.

.17 In addition to the manufacturers specified or named as acceptable, the Contractor may propose alternative manufacturers of equipment and/or apparatus to the Consultant for acceptance, listing in each case a corresponding credit for each alternative proposed, however, the tender price must be based on apparatus or materials specified or named as acceptable. Certify in writing to the Consultant that the alternative meets all space, power, design, and all other required of the specified or equivalent material or apparatus. In addition, it shall be understood that all costs for larger starters, space, power feeders, and changes to associated equipment, mechanical and/or electrical, required by acceptance of proposed alternatives, will be borne by the party making the proposal. Alternative equipment requiring greater than specified energy requirements or unduly limiting service space requirements will not be accepted.

.18 Where a manufacturer is not listed for a particular product, it will be deemed to mean that the contractor will provide the specified manufacturer's product.

1.20 Examination and Preparation

.1 Refer to Section 01 11 00.

.2 Examine the existing equipment, the site and surrounding areas and be fully informed as to the conditions and limitations under which the work has to be executed. Claims for additional costs will not be entertained with respect to conditions which could reasonably have been ascertained by an inspection prior to Tender closing.

.3 Examine work upon which your work depends. Report in writing defects in such work. Application of your work shall be deemed acceptance of work upon which your work depends.

.4 Drawings are, in part, diagrammatic and are intended to convey scope of work and indicate general and approximate location, arrangement and sizes of equipment, piping, and similar items. Obtain more accurate information about locations, arrangement and sizes from study and coordination of drawings, including shop drawings and manufacturers' literature and become familiar with conditions and spaces affecting these matters before proceeding with work.

.5 Where job conditions require reasonable changes in indicated locations and arrangements, make such changes with approval of the Consultant at no additional cost to the Owner. Similarly, where existing conditions interfere with new installation and require relocation, such relocation is included in work.

1.21 Cutting and Patching

.1 Refer to Section 01 73 29.

.2 The Electrical Contractor will be responsible for all cutting and patching required for the electrical installation. Structural members are not to be cut without the consent of the Consultant.

.3 All cutting and patching required under Division 26, Division 27, and Division 28 shall be in accordance with Division 01. Layout such work for approval before undertaking same.

.4 Cutting shall be kept to an absolute minimum and performed in a neat and workmanlike manner using the proper tools and equipment. Caution shall be exercised in all cutting and procedures to ensure that concealed services are not affected. Do not cut if in doubt. Request the Consultant's presence to determine if concealed services exist.

.5 Assume responsibility for prompt installation of Work in advance of concrete pouring or similar Work. Should any cutting or repairing of finished/unfinished Work be required because such installation was not done, employ the particular trade, whose Work is involved, to do such cutting and patching. Pay for any resulting costs. Layout such Work for approval before undertaking same.

1.22 Cleaning and Waste Management

.1 Refer to Section 01 74 00.

.2 The Contractor and associated sub trades, at all times during construction, to keep the site free of all debris, boxes, packing, etc., resulting from work of this trade. At the completion of this work, the electrical installation is to be left in a clean and finished condition to the satisfaction of the Consultant.

.3 Clean and repair existing materials and equipment which remain or are to be reused.

.4 Luminaires to be reinstalled: Remove existing luminaires for cleaning. Use mild detergent to clean all exterior and interior surfaces; rinse with clean water and wipe dry. Replace lamps, ballasts and broken electrical parts.

.5 Assume responsibility for removing tools and waste materials on completion of Work, and leave Work in clean and perfect condition.

1.23 Starting and Adjusting

.1 Refer to Division 01.

.2 Conduct acceptance tests to demonstrate that the equipment and systems actually meet the specified requirements. Tests may be conducted as soon as conditions permit, and consequently make all changes, adjustments, or replacements required as the preliminary tests may indicate prior to the final tests. Tests shall be as specified in various sections of this Division. Carry out tests in the presence of the Consultant. Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project. The Electrical Contractor shall be in charge of the plant during tests. He shall assume responsibility for damages in the event of injury to the personnel, building, equipment, and shall bear all costs for liability, repairs, and restoration in this connection. Submit test results.

.3 Make tests of equipment and wiring at times requested.

.4 Tests shall include meggered insulation values, voltage and current readings to determine balance of panels and feeders under full load, and operation of each piece of equipment for correct operation.

.5 Supply meters, materials and personnel as required to carry out these tests.

.6 Test electrical work to standards and function of Specification and applicable codes in an approved manner. Replace defective equipment and wiring with new material and leave entire system in complete first class operating condition.

.7 Connect single phase loads so that there is the least possible unbalance of the supply phases.

.8 Submit all test results in report format.

.9 Trial Usage

.1 The Consultant reserves the right to use any system, piece of equipment, device, or material for such reasonable lengths of time and at such times as may be required to make a complete and thorough test of the same, or for the purpose of learning operational procedures, before the final completion and acceptance of the work. Such tests shall not be construed as evidence of acceptance of the work, and it is agreed and understood that no claim for damage will be made for injury or breakage to any part or parts of the above due to the aforementioned tests, where such injuries or breakage are caused by a weakness or inaccuracy of parts, or by defective materials or workmanship of any kind. Supply all labour and equipment required for such tests.

.2 Perform and pay for all costs associated with any testing required on the system components where, in the opinion of the Consultant the equipment manufacturer's ratings or specified performance is not being achieved.

1.24 Closeout Procedures

.1 Refer to Section 01 70 00.

.2 The Consultant will carry out inspections and prepare deficiency lists for action by the Contractor, during, and on completion of project.

.3 Building Permit Compliance

.1 Provide a minimum of 10 business days notice to the Consultant for scheduling of Consultant's occupancy inspection.

.2 Prior to requesting the Consultant's letter "Review of General Conformance" for submission to the municipal building department to allow occupancy, the following items must be complete and submitted to the Consultant, as applicable:

.1 General

.1 Submit all applicable inspection reports from Authorities Having Jurisdiction.

.2 Continuity of fire separations at service penetrations must be complete.

.2 Electrical

.1 Provide Certificate of Acceptance from Electrical Inspection Department.

.2 Any devices not installed must have the wiring made safe and terminated in an outlet box complete with cover.

.3 All outlets must have cover plates installed. All electrical equipment not located in service rooms must have covers and/or doors installed complete.

.4 Emergency lighting system must be operational and tested by Contractor. Where battery units and remote heads are indicated on the drawing, provide certification letter from equipment manufacturer indicating the system meets code requirements.

.5 If the building is provided with emergency power with CSA C282 equipment (emergency generator or similar), the contractor is to perform light meter measurements and submit a letter indicating the system meets code requirements.

.6 Simulate normal power failure within the premises in the presence of the consultant and the owner's representative. Test and verify exit lights and emergency lighting operations under emergency conditions. Submit letter of certification copy to the Consultant stating that the systems have been tested, witnessed by the Consultant or the Owner's representative, etc., and the methods of installation and performance are satisfactory to all parties.

.7 All exit lights must be installed and operational.

.3 Electronic Safety and Security

.1 Fire alarm system and devices must be operational. Submit fire alarm verification report per CAN/ULC-S537, and submit audibility test. Indicate tap settings of all signalling devices.

.2 Functional testing of the fire alarm system per CAN/ULC-S1001 must be completed.

.3 If any of the above items have not been completed at the time of Consultant's Inspection, and the letter of "assurance of professional field review and compliance" cannot be issued, any costs for subsequent Inspections will be charged to the Contractor.

1.25 Closeout Submittals

.1 Refer to Section 01 78 23 and Section 01 78 39.

.2 Project Record Documents

.1 Provide extra sets of white prints on which to make, as the job progresses, all approved changes and deviations from the original drawings. Complete as-built drawings, accurately marked up in red ink must be submitted for review by the Consultant before the contract is considered to be complete.

.2 Changes and deviations include those made by addenda, change orders, and supplemental instructions, and changes and deviations to be marked on the white print record drawings indicated on supplemental drawings issued with addenda, change orders, and supplemental instructions. Maintain the "as-built" white prints at the site for periodic inspection by the Consultant throughout the duration of the work.

.3 Upon substantial completion of the work, obtain a set of reproducible white prints of the drawings and neatly amend the print in accordance with the marked-up white prints to produce a true "as-built" set of drawings.

.4 As-built drawings are to indicate all circuiting as installed and all distribution junction box locations as well as conduit routes.

.5 [Trace routing of existing panelboard feeders for all panelboards and indicate on as-built drawings.]

.6 As-built [Revit] Drawings

.1 Submit completed Document 00 64 01 to the Consultant for release of Consultant's BIM files.

.2 Transfer the information from the "as-built" white prints to the files, and submit to the Consultant for review.

.3 Employ a competent computer draftsperson to indicate changes on the electronic set of record drawings. Provide drawings in PDF and Revit formats.

.4 Submit three (3) USB flash drives including as-built drawings in Revit format, one with each O&M manual.

.5 Provide three (3) sets of full size as-built drawings in hard copy format, one with each O&M manual.

.7 As-built Single Line Diagram

.1 Provide in Main Electrical Room one wall mounted copy of as-built Single Line Diagram on 6 mm (1/4 in) foam board.

.2 As-built Single Line Diagram to indicate manufacturer name and catalogue numbers of as-installed products.

.3 Operations and Maintenance (O&M) Data

.1 Submit two complete sets of Operation and Maintenance instruction manuals in hard copy, and one in electronic format. Include in each copy of the manual:

.1 Verification certificates for installation of life safety systems by the manufacturer's representative.

.2 A copy of "reviewed" shop drawings.

.3 Complete explanation of operating principles and sequences.

.4 Recommended maintenance practices and precautions.

.5 Complete wiring and connection diagrams.

.6 Certificates of guarantees.

.2 Ensure that operating and maintenance instructions are specific and apply to the model and types of equipment provided.

.3 Include attendance records for each training session in the O&M manual.

.4 Warranties

.1 Submit a written guarantee to the Owner for one year from the date of acceptance. This guarantee shall bind the contractor to correct, replace or repair promptly any defective equipment workmanship without cost to the Owner.

.2 All equipment, materials and workmanship shall be unconditionally guaranteed for a minimum period of one year from the date of acceptance.

.3 Provide warranty certificates, wherever given or required, in excess of the normal warranty period showing the name of the firm giving the warranty, dated and acknowledged, on specific equipment and systems.

.4 Warranties for temperature controls and building automation systems will start on the date of verification of acceptance by the Consultant.

.5 Include these certificates with the maintenance and operating manuals in the appropriate sections.

2 Products – Not Used

3 Execution

3.01 Demolition

.1 Refer to Division 02 and Section 26 05 05.

.2 Remove all electrical equipment and devices on redundant structures. Make safe all circuits, and provide continuity of remaining circuits.

.3 To make safe: Withdraw redundant wiring and remove unwanted conduit/wiring and accessories. Position breakers to OFF position and update panel schedules.

.4 Make safe any redundant mechanical devices as shown on mechanical drawings.

.5 Maintain continuity of existing services for other circuits/devices serving areas outside the Work area. Provide additional wiring/conduits/boxes etc. to suit existing services to be maintained and also implement new Work as detailed.

.6 Allow for this work in Tender Price.

.7 Turn over designated equipment to the Owner. Dispose of unwanted materials and equipment.

3.02 Concrete Work

.1 Refer to Division 03 – Concrete.

.2 Provide all concrete work required for the electrical work. Reinstall surfacing as per architectural requirements.

.3 Provide a 100 mm (4 inch) high concrete housekeeping pad for floor mounted electrical distribution equipment, such as the following:

.1 Transformers.

.2 Switchgear and switchboards.

.3 Distribution panelboards.

.4 Engine Generators.

.5 Uninterruptible Power Supplies and batteries.

.6 Transfer Switches.

3.03 Lintels

.1 Refer to Division 04 – Masonry.

.2 Lintels for openings in masonry shall conform with requirements of by-laws, and as approved by the Structural Engineer.

.3 Pay all costs for lintels over openings, required solely by the electrical trades, not shown on architectural or structural drawings.

3.04 Metals

.1 Refer to Division 05 – Metals.

.2 Steel construction required solely for the work of this trade, and not shown on architectural or structural drawings shall be provided by this Division to the requirements of Division 05.

3.05 Flashing and Sheet Metal

.1 Refer to Section 07 62 00.

.2 Flash all conduits and systems passing through roof or built into an outside wall, or a waterproof floor.

.3 Provide copper flashing for sleeves passing through exterior walls or waterproof floors.

3.06 Firestopping

.1 Provide firestopping in accordance with Section 07 85 00.

.2 Ensure that fire ratings of floors and walls are maintained.

.3 Provide ULC classified firestopping products by 3M, Hilti, STI, or approved equal which have been tested in accordance with ULC-S115.

.4 Pack clearance spaces, fill all spaces between openings, pipes and ducts passing through fire separations and install firestopping systems in accordance with the appropriate ULC system number for the products and type of penetration.

.5 Install firestopping systems using personnel trained or instructed by the product manufacturer.

3.07 Access Doors

.1 Provide access doors in accordance with Section 08 31 00.

.2 Group conduit work to ensure the minimum number of access doors is required.

.3 Access doors are to be installed by the trade responsible for the particular type of construction in which the doors are required.

3.08 Painting and Finishes

.1 Refer to Section 09 91 00.

.2 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two coats of finish enamel.

.3 Repair and finish factory finished equipment, damaged or scratched during installation, in an approved manner.

.4 All structural steel including hangers, brackets, supports and other ferrous metals shall be shop or factory prime painted wherever practicable. Wherever structural steel including hangers, brackets, supports, and other ferrous metals cannot be shop or factory prime painted, wire brush to remove all traces of rust, clean of all traces of dirt, oil, and grease, and apply one coat of an approved rust inhibiting primer in accordance with CGSB-GB-40d, and leave ready to receive finish paint.

.5 Primary and final painting for Work, other than items specified as factory primed or finished, will be performed as described in Division 09 – Finishes.

.6 All electrical fittings, supports, hanger rods, pull boxes, channel frames, conduit racks, outlet boxes, brackets, clamps etc., to have galvanized finish or paint finish over corrosion-resistant primer.

.7 All panelboards, motor starters etc., to be factory finished with baked on enamel. All enamel to be baked on gloss over corrosion resistant primer.

.8 Touch up minor damage to finish on factory finished equipment. Items suffering major damage to finish shall be replaced at the direction of the Consultant.

.9 Protect work so that finishes will not be damaged or marred during construction. Maintain the necessary protection until completion of the work.

.10 Provide all exposed ferrous metal work on equipment with at least one factory prime coat, or paint one prime coat on job. Clean up or wire brush all equipment, etc., before painting.

.11 For factory applied finishes, repaint or refinish surfaces damaged during shipment, erection or construction work.

3.09 Location of Outlets

.1 Refer to Architectural drawings for dimensions denoting exact locations.

.2 The Consultant reserves the right to change the location of outlets to within 3 m from the point indicated on the plans without extra charge providing the Contractor is advised before installation is made.

.3 Location of lighting, convenience, telephone, power and communication outlets shall be subject to change, without extra cost to Owners, provided information is given prior to installation. No extra amount will be paid for extra labour and materials for relocating outlets up to 3000 mm from their original location

nor will credits be anticipated where relocation up to 3000 mm reduces materials and labour. Other cases will be considered on their individual merits.

.4 Coordinate location of boxes with latest architectural drawings and instructions to suit door swings, millwork etc. prior to rough-in.

3.10 Mounting Heights and Device Locations

.1 Refer to architectural drawings for exact location of electrical equipment and devices.

.2 Architectural elevations take precedence over electrical elevations. If there are conflicts between architectural and electrical, adjust locations of electrical equipment at no additional cost to the owner.

.3 Prior to roughing-in, the contractor is to mark locations of electrical equipment and devices for conflicts with architectural, studs, etc. If conflicts are noted, inform the consultant for a decision prior to commencing the rough-in.

.4 Mounting heights of equipment and devices listed below is from finished floor to centreline of equipment, unless specified or indicated otherwise.

.5 If mounting height of equipment is not specified or indicated, verify before proceeding with installation.

.6 Install electrical equipment at following heights above finished floor (AFF). Dimensions are to centre of device unless indicated otherwise.

.1 Power door operator push buttons: 1000 mm.

.2 HVAC thermostats and manual HVAC controls: 1200 mm.

.3 Local switches, and manual lighting control devices:

.1 1100 mm.

.2 Locate on lock side of door.

.4 System furniture service fittings: to suit furniture layout.

.5 Wall receptacles:

.1 General: min. 400 mm AFF.

.2 Above top of counters: 175 mm.

.3 Above top of continuous baseboard heater, or mechanical heating/radiation units: 75 mm to bottom of device.

.4 In fan rooms, mechanical rooms, and electrical rooms: 1100 mm.

.5 For electric ranges: 130 mm.

.6 Outlets in raceways or millwork to be located as per Architectural details.

.7 Door bell pushbuttons: 1100 mm.

.8 Panelboards: as indicated in Section 26 24 16.

.9 Emergency lighting remote heads: 300 mm below finished ceiling, or 2400 mm AFF for exposed areas or areas with ceiling height above 2750 mm (9 feet).

.10 Communications:

.1 Typical communication outlets (voice and data): 400 mm.

.2 Communications outlets for wall mounted telephones, intercom, or similar: 1100 mm.

.3 Television outlets: 200 mm below finished ceiling.

.4 Wall mounted public address speakers: 2100 mm.

.5 Clocks: 2100 mm.

.11 Access control card readers and keypads: 900 mm.

.12 Fire alarm manual pull stations: 1200 mm.

.13 Wall mounted fire alarm audible devices, including bells or horns:

.1 2300 mm to the top of the device in areas of ceiling height 2450 mm or greater.

.2 150 mm below the finished ceiling for ceiling heights less than 2450 mm, measured to the top of the device.

.14 Wall mounted fire alarm visible signal devices, including strobes: 2300 mm.

.15 Fire Alarm emergency telephones: 1400 mm.

3.11 Manufacturer's Instructions

.1 Where the specifications call for an installation to be made in accordance with Manufacturer's recommendations, a copy of such recommendations shall be at all times be kept on the job site and be available to the Owner's Representative.

.2 Follow manufacturer's instructions where they cover points now specifically indicated on the drawings and specifications. If they are in conflict with the drawings and specifications obtain clarification from the Consultant before starting work.

3.12 Tests and Acceptance

.1 The operation of the equipment and electrical system does not constitute an acceptance of the work by the Owner. The final acceptance is to be made after the Contractor has adjusted his equipment and demonstrated that it fulfills the requirements of the drawings and the specifications.

.2 Testing of all systems shall be performed in the presence of the Owner's designated representative. The contractor shall give 72 hours advance notice to the Owner before beginning the tests.

.3 Upon completion of the installation, the Contractor shall furnish certificates of approval from all authorities having jurisdiction, as applicable. Contractor shall demonstrate that work is complete and in perfect operating condition, with raceway and conduit systems properly grounded, wiring free from grounds, shorts, and that the entire installation is free for any physical defects.

3.13 Closeout Activities

.1 Refer to Section 01 70 00.

.2 In the presence of the Owner, demonstrate the proper operation of all systems.

.3 Instruct the Owner's designated representatives in all aspects of the operation and maintenance of systems and equipment listed in the trade sections governed by this Section. Obtain in writing from the Consultant a list of the Owner's representatives qualified to receive instructions.

.4 Arrange for and pay for the services of qualified service technicians and other manufacturer's representatives required for instruction of specialized portions of the installation.

End of Section

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1 General

1.01 Section Includes

.1 Work in existing facilities.

.2 Electrical demolition.

1.02 Related Requirements

.1 Section 02 40 00 – Demolition and Removals.

1.03 Scheduling

.1 Refer to Section 01 32 13.

.2 All work in the existing buildings, other than minor works required to permit construction of the new Work, is to be performed in such a manner as to not disrupt the building operations.

.3 All systems are to be kept in full operation during normal building hours.

.4 Coordinate any noise generating works that disrupt the building operation to be carried out after/before normal operating hours.

2 Products

2.01 Materials

.1 Materials and equipment for patching and extending work: As specified in individual sections.

3 Execution

3.01 Examination

.1 Verification of Conditions

.1 Verify field measurements and circuiting arrangements are as shown on Drawings.

.2 Verify that abandoned wiring and equipment serve only abandoned facilities.

.3 Demolition drawings are based on casual field observation. Report discrepancies to the Consultant before disturbing existing installation.

.4 Beginning of demolition means installer accepts existing conditions.

.2 Tracing Existing Electrical Circuits

.1 Trace all circuits in the area of work listed as existing and verify existing conditions prior to any modifications as indicated.

.2 Where drawings indicate "connect to existing circuit", use a spare breaker, where available. Otherwise, verify existing load with a meter and advise the Consultant if the additional load will cause a circuit to trip.

.3 Where provided panelboard schedules indicate "Existing Circuit" or similar, provide the correct description for the circuit. Existing Circuit will not be acceptable in the final panelboard schedules submitted as part of closeout submittals.

.3 Existing Cabling in Return Air Plenums

.1 In ceilings being used as a return air-plenum, Contractor to review existing low-voltage cabling uncovered as part of the work.

.2 Immediately notify the Consultant if any cables identified are not plenum rated (i.e. CMP, or FT6 rated).

3.02 Preparation

.1 Coordinate utility service outages with utility company.

.2 Provide temporary wiring and connections to maintain existing systems in service during construction. When work must be performed on energized equipment or circuits, use personnel experienced in such operations.

.3 Existing electrical service: Maintain existing system in service until new system is complete and ready for service. Disable system only to make switch overs and connections. Obtain permission from Owner at least 24 hours before partially or completely disabling system. Minimize outage duration. Make temporary connections to maintain service in areas adjacent to work area.

.4 Existing Telephone System: Maintain existing system in service. Notify Owner at least 24 hours before partially or completely disabling system. Minimize outage duration. Make temporary connections to maintain service in areas adjacent to work area.

.5 Existing Fire Alarm System: Maintain existing system in service. Minimize outage duration. Provide fire watch as required. Make temporary connections to maintain service in areas adjacent to work area.

3.03 Demolition

.1 Disconnect electrical systems in walls, floors, and ceilings scheduled for removal.

.2 Demolish and extend existing electrical work to Section 02 40 00, and this Section.

.3 Remove, relocate, and extend existing installations to accommodate new construction.

.4 Remove abandoned wiring to source of supply.

.5 When relocating or removing equipment, should any circuits be abandoned, the conductors to these circuits must be removed or properly terminated as detailed in Ontario Electrical Safety Code (OESC) bulletin 12-25-1, or latest revision.

.6 Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors, and patch surfaces.

.7 Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit servicing them is abandoned and removed. Provide blank cover for abandoned outlets which are not removed.

.8 Disconnect and remove abandoned panelboards and distribution equipment.

.9 Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.

.10 Disconnect and remove abandoned luminaires. Remove brackets, stems, hangers, and other accessories.

.11 Repair adjacent construction and finishes damaged during demolition and extension work.

.12 Extend existing installations using materials and methods compatible with existing electrical installations, or as specified.

.13 Maintain continuity of existing services for other circuits/devices serving areas outside the Work area. Provide additional wiring/conduits/boxes etc. to suit existing services to be maintained and also implement new Work as detailed.

3.04 Restoration

.1 Install relocated materials and equipment under the provisions of Division 01.

3.05 Cleaning

.1 Clean and repair existing materials and equipment which remain or are to be reused.

.2 Waste Management

.1 Turn over designated equipment to the Owner.

.2 Dispose of unwanted materials and equipment.

3.06 Protection

.1 Maintain access to existing electrical installations which remain active. Modify installation or provide access panels as appropriate.

End of Section

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1 General

1.01 Section Includes

.1 Building wire and cable.

.1 Armoured cable.

.2 Metal clad cable.

.3 Wiring connectors and connections.

.2 Permitted voltage drop for feeder and branch circuits.

.3 Conductor sizes are based on copper unless indicated as aluminum or "AL".

1.02 References

.1 CSA Group:

.1 CSA C22.1-18, Canadian Electrical Code, Part 1 (24th Edition), Safety Standard for Electrical Installations.

.2 Ontario Electrical Safety Code (27th edition/2018).

.3 CSA C22.2 No. 0.3-09 (R2019), Test methods for electrical wires and cables.

.4 CSA C22.2 No. 48-15, Nonmetallic sheathed cable.

.5 CSA C22.2 No. 51-14, Armoured cables.

.6 CSA C22.2 No. 52-15, Underground secondary and service-entrance cables.

.7 CSA C22.2 No. 65-13, Wire connectors.

.8 CSA C22.2 No. 75-17, Thermoplastic insulated wires and cables.

.9 CSA C22.2 No. 123-16, Aluminum sheathed cables.

.10 CSA C22.2 No. 131-14, Type TECK 90 cable.

.2 NECA (National Electrical Contractors Association) - Standard of Installation.

.3 NETA (International Electrical Testing Association) - ATS-2003 - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

.4 CAN/ULC-S139:2017 – Standard Method of Fire Test for Evaluation of Integrity of Electrical Power, Data and Optical Fibre Cables.

1.03 Coordination

.1 Where wire and cable destination is indicated, and routing is not shown, determine exact routing and lengths required.

1.04 Closeout Submittals

.1 Record Documents: Indicate as-constructed feeder sizes on single line diagram.

.2 Megger test results.

1.05 Qualifications

.1 Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' experience.

2 Products

2.01 Manufacturers

.1 American Wire Group.

.2 BICC Phillips.

.3 General Cable.

.4 Nexans.

.5 Prysmian.

.6 Southwire.

2.02 Regulatory Requirements

.1 Provide products listed and classified by CSA Group as suitable for the purpose specified and indicated.

2.03 Conductor Material

.1 Submit bid based on copper conductors only.

.2 Aluminum: not permitted.

2.04 Building Wire

.1 RW90:

.1 Single copper conductor.

.2 Minimum #12 AWG for branch circuit wiring.

.3 Minimum #14 AWG for 120 V control wiring.

.4 Chemically cross-linked polyethylene insulation.

.5 Rated for 90 degrees C, (600 V).

.6 Suitable for handling to minus 40 degrees C.

.7 For interior installations in conduit.

.2 RWU90:

.1 Single copper conductor.

.2 Minimum 12 AWG for branch circuit wiring.

.3 Minimum 14 AWG for 120 V control wiring.

.4 Chemically cross-linked polyethylene insulation.

.5 Rated for 90 degrees C, 600 V.

.6 Suitable for handling to minus 4 degrees C.

.7 For exterior installations in conduit.

.3 T90 Nylon:

.1 Single copper conductor.

.2 Thin wall PVC insulation with nylon covering.

.3 Rated for 90 degrees C, 600 V.

.4 May be used up to size 10 AWG for interior installations.

.5 Base conduit fill on RW90 cable diameters.

2.05 Armoured Cable

.1 General

.1 Connectors: standard as required, complete with anti-short rings.

.2 Runs to be limited to fixture drops and in walls, maximum exposed run 1.5 m.

.3 Do not daisy chain (leap frog) luminaires with armoured cable.

.2 Type AC.

.1 Two, three or four copper conductors rated RW90, 1000 V.

.2 Bare copper ground wire.

.3 Insulation Voltage Rating: 600 volts.

.4 Insulation Temperature Rating: 90 degrees C (194 degrees F).

.5 Insulation Material: Thermoplastic.

.3 Type SPC90:

.1 Use for LED lighting, fluorescent dimming controls, and other SMART building applications.

.2 Colour coded cable with power, control and signal under one cable.

.3 12-2C Power with a 16-2C Control, .

.4 Bare copper ground wire.

.5 Insulation Voltage Rating: 600 volts.

.6 Insulation Temperature Rating: 90 degrees C (194 degrees F).

.7 Insulation Material: Thermoplastic.

2.06 Fire Rated Cables

.1 General:

.1 2 hour fire rating to ULC S139 and to meet 2020 Ontario Building Code Rule 3.2.7.10.

.2 Alternative means of compliance:

.1 Conduits encased in a minimum of (50 mm (2 in)) of concrete.

.2 Be protected by a fire rated assembly listed to achieve the minimum fire rating as indicated.

.2 Manufacturers:

.1 nVent Pyrotenax 1850 series.

.2 VITALink MC Brand Type MC, manufactured by Marmon Wire & Cable Inc. (listed by ULC under ULC category code 'FHIT7' or 'FHJR7', dated 19 May 2015).

.1 Request quotation from manufacturer or manufacturer's representative for field certification of installed Vitalink cables prior to requesting Consultant's construction field review.

.2 2-Hour rated Vitalink RC90 power cable must be installed according to UL protocol FHIT7.120 – Electrical circuit integrity systems certified in Canada.

.3 Substitution Limitations:

.1 "Lifeline" installed in conduit may only be considered if listed by ULC under ULC Category Codes 'FHIT7' or 'FHJR7'.

2.07 TECK90 Cable

.1 Single, three, or four conductors as indicated on drawings.

.2 Cable to CAN/CSA-C22.2 No. 131.

.3 Conductors:

.1 Grounding conductor: copper.

.2 Circuit conductors: copper, size as indicated.

.4 Insulation: Cross-linked polyethylene (XLPE), type RW90, rating: 600 V.

.5 Inner jacket: polyvinyl chloride.

.6 Armour: interlocking aluminum.

.7 Overall covering: thermoplastic.

.8 Fastenings:

.1 One-hole steel straps to secure surface cables 50 mm diameter and smaller. Two-hole steel straps for cables larger than 50 mm diameter.

.2 Channel type supports for two or more cables at 1500 mm centres.

.3 Threaded rods: 6 mm diameter to support suspended channels.

.9 Connectors: Watertight, approved for TECK cable.

2.08 Wiring Termination

.1 Lugs, terminals, or screws used for termination of wiring to be suitable for copper conductors. Identify wiring with permanent indelible identifying markings, either numbered or coloured plastic tapes, on both

ends of phase conductors of feeders and branch circuit wiring. Maintain phase sequence and colour coding throughout.

.2 Splice wire, up to and including No. 6 gauge, with nylon insulated expandable spring type connectors.

.1 Thomas & Betts – Marr Max Series

.3 Splice large conductors using compression type connections insulated with heat shrink sleeves.

.1 Thomas & Betts – 5400 Series lugs & heat shrink type #s series

2.09 Conductors, Wires, and Cables

.1 Indoor wiring installed in conduit, unless otherwise noted: 600 volt "RW90 XLPE".

.2 Wiring in channel back of fluorescent lighting fixtures: 600 volt type GTF or TEW.

.3 Lighting and power branch circuit wiring:

.1 Copper, minimum No. 12 gauge.

.2 Home runs to lighting and receptacle panels, which exceed 22 m (75 feet) in length: minimum No. 10 gauge.

.4 Size wires for 2 per cent maximum voltage drop to farthest outlet on a maximum 80 per cent loaded circuit.

.5 Outdoor wiring: “RWU90 XLPE”.

.6 Conductors shall be colour coded. Conductors No. 10 gauge and smaller shall have colour impregnated into insulation at time of manufacture. Conductors size No. 8 gauge and larger may be colour coded with adhesive colour coding tape but only black insulated conductors shall be employed in this case, except for neutrals which shall be white wherever possible.

.7 Colour coding as follows:

.1 Phase "A" - Red

.2 Phase "B" - Black

.3 Phase "C" - Blue

.4 Control - Orange

.5 Ground - Green

.6 Neutral - White

.8 Neatly train circuit wiring in cabinets, panels, pull boxes and junction boxes and hold with nylon cable ties.

3 Execution

3.01 Examination

.1 Verify that field measurements are as indicated.

.2 Wire and cable routing indicated is approximate unless dimensioned.

.3 Voltage Drop

.1 Ensure voltage drop in power and control conductors is in accordance with the requirements of the OESC.

.2 Size conductors accordingly when sizes are not identified.

.1 Feeder conductors: maximum voltage drop of 2 per cent.

.2 Branch circuit conductors: maximum voltage drop of 3 per cent.

.4 Verify that mechanical work likely to damage wire and cable has been completed.

.5 Verify that raceway installation is complete and supported.

3.02 Preparation

.1 Completely and thoroughly swab raceway before installing wire.

3.03 Installation

.1 Route wire and cable as required to meet project conditions.

.2 Install cable to CSA C22.1 and per manufacturer's installation guidelines.

.3 Conduit and cable supports:

.1 All wiring to be installed in EMT at all exposed areas and in partitions unless otherwise specified.

.2 All mechanical equipment to be connected with liquid tight flexible conduit.

.3 Support cables above accessible ceiling, using spring metal clips to support cables from structure. Do not rest cable on ceiling panels.

.4 Conductors

.1 Provide separate neutral for each circuit. Common neutrals not permitted.

.2 Use solid conductor for feeders and branch circuits 10 AWG and smaller.

.3 Use stranded conductors for control circuits.

.4 Use conductor not smaller than 12 AWG for power and lighting circuits.

.5 Use conductor not smaller than 16 AWG for control circuits.

.6 Armoured cable (commonly referred to as BX) is only to be used for light fixture connections and limited to maximum 1830 mm in length.

.7 Use 10 AWG conductors for 20 ampere, 120 volt branch circuits longer than 25 m.

.5 Pulling conductors

.1 Pull all conductors into raceway at same time.

.2 Use suitable wire pulling lubricant for building wire 4 AWG and larger.

.3 Neatly train and lace wiring inside boxes, equipment, and panelboards.

.4 Protect exposed cable from damage.

.6 Connectors

.1 Use suitable cable fittings and connectors.

.2 Clean conductor surfaces before installing lugs and connectors.

.3 Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.

.4 Use split bolt connectors for copper conductor splices and taps 6 AWG and larger. Tape uninsulated conductors and connector with electrical tape to 150 per cent of insulation rating of conductor.

.5 Use solderless pressure connectors with insulating covers for copper conductor splices and taps, 8 AWG and smaller.

.6 Use insulated spring wire connectors with plastic caps for copper conductor splices and taps, 10 AWG and smaller.

.7 Identification

.1 Identify and colour code wire and cable to Section 26 05 53. Identify each conductor with its circuit number or other designation indicated.

.2 Where colour-coded tape is utilized, apply a minimum of 50 mm (2 inches) at terminations, junction and pull boxes and conduit fittings. Do not paint conductors under any condition.

.3 Utilize colour coding on bussing in panels and, switchgear, disconnects, and metering cabinets to match conductor colour coding.

3.04 Site Tests and Inspections

.1 Perform continuity tests of all feeders, motor circuits, and branch circuits.

.2 Perform insulation-resistance test (megger test) on each feeder. Submit report to the Consultant.

End of Section

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1 General

1.01 Section Includes

.1 Low-voltage control cabling.

.2 Control-circuit conductors.

1.02 References

.1 CSA Group:

.1 CSA C22.1-18, Canadian Electrical Code, Part 1 (24th Edition), Safety Standard for Electrical Installations.

.2 Ontario Electrical Safety Code (27th edition/2018).

.3 CSA C22.2 No. 0.3-09 (R2019), Test methods for electrical wires and cables.

.4 CSA C22.2 No. 48-15, Nonmetallic sheathed cable.

.5 CSA C22.2 No. 51-14, Armoured cables.

.6 CSA C22.2 No. 65-13, Wire connectors.

.7 CSA C22.2 No. 75-17, Thermoplastic insulated wires and cables.

.8 CSA C22.2 No. 208-14, Fire alarm and signal cable.

.2 NECA (National Electrical Contractors Association) - Standard of Installation.

1.03 Qualifications

.1 Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' experience.

1.04 Coordination

.1 Where wire and cable destination is indicated and routing is not shown, determine exact routing and lengths required.

2 Products

2.01 Regulatory Requirements

.1 Conform to CSA C22.1.

.2 Provide products listed and classified by CSA Group as suitable for the purpose specified and indicated.

2.02 Low Voltage Wiring

.1 LVT:

.1 Multi conductor PVC insulated.

.2 Bare copper ground conductor.

.3 Overall PVC jacket.

.4 Rated 30 V.

.5 CMP (FT6) rated if cable is exposed.

.6 CMR (FT4) rated if cable is installed in conduit.

.2 Category 5e Network Cabling.

.1 CMP (FT6) rated if cable is exposed.

.2 CMR (FT4) rated if cable is installed in conduit.

2.03 Terminations and Splices

.1 All terminations and splices shall be of an approved type for the conductors being used.

.2 Where conductors are terminated or spliced, it shall be done in the following manner:

.1 Where a single solid conductor is terminated in a device under one screw or clamping mechanism, no additional terminating hardware is required.

.2 Where multiple or stranded conductors are terminated in a device under one screw or clamping mechanism, self insulated crimp-on cable ends or approved equal shall be used up to and including No. 10 sized conductors. Approved compression lugs shall be used for larger conductor sizes.

.3 Where multiple conductors are spliced, properly sized Wing Nut connectors, or approved equal, shall be used for up to two No. 8 or three No. 10 AWG conductors. Pressure type sleeve cable connectors, splices, tee's, etc., shall be used for all larger size connections and terminations.

.4 Insulate all bare surfaces of splices with heat shrink sleeving or equivalent.

.5 Conductors connected to ground rods for service or equipment grounding or to building structural or architectural elements shall be terminated, connected and spliced using a thermoweld process or approved non-mechanical compression type connectors.

.3 Install all service and feeder conductors as continuous lengths without breaks, measured and cut based on site dimensions.

3 Execution

3.01 Examination

.1 Verify that mechanical work likely to damage wire and cable has been completed.

.2 Verify that raceway installation is complete and supported.

.3 Verify that field measurements are as indicated.

.4 Wire and cable routing indicated is approximate unless dimensioned.

3.02 Preparation

.1 Completely and thoroughly swab raceway before installing wire.

3.03 Installation

.1 Route control cabling as required to meet project conditions.

.2 Install cable to the CSA C22.1.

.3 Conduit and supports

.1 All wiring to be installed in EMT at all exposed areas and in partitions unless otherwise specified.

.2 All mechanical equipment to be connected with liquid tight flexible conduit.

.3 Support cables above accessible ceiling, using spring metal clips to support cables from structure. Do not rest cable on ceiling panels.

.4 Conductors

.1 Use stranded conductors for control circuits.

.2 Use conductor not smaller than 16 AWG for control circuits.

.5 Pulling conductors

.1 Pull all conductors into raceway at same time.

.2 Neatly train and lace wiring inside boxes, equipment, and panelboards.

.3 Neatly train circuit wiring in cabinets, panels, pull boxes and junction boxes and hold with nylon cable ties.

.4 Protect exposed cable from damage.

.6 Connectors

.1 Use suitable cable fittings and connectors.

.2 Clean conductor surfaces before installing lugs and connectors.

.3 Use solderless pressure connectors with insulating covers for copper conductor splices and taps, 8 AWG and smaller.

.4 Use insulated spring wire connectors with plastic caps for copper conductor splices and taps, 10 AWG and smaller.

.7 Identification

.1 Identify and colour code wire and cable to Section 26 05 53. Identify each conductor with its circuit number or other designation indicated.

.2 Where colour coded tape is utilized, apply a minimum of 50 mm (2 inches) at terminations, junction and pull boxes and conduit fittings. Do not paint conductors under any condition.

End of Section

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1 General

1.01 Section Includes

.1 Grounding electrodes and conductors.

.2 Equipment grounding conductors.

.3 Bonding.

.4 The terms "connect" and "bond" are used interchangeably in this Specification and have the same meaning.

1.02 Related Requirements

.1 Section 27 05 26 – Grounding and Bonding for Communications Systems.

1.03 References

.1 CSA Group

.1 CSA C22.1-18, Canadian Electrical Code, Part 1 (24th Edition), Safety Standard for Electrical Installations.

.2 Ontario Electrical Safety Code (27th edition/2018).

.3 CSA C22.2 No.0.4-17, Bonding of electrical equipment.

.4 CSA C22.2 No. 41-13, Grounding and bonding equipment.

.5 CSA C22.2 No. 75-17, Thermoplastic insulated wires and cables.

.2 ANSI/TIA/EIA J-STD-607-A - Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications.

.3 Institute of Electrical and Electronics Engineers, Inc.

.1 IEEE 81-1983 - IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System.

1.04 Action Submittals

.1 Product Data: Provide for grounding electrodes and connections.

1.05 Informational Submittals

.1 Test Reports: Indicate overall resistance to ground and resistance of each electrode.

.2 Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.06 Closeout Submittals

.1 Project Record Documents: Record actual locations of components and grounding electrodes.

.2 Certificate of Compliance: Indicate approval of installation by authority having jurisdiction.

1.07 Qualifications

.1 Manufacturer: Company specializing in manufacturing the products specified in this section with minimum three years' experience.

1.08 Regulatory Requirements

.1 Products: Listed and classified testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

2 Products

2.01 Manufacturers

.1 B-Line by Eaton.

.2 Hubbell (Burndy).

.3 Panduit.

.4 Thomas & Betts.

2.02 Performance Criteria

.1 Grounding System Resistance: 5 ohms.

.2 Provide all equipment grounding as required regardless of whether it has been shown on drawings or called for in this specification. Arrange grounds so that under normal operating conditions no injurious amount of current will flow in any grounding conductor.

2.03 Grounding and Bonding Conductors

.1 Electrical grounding conductors shall be CSA C22.2 No. 75 insulated stranded copper, except that sizes #10 AWG and smaller shall be solid copper. Insulation colour shall be continuous green for all equipment grounding conductors.

.2 Bonding conductors shall be ASTM B8 bare stranded copper, except that sizes #10 AWG and smaller shall be ASTM B1 solid bare copper wire.

2.04 Rod Electrodes

.1 Material: Copper-clad steel.

.2 Diameter: 19 mm.

.3 Length: 3000 mm.

2.05 Ground Rods

.1 Copper clad steel, 19 mm (3/4 inch) diameter by 3000 mm (10 feet) long, conforming to CSA C22.2 No. 41.

.2 Quantity of rods shall be as required to obtain the specified ground resistance.

2.06 Splices and Termination Components

.1 Components shall meet or exceed CSA C22.2 No. 41, and be clearly marked with the manufacturer, catalog number, and permitted conductor size(s).

2.07 Ground Connections

.1 Below Grade: Exothermic-welded type connectors.

.2 Above Grade:

.1 Bonding Jumpers: compression type connectors, using zinc-plated fasteners and external tooth lockwashers.

.2 Ground Busbars: Two-hole compression type lugs using tin-plated copper or copper alloy bolts and nuts.

2.08 Ground Terminal Blocks

.1 At any equipment mounting location (e.g. backboards and hinged cover enclosures) where rack-type ground bars cannot be mounted, provide screw lug-type terminal blocks.

2.09 Splice Case Ground Accessories

.1 Splice case grounding and bonding accessories shall be supplied by the splice case manufacturer when available. Otherwise, use 6 AWG insulated ground wire with shield bonding connectors.

2.10 Mechanical Connectors

.1 Material: Bronze.

2.11 Wire

.1 Material: Stranded copper.

.2 Foundation Electrodes: 2/0 AWG.

.3 Grounding Electrode Conductor: Size to meet Ontario Electrical Safety Code requirements.

2.12 Grounding Well Components

.1 Well Pipe: 200 mm by 600 mm long concrete pipe with belled end.

.2 Well Cover: Cast iron with legend "GROUND" embossed on cover.

3 Execution

3.01 Examination

.1 Verify that final backfill and compaction has been completed before driving rod electrodes.

3.02 Installation

.1 General

.1 Ground in accordance with the Ontario Electrical Safety Code, as shown on drawings, and as hereinafter specified.

.2 System Grounding:

.1 Secondary service neutrals: Ground at the supply side of the secondary disconnecting means and at the related transformers.

.2 Separately derived systems (transformers downstream from the service entrance): Ground the secondary neutral.

.3 Equipment Grounding: Metallic structures (including ductwork and building steel), enclosures, raceways, junction boxes, outlet boxes, cabinets, machine frames, and other conductive items in close proximity with electrical circuits shall be bonded and grounded.

.4 Ground electrical equipment and wiring in accordance with Ontario Electrical Safety Code and Local Inspection Authority's Rules and Regulations.

.5 Install grounding conductors, outside Electric Rooms and Electrical Closets in conduit and conceal where possible. Make connections to water mains, all metallic piping systems, neutral and equipment with brass, copper or bronze bolts and connectors or weld using Cadweld or Thermoweld processes.

.6 Provide grounding conductors, sized as per Code, and connect to grounding bus or water main wherever non-raceways are installed.

.2 Provide grounding electrode conductor and connect to reinforcing steel in foundation footing. Bond steel together.

.3 Provide bonding to meet Regulatory Requirements.

.4 Bond together metal siding not attached to grounded structure; bond to ground.

.5 Install ground grid under access floors indicated.

.6 Bond together each metallic raceway, pipe, duct and other metal object entering space under access floors. Bond to underfloor ground grid. Use #6 AWG bare copper conductor.

.7 Equipment Grounding Conductor: Provide separate, insulated conductor within each feeder and branch circuit raceway. Terminate each end on suitable lug, bus, or bushing.

.8 Ground Resistance

.1 Grounding system resistance to ground not to exceed 5 ohms. Make necessary modifications or additions to the grounding electrode system for compliance without additional cost to the Owner. Final tests shall assure that this requirement is met.

.2 Resistance of the grounding electrode system shall be measured using a four-terminal fall-of-potential method as defined in IEEE 81. Ground resistance measurements shall be made before the electrical distribution system is energized and shall be made in normally dry conditions not less than 48 hours after the last rainfall. Resistance measurements of separate grounding electrode systems shall be made before the systems are bonded together below grade. The combined resistance of separate systems may be used to meet the required resistance, but the specified number of electrodes must still be provided.

.3 Services at power company interface points shall comply with the power company ground resistance requirements.

.9 Ground Rod Installation

.1 Drive each rod vertically in the earth, not less than 3000 mm (10 feet) in depth.

.2 Where permanently concealed ground connections are required, make the connections by the exothermic process to form solid metal joints. Make accessible ground connections with mechanical pressure type ground connectors.

.3 Where rock prevents the driving of vertical ground rods, install angled ground rods or grounding electrodes in horizontal trenches to achieve the specified resistance.

.10 Inaccessible Grounding Connections

.1 Make grounding connections, which are buried or otherwise normally inaccessible (except connections for which periodic testing access is required) by exothermic weld.

.11 Secondary Equipment and Circuits

.1 Main Bonding Jumper: Bond the secondary service neutral to the ground bus in the service equipment.

.2 Metallic Piping, Building Steel, and Supplemental Electrode(s):

.1 Provide a grounding electrode conductor sized per code between the service equipment ground bus and all metallic water and gas pipe systems, building steel, and supplemental or made electrodes. Jumper insulating joints in the metallic piping. All connections to electrodes shall be made with fittings that conform to CSA C22.2 No 41.

.2 Provide a supplemental ground electrode and bond to the grounding electrode system.

.3 Conduit Systems:

.1 Ground all metallic conduit systems. All metallic conduit systems shall contain an equipment grounding conductor.

.2 Non-metallic conduit systems shall contain an equipment grounding conductor, except that non-metallic feeder conduits which carry a grounded conductor from exterior transformers to interior or building-mounted service entrance equipment need not contain an equipment grounding conductor.

.3 Conduit containing only a grounding conductor, and which is provided for mechanical protection of the conductor, shall be bonded to that conductor at the entrance and exit from the conduit.

.4 Feeders and Branch Circuits: Install equipment grounding conductors with all feeders and power and lighting branch circuits.

.5 Boxes, Cabinets, Enclosures, and Panelboards:

.1 Bond the equipment grounding conductor to each pull box, junction box, outlet box, device box, cabinets, and other enclosures through which the conductor passes (except for special grounding systems for intensive care units and other critical units shown).

.2 Provide lugs in each box and enclosure for equipment grounding conductor termination.

.3 Provide ground bars in panelboards, bolted to the housing, with sufficient lugs to terminate the equipment grounding conductors.

.6 Receptacles shall not be grounded through their mounting screws. Ground with a jumper from the receptacle green ground terminal to the device box ground screw and the branch circuit equipment grounding conductor.

.7 Raised Floors: Provide bonding of all raised floor components.

.12 Corrosion Inhibitors

.1 When making ground and ground bonding connections, apply a corrosion inhibitor to all contact surfaces. Use corrosion inhibitor appropriate for protecting a connection between the metals used.

.13 Conductive Piping

.1 Bond all conductive piping systems, interior and exterior, to the building to the grounding electrode system. Bonding connections shall be made as close as practical to the equipment ground bus.

3.03 Field Quality Control

.1 Perform inspections and tests listed in NETA ATS, Section 7.13.

End of Section

1 General

1.01 Section Includes

.1 Conduit and equipment supports.

.2 Anchors and fasteners.

1.02 References

.1 CSA C22.1-18, Canadian Electrical Code, Part 1 (24th Edition), Safety Standard for Electrical Installations.

.2 Ontario Electrical Safety Code (27th edition/2018).

.3 CECA - Canadian Electrical Contractors Association.

1.03 Closeout Submittals

.1 Submit the following in the Operation and Maintenance Manual for products used over the course of the project:

.1 Product Data: Provide manufacturer's catalogue data for fastening systems.

.2 Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.

1.04 Regulatory Requirements

.1 Provide products listed and classified by Canadian Standards as suitable for purpose specified and shown.

2 Products

2.01 Manufacturers

.1 B-line by Eaton.

.2 Burndy Canada Ltd. (Hubbell).

.3 Erico Caddy.

.4 E. Myatt & Co. Inc.

.5 Hilti Canada.

.6 Thomas & Betts.

.7 Unistrut.

.8 Approved equal.

2.02 General

.1 All supporting devices, strut channel, threaded rod, anchors, etc. to be used shall be of the “hot dipped” galvanized type. Electrogalvanized components will not be accepted.

.2 Materials and Finishes: Provide adequate corrosion resistance.

.3 Provide materials, sizes, and types of anchors, fasteners and supports to carry the loads of equipment and conduit. Consider weight of wire in conduit when selecting products.

.4 Anchors and Fasteners:

.1 Concrete Structural Elements: Use expansion anchor sand preset inserts.

.2 Steel Structural Elements: Use beam clamps and welded fasteners.

.3 Concrete Surfaces: Use self-drilling anchors and expansion anchors.

.4 Hollow Masonry, Plaster, and Gypsum Board Partitions: Use toggle bolts and hollow wall fasteners.

.5 Solid Masonry Walls: Use expansion anchors and preset inserts.

.6 Sheet Metal: Use sheet metal screws.

.7 Wood Elements: Use wood screws.

2.03 Anchors and Hangers

.1 Hangers for electrical conduit shall be galvanized after fabrication.

.2 Perforated strapping: not permitted.

2.04 Inserts

.1 Use only factory-made threaded or toggle type.

.2 Where inserts cannot be placed, use factory-made expansion shields for light weights, where approved by the Consultant.

.3 Do not use powder-activated tools except with the written permission of the Consultant.

2.05 Sleeves

.1 Through interior walls, use standard weight steel pipes, conduit, or 18 gauge galvanized steel. Cut flush with finished surfaces. Check room finish schedules.

.2 Through exterior walls above grade, floors, and roof use standard weight steel pipes, machine cut, flush with finished surface inside and to suit flashing outside.

.3 Through exterior walls below grade, water-proofed floors, and other water-proof walls, use heavy weight cast iron pipes, machine cut. Extend sleeves 100 mm (4 inches) above finished floors, and cut flush with underside of floor.

2.06 Steel Channel

.1 Description: Painted steel.

2.07 Supports

.1 Steel supports in wet or dry locations to be galvanized after fabrication.

.2 Where galvanized members are bolted together use cadmium plated bolts.

.3 For hanger rods use minimum 10 mm (3/8 inch) diameter steel threaded rod. Use clevis type attachment.

.4 Provide minimum 100 mm (4 inch) high concrete bases for all floor mounted equipment.

2.08 Supports and Bases

.1 Submit proposed method of attachment of hangers and beam clamps, to cellular steel deck for approval before proceeding with Work.

.2 Supply and erect special structural Work required for the installation of electrical equipment. Provide anchor bolts and other fastenings unless noted otherwise. Mount equipment required to be suspended above floor level, where details are not shown, on a frame or platform bracketed from the wall or suspended from the ceiling. Carry supports to either the ceiling or the floor, or both as required, at locations where, because wall thickness is inadequate, it is not permitted to use such brackets.

.3 Electrical panels, switches or other electrical equipment shall be complete with suitable bases or mounting brackets.

.4 Provide channel or other metal supports where necessary, to adequately support lighting fixtures. Do not use wood unless wood forms part of the building structure.

.5 Support hangers, in general, from inserts in concrete construction or from building structural steel beams, using beam clamps. Provide additional angle or channel steel members, required between beams for supporting conduits and cables.

.6 Provide any additional supports required from existing concrete construction for any piping or equipment, by drilling same and installing expansion bolt cinch anchors.

.7 Do not use explosive drive pins in any section of Work without obtaining prior approval.

2.09 Threaded Rod Covers

.1 Protect cable from abrasion caused by contact with threaded rod.

.2 To meet UL 94V-0 specifications.

.3 Colour: Black.

.4 Example product: Panduit TRC18FR-X20Y.

3 Execution

3.01 Installation

.1 Obtain permission from the Consultant before drilling or cutting structural members.

.2 Fabricate supports from structural steel or steel channel. Rigidly weld members or use hexagon head bolts to present neat appearance with adequate strength and rigidity. Use spring lock washers under all nuts.

.3 Install surface-mounted cabinets and panelboards with minimum of four anchors.

.4 In wet and damp locations use steel channel supports to stand cabinets and panelboards 25 mm (1 inch) off wall.

.5 Use sheet metal channel to bridge studs above and below cabinets and panelboards recessed in hollow partitions.

.6 Provide inserts, sleeves, equipment supports and hangers, sealing of sleeves and openings, as required for all electrical work. Ensure that the load onto structures does not exceed the maximum loading per square metre as shown on Structural Drawings or as directed by the Consultant.

.7 Provide insets, holes, anchor bolts and sleeves in time when walls, floors, and roof are erected.

.8 Place insets only in structural members and not in the finishing material.

.9 Secure all supports and hangers to the structure unless noted otherwise.

.10 Suspend hanger rods from approved concrete inserts and from beam clamps. Obtain Consultant's approval before welding to steel structural members.

.11 Secure supports to precast concrete members to inserts originally cast into the members or by rods passing between the members and connected to a steel plate bearing.

.12 Sealing of Sleeves and Openings to Maintain Fire Rating

.1 Use Dow-Corning #3-6548 'Silicone RTV' foam, Thomas & Betts "Flamesafe' firestopsystem, Electrovert 'Flameseal" firestop putty, or approved equal materials installed in accordance with the manufacturer's specifications and recommendations.

.2 Submit data sheets for review prior to installation.

.13 Supports

.1 All conduits, panels, etc. to be securely and adequately supported.

.2 Where more than three conduits run together, conduit racks to be used.

.3 Single runs of conduit to be supported by galvanized conduit straps or ring bolt type hangers. Tie wire or perforated metal strap hangers will NOT be accepted.

End of Section

1 General

1.01 Section Includes

.1 Rigid steel conduit.

.2 Flexible metal conduit.

.3 Liquid tight flexible metal conduit.

.4 Electrical metallic tubing (EMT).

.5 Electrical non-metallic tubing (ENT).

.6 Rigid PVC conduit.

.7 Fittings and conduit bodies.

1.02 References

.1 Canadian Standards Association

.1 CSA C22.1-18, Canadian Electrical Code, Part 1 (24th Edition), Safety Standard for Electrical Installations.

.2 Ontario Electrical Safety Code (27th edition/2018).

.3 CAN/CSA-C22.2 No. 18 – Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware.

.4 CSA C22.2 No. 45 – Rigid Metal Conduit.

.5 CSA C22.2 No. 45.1 – Rigid Metal Conduit - Steel.

.6 CSA C22.2 No. 56-17, Flexible metal conduit and liquid-tight flexible metal conduit.

.7 CSA C22.2 No. 83.1 – Electrical Metallic Tubing - Steel.

.8 CSA C22.2 No. 211.1 – Rigid Types EB1 and DB2/ES2 PVC Conduit.

.9 CSA C22.2 No. 211.2 – Rigid PVC (Unplasticized) Conduit.

.10 CSA C22.2 No. 211.3 – Reinforced Thermosetting Resin Conduit (RTRC) on Fittings.

.11 CSA C22.2 No. 227.1 – Electrical Nonmetallic Tubing.

.12 CSA C22.2 No. 227.2.1 – Liquid-Tight Flexible Nonmetallic Conduit.

1.03 Record Documentation

.1 Accurately record actual routing of conduits larger than 51 mm.

.2 Accurately record actual routing of all conduits installed below grade, regardless of size, including whether direct buried or installed in concrete duct bank.

1.04 Regulatory Requirements

.1 Provide products listed and classified by CSA (Canadian Standards Association) as suitable for purpose specified and shown.

1.05 Delivery, Storage, and Handling

.1 Accept conduit on site. Inspect for damage.

.2 Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.

1.06 Project Conditions

.1 Verify that field measurements are as shown on drawings.

.2 Verify routing and termination locations of conduit prior to rough-in.

.3 Conduit routing, if shown on drawings, is approximate unless dimensioned. Route as required to provide a complete wiring system.

2 Products

2.01 Manufacturers

.1 Where products are listed in this section based on a single manufacturer, the equivalent product from the following manufacturers is acceptable:

.1 Appleton.

.2 Columbia-MBF.

.3 Crouse-Hinds by Eaton.

.4 Hubbell.

.5 Thomas & Betts Ltd.

2.02 Rigid Metal Conduit

.1 Rigid metal conduit: to CSA C22.2 No. 45, hot dipped galvanized steel, threaded.

.2 Epoxy coated conduit: to CSA C22.2 No. 45, with zinc coating and corrosion resistant epoxy finish inside and outside.

.3 Fittings and conduit bodies: Material to match conduit.

2.03 Flexible Metal Conduit

.1 Flexible metal conduit: to CSA C22.2 No. 56, interlocked steel construction.

.2 Fittings: CSA C22.2 No. 56.

2.04 Liquid Tight Flexible Metal Conduit

.1 Description: Interlocked steel construction with PVC jacket.

.2 Fittings: CSA C22.2 No. 56.

2.05 Electrical Metallic Tubing (EMT)

.1 Description: CSA C22.2 No. 83.1; galvanized tubing.

.2 Fittings and Conduit Bodies: CSA C22.2 No. 83.1; steel type.

2.06 Electrical Non-metallic Tubing (ENT)

.1 To CSA C22.2 No. 227.1.

2.07 Conduit, Fittings, and Accessories

.1 Conduit accessories, conduits and fittings conforming to CSA Standard C22.2 No. 18-1972.

.2 Provide rain tight connectors, couplings, fittings, junction boxes, pull boxes and surface outlet boxes shall be used for surface conduit installations exposed to moisture or in sprinklered buildings.

.3 Rigid conduit bushings:

.1 Thomas & Betts Ltd. - Series 5031.

.4 EMT Connectors:

.1 Thomas & Betts Ltd. - Steel City TC 121E Series.

.5 Ground Bushings:

.1 Thomas & Betts – Blackjack or 1220 Series.

.6 Flexible conduit connectors:

.1 Thomas & Betts Ltd. - Series 3110.

.2 EMT couplings: steel concrete tight to match connectors.

.7 Terminate rigid conduit entering boxes or enclosures with nylon insulated steel threaded bushings.

.1 Thomas & Betts – 8125 Series.

.8 Terminate EMT entering boxes or enclosures with nylon insulated steel concrete tight connectors.

.9 Terminate flexible conduit entering boxes or enclosures with nylon insulated steel connectors.

.1 Thomas & Betts – 5332 Series.

3 Execution

3.01 Preparation

.1 Produce layout sketches of conduit runs through mechanical and electrical service areas, through corridors, and other congested areas in order to resolve any interferences with other work, and to determine the most efficient route to run the conduit.

3.02 Installation

.1 Minimum size: 21 mm (3/4 inch) unless otherwise specified.

.2 All conduit shall be concealed except in mechanical rooms and electrical rooms, or unless otherwise indicated in this specification, or noted on the drawings. Surface conduit work is not permitted unless specifically noted.

.3 Install wiring in conduit unless otherwise specified. Where conduit sizes are not shown on drawings, provide conduits sized in accordance with Ontario Electrical Safety Code, CSA C22.1. When conduits are indicated, they are the minimum size required, and must be increased to suit the length of run or voltage drop requirements.

.4 Conduit use:

.1 Unless otherwise specified below or shown on the drawings, all systems shall be installed in electrical metallic tubing (EMT).

.2 Outdoor locations:

.1 Above grade: use rigid steel.

.2 Use liquid tight flexible metal conduit for connections to transformers, motors, and equipment, subject to vibration and movement.

.3 Underground: Use rigid PVC conduit for wiring in slabs on grade and wiring below grade.

.4 Wet and damp locations:

.1 Use rigid steel.

.2 Use liquid tight flexible metal conduit for connections to transformers, motors, and equipment, subject to vibration and movement.

.5 Dry locations:

.1 Concealed in metal stud partitions:

.1 Use electrical metallic tubing.

.2 Use of AC90 (Bx) as described in Section 26 05 19.

.2 Concealed in concrete: Use electrical non-metallic tubing or rigid PVC.

.3 Exposed areas: Use electrical metallic tubing.

.4 Use flexible metal conduit for connections to transformers, motors, and equipment, subject to vibration and movement.

.5 Use liquid tight flexible metal conduit below raised floors for connections to all devices.

.6 Aluminium conduit may be used, in lieu of steel conduit, in clean and dry locations, but shall not be used in poured concrete, or for signal and intercommunication systems wiring.

.7 Raceways installed less than 2 m above grade in an area where they are subject to mechanical damage, including parking garages, loading docks, warehouse spaces, and service rooms shall be of the rigid steel type or protected by a steel guard of not less than no. 10 MSG, adequately secured in place.

.8 Use epoxy coated conduit in corrosive areas.

.6 Telecommunications conduits: in accordance with Section 27 05 28.

.5 Arrangement and supports

.1 Arrange supports to prevent misalignment during wiring installation.

.2 Arrange conduit to maintain headroom and present neat appearance.

.3 Support conduit using coated steel or malleable iron straps, lay-in adjustable hangers, clevis hangers, and split hangers.

.4 Group related conduits; support using conduit rack.

.5 Construct rack using steel channel; provide space on each for 25 per cent additional conduits.

.6 Fasten conduit supports to building structure and surfaces to Section 26 05 29.

.7 Do not support conduit with wire or perforated pipe straps.

.8 Remove wire used for temporary supports

.9 Do not attach conduit to ceiling support wires.

.10 Route exposed conduit parallel and perpendicular to walls.

.11 Route conduit installed above accessible ceilings parallel and perpendicular to walls.

.12 Route conduit in and under slab from point-to-point.

.13 In damp and unheated areas, avoid moisture traps; provide junction box with drain fitting at low points in conduit system.

.14 Provide suitable fittings to accommodate expansion and deflection where conduit crosses expansion joints.

.6 Clearances

.1 Maintain adequate clearance between conduit and piping.

.2 Maintain 300 mm (12 inch) clearance between conduit and surfaces with temperatures exceeding 40 degrees C.

.7 Conduit bends

.1 Install no more than equivalent of three 90 degree bends between boxes.

.1 Use conduit bodies to make sharp changes in direction, as around beams.

.2 Use hydraulic one-shot bender to fabricate bends in metal conduit larger than 50 mm size or provide prefabricated conduit bends.

.8 Install wall entrance seals where conduits pass through exterior walls below grade.

.9 Provide expansion coupling in conduit runs at building expansion joints and in long runs subject to thermal expansion, all in accordance with manufacturer recommendations.

.10 Cut conduit square using saw or pipe cutter; de-burr cut ends.

.11 Bring conduit to shoulder of fittings; fasten securely.

.12 Use suitable caps to protect installed conduit against entrance of dirt and moisture.

.13 Use conduit hubs or sealing locknuts to fasten conduit and to cast boxes.

.14 Provide suitable pull string in each empty conduit except sleeves and nipples.

.15 Ground and bond conduit to Section 26 05 26.

.16 Identify conduit to Section 26 05 53.

.17 Flexible conduit and armoured cable will be accepted for a maximum length of 1500 mm for final connection to lighting fixtures. Do not connect from fixture to fixture.

3.03 Cleaning

.1 Conduit manufacturer's touch-up enamel shall be used to repair all scratches and gouges on epoxy-coated conduit.

End of Section

1 General

1.01 Section Includes

.1 Wall and ceiling outlet boxes.

.2 Pull and junction boxes.

1.02 Related Requirements

.1 Section 26 09 43 – Network Lighting Controls.

.2 Section 26 27 16 – Electrical Cabinets and Enclosures.

.3 Section 26 27 26 – Wiring Devices: Wall plates in finished areas, floor box service fittings, fire-rated poke-through fittings, and access floor boxes.

.4 Section 26 27 26.13 – Floor Box Assemblies.

1.03 References

.1 CSA C22.1-18, Canadian Electrical Code, Part 1 (24th Edition), Safety Standard for Electrical Installations.

.2 Ontario Electrical Safety Code (27th edition/2018).

.3 CAN/CSA-C22.2 No. 18 - Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware.

.4 CSA C22.2 No. 18.1 (CSA/UL/ANCE) - Metallic Outlet Boxes.

.5 CSA C22.2 No. 40 - Cutout, Junction and Pull Boxes.

.6 CAN/CSA-C22.2 No. 85 - Rigid PVC Boxes and Fittings.

1.04 Closeout Submittals

.1 Record actual locations and mounting heights of outlet, pull, and junction boxes on project record documents.

1.05 Regulatory Requirements

.1 Provide products listed and classified by CSA (Canadian Standards Association) as suitable for the purpose specified and indicated.

2 Products

2.01 Outlet Boxes

.1 Sheet Metal Outlet Boxes: CSA C22.2 No. 18, galvanized steel.

.1 Luminaire and Equipment Supporting Boxes: Rated for weight of equipment supported; include 13 mm male fixture studs where required.

.2 Concrete Ceiling Boxes: Concrete type.

.2 Non-metallic Outlet Boxes: CSA C22.2 No. 18.

.3 Cast Boxes: CSA C22.2 No. 18, Type FD, aluminum. Provide gasketed cover by box manufacturer. Provide threaded hubs.

.4 Wall Plates for Finished Areas: As specified in Section 26 27 26.

2.02 Pull Boxes and Junction Boxes

.1 Sheet Metal Boxes: CSA C22.2 No. 18, galvanized steel.

.2 Hinged Enclosures: As specified in Section 26 27 16.

.3 Surface Mounted Cast Metal Box: CSA C22.2 No. 18, Type 4; flat-flanged, surface mounted junction box:

.1 Material: Cast aluminum.

.2 Cover: Provide with ground flange, neoprene gasket, and stainless steel cover screws.

2.03 Outlet Boxes

.1 Conform to CSA C22.2 No. 18.

.2 Where 103 mm (4 inch) square outlet boxes are installed in exposed concrete or cinder block finished areas, blocks will be cut as described in Division 04 as instructed under this Section. Cut openings to provide a close fit to boxes and covers so that edges of openings are not visible after installation of plates. Use of mortar to patch up openings that are cut too large or to patch ragged edges is not permitted.

.3 Ceiling boxes: 103 mm (4 inch) octagon or square, complete with fittings, where required to support fixtures.

.4 Switch and receptacle boxes:

.1 103 mm (4 inch) square with plaster ring, where flush mounted in plaster walls.

.2 Iberville 1104 series box, or equal, where flush mounted in wood or drywall, with stud fasteners as required.

.3 Masonry boxes in masonry walls.

.5 Where boxes are surface mounted in unfinished areas they shall be FS conduits.

.6 Standard outlet boxes manufactured from code gauge galvanized steel.

.7 Provide a suitable outlet box for each light, switch, receptacle or other outlet, approved for the particular area it is to be installed.

.8 Support outlet boxes independently of conduit and cable.

.9 Locate outlet boxes, mounted in hung ceiling space, so they do not obstruct or interfere with the removal of lay-in ceiling tiles.

.10 Offset outlet boxes, shown back to back in partitions, horizontally a minimum 150 mm (6 inch) to minimize noise transmission between adjacent rooms.

.11 Use gang boxes at locations where more than one device, of the same system only, is to be mounted. Utilize separate boxes for each system.

.12 Use tile wall covers where 103 mm (4 inch) square outlet boxes are installed in exposed concrete or cinder block in finished areas.

.13 Provide flush mount boxes, panels, cabinets and electrical devices, which are installed in finished areas, with suitable flush trims and doors or covers, unless specifically noted otherwise.

.14 Provide pre-formed polyethylene vapour barriers for all boxes located in walls with internal vapour barriers.

3 Execution

3.01 Examination

.1 Verify locations of floor boxes prior to rough-in.

3.02 Installation

.1 Install boxes to CSA C22.1.

.2 Install in locations as shown on drawings, and as required for splices, taps, wire pulling, equipment connections and compliance with regulatory requirements.

.3 Set wall mounted boxes at elevations to accommodate mounting heights indicated.

.4 Electrical boxes are shown on drawings in approximate locations unless dimensioned. Adjust box location up to 3 m (10 feet) if required to accommodate intended purpose.

.5 Orient boxes to accommodate wiring devices oriented as specified in Section 26 27 26.

.6 Maintain headroom and present neat mechanical appearance.

.7 Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only.

.8 Inaccessible Ceiling Areas: Install outlet and junction boxes no more than 150 mm (6 inch) from ceiling access panel or from removable recessed luminaire.

.9 Install boxes to preserve fire resistance rating of partitions and other elements, using materials and methods.

.10 Coordinate mounting heights and locations of outlets mounted above counters, benches, and backsplashes.

.11 Locate outlet boxes to allow luminaires positioned as shown on reflected ceiling plan.

.12 Align adjacent wall mounted outlet boxes for switches, thermostats, and similar devices.

.13 Use flush mounting outlet box in finished areas.

.14 Locate flush mounting box in masonry wall to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat opening.

.15 Do not install flush mounting box back-to-back in walls; provide minimum 150 mm separation. Provide minimum 600 mm separation in acoustic rated walls.

.16 Secure flush mounting box to interior wall and partition studs. Accurately position to allow for surface finish thickness.

.17 Use stamped steel bridges to fasten flush mounting outlet box between studs.

.18 Install flush mounting box without damaging wall insulation or reducing its effectiveness.

.19 Use adjustable steel channel fasteners for hung ceiling outlet box.

.20 Do not fasten boxes to ceiling support wires.

.21 Support boxes independently of conduit.

.22 Use gang box where more than one device is mounted together. Do not use sectional box.

.23 Use gang box with plaster ring for single device outlets.

.24 Use cast outlet box in exterior locations exposed to the weather.

.25 Use cast outlet box in wet locations.

.26 Set floor boxes level.

.27 Large pull boxes: Use hinged enclosure in interior dry locations, surface-mounted cast metal box in other locations.

3.03 Adjusting

.1 Adjust floor box flush with finish flooring material.

.2 Adjust flush-mounting outlets to make front flush with finished wall material.

.3 Install knockout closures in unused box openings.

3.04 Cleaning

.1 Clean interior of boxes to remove dust, debris, and other material.

.2 Clean exposed surfaces and restore finish.

End of Section

1 General

1.01 Section Includes

.1 Metal Raceway is an enclosed pathway used for surface distribution of branch circuit electrical wiring, and cabling for voice, data, multi-media, low voltage, and optical fiber. Raceway is typically installed in existing building structures, or after construction is complete. A complete raceway system includes raceway, covers, mounting hardware, various fittings, and outlet boxes installed at specific locations. Specific codes and standards apply to electrical wires and telecommunications cables that are deployed within metal raceway. Compliance to codes and standards is required for installation, grounding and bonding, and cable deployment.

1.02 Related Requirements

.1 Section 26 05 33.13 – Conduit for Electrical Systems.

.2 Section 26 05 33.16 – Boxes for Electrical Systems.

1.03 Quality Assurance

.1 Product free from defects in material or workmanship.

.2 Materials and work specified in this document shall comply with, and are not limited to the codes, standards, and regulations listed below.

.1 CSA C22.1 - Canadian Electrical Code, Part I, Safety Standard for Electrical Installations.

.2 National Electrical Manufacturer's Association (NEMA)

.1 ANSI/NEMA WD-6-2002: Wiring Devices – Dimensional Requirements

.2 NEMA 250-2003: Enclosures for Electrical Equipment.

.3 Performance Requirements:

.1 Metal raceway and fittings UL Listed and CSA certified.

1.04 Submittals

.1 Product Data Sheet.

.2 Manufacturer's Instructions.

.3 Product Catalog Literature.

.4 Product Drawings.

1.05 Warranty

.1 Product is warranted free of defects in material or workmanship.

.2 Product is warranted to perform the intended function within design limits.

2 Products

2.01 Manufacturers

.1 Wiremold Legrand.

.2 Hubbell.

.3 Thomas & Betts Canada.

2.02 Surface Mounted Raceway, General

.1 The raceway and all system components must be UL Listed and exhibit non-flammable self-extinguishing characteristics tested to comparable specifications of UL94V-0. The raceway base and cover shall be manufactured by rigid compound, available in ivory or white colours, and allow for field painting.

2.03 Metal Raceway

.1 Metal raceway shall be a one-piece design with base and cover, factory assembled, with mounting hardware and instructions included.

.2 Metal raceway, cover, surface boxes, shall be a formed steel construction with a thickness of 0.040", and zinc plated. Related fittings shall be galvanized on all surfaces.

.3 Metal raceway, cover, and related fittings shall have an Ivory color powder coat paint finish on all external surfaces.

.4 Have tools available for field cutting and bending.

.5 Assembly and disassembly of raceway base, cover, and fittings requiring no special tools.

.6 Available fittings including couplings, internal and external elbows, tees, entrance fittings, conduit adapters and bushings.

.7 Available fittings including internal, external and flat elbows, and tee fitting, with a 1 ½" radius to accommodate communications UTP and fiber cabling minimum bend radius requirements.

.8 Installed fittings designed to overlap the raceway to cover exposed or uneven edges from field cutting.

2.04 Device Boxes

.1 Compatible device boxes shall have a removable knockout portion to permit metal raceway entry and exit.

.2 Device boxes available in standard NEMA single- and double-gang, and multiple gang up to six-gang. Device box depth shall range from 1.125" to 2.75".

.3 Device boxes shall have a single seam construction with rounded corners to eliminate sharp edges.

.4 Assembled device box front face design to permit flush mounting of standard wall plates to minimize perimeter profile exposure.

.5 Device boxes shall have threaded standoff posts attached to the base, to facilitate mounting of covers with short screws for ease of alignment during installation.

3 Execution

3.01 Preparation

.1 Submit layout drawings of the raceway system for reviewed prior to installation.

.2 Installation of metal raceway in wet areas is not permitted.

.3 Manufacturer's instructions for installing raceway and fittings shall be followed by the installer.

.4 All wall surfaces, or other permanent structures to which raceway is mounted shall be finished complete.

3.02 Installation

.1 Mount base and cover together to wall or structure using the appropriate fasteners and clips, per manufacturer's instructions.

.2 Securely support raceway in intervals not exceeding 3 m (10 feet) or per manufacturer's instructions.

.3 Install fittings and device boxes in the specified locations, per manufacturer's instructions and per contract drawing specifications.

.4 Completed raceway installation shall be mechanically continuous and connected to all electrical outlets, device boxes, and enclosures with no gaps or exposed cuts.

.5 Provide insulated ground wire for power raceways per OESC requirements. Raceway shall not be used as the primary ground path.

.6 Prior to wire and cable installation, the raceway system shall be installed complete, including insulating bushings, adapters, fittings, outlets, boxes, and enclosures. Unused raceway openings shall be closed.

.7 Make wiring connections with the proper approved insulated wire connectors or lugs. Exposed conductors at harness wiring junctions are not permitted regardless of connection method.

.8 Provide a physical barrier in raceway and boxes to separate power and communication wiring.

.9 Install covers on raceway, boxes and fittings after wiring is complete, or if wire and cable installation is to be done at a later date.

3.03 Field Quality Control

.1 Verify layout of system to contract drawings.

.2 Raceway system shall be free of dents, scratches, bare metal edges, and exposed uneven cuts.

.3 Securely fasten all outlets, boxes, and enclosures walls or permanent structures.

.4 Verify that all wiring junctions or connections have no exposed conductors prior to energizing the circuits.

.5 Verify that all bonding locations are code and standards compliant.

.6 Verify that power and communications wiring are separated by a physical barrier in raceway and boxes.

End of Section

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1 General

1.01 Section Includes

.1 Cables installed in ducts.

.2 Direct buried cables.

1.02 Related Requirements

.1 Section 31 00 00 – Earthwork.

1.03 References

.1 CSA Group.

.2 Insulated Cable Engineers Association, Inc. (ICEA).

1.04 Submittals

.1 Submit records of underground utility locates, indicating location plan of existing utilities as found in field and clearance record from utility authority and location plan of relocated and abandoned services, as required.

1.05 Closeout Submittals

.1 Record documentation:

.1 Records of underground utility locates.

.2 Record as-constructed location of all underground conduits and feeders on as-built drawings regardless of conduit size.

.3 Hipot testing report.

2 Products

2.01 Fill Materials

.1 Sand fill: clean, natural sand and gravel material, free from silt, clay, loam, friable or soluble materials and vegetable matter.

.2 Backfill material: Selected material from excavation or other sources, reviewed by the Consultant, unfrozen and free from rocks larger than 75 mm (3 inch), rock with sharp angular surfaces, cinders, ashes, sods, refuse, or other deleterious materials.

2.02 Tracer Wire

.1 Direct burial rated tracer wire: single, solid copper, #12 AWG minimum size with 30 mm PVC jacket.

.1 Provide red jacket for circuits 120 V and higher.

.2 Provide orange jacket for communications conduits and services lower than 120 volt.

3 Execution

3.01 Excavation and Fill

.1 In accordance with Section 31 00 00.

.2 Trenching:

.1 Excavate to dimensions indicated. Ensure trench width is sufficient to accommodate mechanical vibratory compactor.

.2 Do not leave open trench at end of day's operation.

.3 Backfilling

.1 Do not proceed with backfilling operations until Electrical Inspection Authority has inspected and approved installation.

.4 Restoration

.1 Restore surface of work area to conditions existing prior to execution of work.

.2 After backfilling trench, provide new topsoil as required to follow minimum depths after settlement of 100 mm (4 inches) for grass seeded areas.

.3 Restore surface of paved areas to match existing.

3.02 Cable Installation in Ducts

.1 Install cables as indicated in ducts.

.2 Do not pull spliced cables inside ducts.

.3 Install multiple cables in duct simultaneously.

.4 Use CSA approved lubricants of type compatible with cable jacket to reduce pulling tension.

.5 To facilitate matching of colour coded multiconductor control cables reel off in same direction during installation.

.6 Before pulling cable into ducts and until cables are properly terminated, seal ends of lead covered cables with wiping solder; seal ends of non-leaded cables with moisture seal tape.

.7 After installation of cables, seal duct ends with duct sealing compound.

3.03 Direct Burial of Cable

.1 Provide sand bed as indicated.

.2 Lay cables maintaining 75 mm (3 inch) clearance from each side of trench to nearest cable. Do not pull cable into trench.

.3 Provide offsets for thermal action and minor earth movements. Offset cable 150 mm for each 60 m run, maintaining minimum cable separation and bending radius requirements.

.4 Install treated planks on cables for mechanical protection. Install above cables and below markers.

.5 Cable separation:

.1 Maintain 75 mm (3 inch) minimum separation between cables of different circuits.

.2 Maintain 300 mm (12 inch) horizontal separation between low and high voltage cables.

.3 When low voltage cables cross high voltage cables maintain 300 mm (12 inch) vertical separation with low voltage cables in upper position.

.4 At crossover, maintain 75 mm (3 inch) minimum vertical separation between low voltage cables and 150 mm between high voltage cables.

3.04 Markers

.1 Mark cable every 150 m along duct runs and changes in direction.

.2 Mark underground splices.

.3 Where markers are removed to permit installation of additional cables, reinstall existing markers.

.4 Install cedar post type markers.

.5 Lay concrete markers flat and centred over cable with top flush with finish grade.

.1 Where warning tape is used to comply with 2018 OESC Rule 12-012(11), bury the tape approximately halfway between the installation and grade level, covering the width of the raceways or cables installed, in accordance with OESC Bulletin 12-2-(latest version).

.2 Tracer wires:

.1 Provide direct burial rated tracer wire above all underground raceways and duct banks for power, control/monitoring, lighting and branch circuits, and communications raceways.

.2 Install tracer wire above the warning tape.

3.05 Field Quality Control

.1 Perform tests in accordance with Section 26 05 00.

.2 Perform tests using qualified personnel. Provide necessary instruments and equipment.

.3 Check phase rotation and identify each phase conductor of each feeder.

.4 Check each feeder for continuity, short circuits and grounds. Ensure resistance to ground of circuits is not less than 50 megohms.

.5 Pre-acceptance tests:

.1 After installing cable but before splicing and terminating, perform insulation resistance test with 1000 V megger on each phase conductor.

.2 Check insulation resistance after each splice and/or termination to ensure that cable system is ready for acceptance testing.

.6 Acceptance Tests:

.1 Ensure that terminations and accessory equipment are disconnected.

.2 Ground shields, ground wires, metallic armour and conductors not under test.

.3 High Potential (Hipot) Testing.

.1 Conduct hipot testing in accordance with manufacturer's recommendations.

.7 Provide Owner with list of test results showing location at which each test was made, circuit tested and result of each test.

.8 Non-Conforming Work: Remove and replace entire length of cable if cable fails to meet any of test criteria.

3.06 Waste Management

.1 Remove from site and dispose of all packaging materials at appropriate recycling facilities.

.2 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard, packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.

.3 Do not dispose of unused material into sewer system, into streams, lakes, onto ground or in other location where it will pose health or environmental hazard.

.4 Divert unused metal and wiring materials from landfill to metal recycling facility.

.5 Do not dispose of preservative treated wood through incineration.

.6 Do not dispose of preservative treated wood with other materials destined for recycling or reuse.

.7 Dispose of treated wood, end pieces, wood scraps and sawdust at sanitary landfill.

.8 Fold up metal banding, flatten and place in designated area for recycling.

End of Section

1 General

1.01 Section Includes

.1 Sleeves, sealing of sleeves and openings, as required for all electrical work.

1.02 Submittals

.1 Submit data sheets for firestopping in accordance with Section 01 33 00.

.2 Submit copies of firestopping drawings with ULC certificate and system number for each specific installation.

.3 Submit schedule of opening locations and sizes, penetrating items, and required listed design numbers to seal openings to maintain fire resistance ratings.

.4 Submit dimensioned location drawings indicating required sleeves and formed openings in structural poured concrete or precast concrete construction or in roofing, and locations of cutting or drilling required for Electrical work.

2 Products

2.01 Sleeves

.1 Galvanized steel sleeves:

.1 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.

2.02 Sleeve Seals

.1 Manufacturers

.1 Hilti Canada.

.2 Specified Technologies Inc.

.3 3M Canada Inc.

.4 Tremco.

.5 A/D Fire Protection Systems.

.6 Nelson.

.7 Approved equal.

.2 Asbestos-free, elastomeric materials and intumescent materials, tested, listed and labelled by ULC in accordance with CAN/ULC-S115, and CAN/ULC-S101 for installation in ULC designated firestopping, and smoke seal systems to provide a positive fire, water and smoke seal and a fire resistance rating (flame, hose stream and temperature) no less than fire rating for surrounding construction.

.3 Materials are to be compatible with abutting dissimilar materials and finishes and complete with primers, damming and back-up materials, supports, and anchoring devices in accordance with firestopping manufacturer's recommendations and ULC tested assembly. Coordinate material requirements with trades supplying abutting areas of materials.

.4 Maintain fire rating of separation in accordance with architectural drawings.

3 Execution

3.01 Installation

.1 Where conduits and conductors pass through structural poured concrete, provide sleeves of type suitable for application, and approved by local governing codes.

.2 Sleeves in concrete slabs, except as noted below, are to be 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 Through interior walls, use standard weight steel pipes, conduit, or galvanized steel. Cut flush with finished surfaces. Check room finish schedules.

.6 Through exterior walls above grade, floors, and roof use standard weight steel pipes, machine cut, flush with finished surface inside and to suit flashing outside.

.7 Through exterior walls below grade, water-proofed floors, and other water-proof walls, use heavy weight cast iron pipes, machine cut. Extend sleeves 100 mm (4") above finished floors, and cut flush with underside of floor.

.8 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 entitled "Sleeve Seals" specified in this Section. Pack and seal sleeves set in exterior walls with governing authority approved materials suitable for application and pack both ends of sleeves watertight with approved permanently flexible and water tight materials. Coordinate exact responsibility of work with General Trades Contractor.

.9 Submit to concrete reinforcement detailer at proper time, drawings indicating required sleeves, recesses and formed openings in poured concrete work. Completely and accurately dimension such drawings and relate sleeves, recesses and formed openings to suitable grid lines and elevation datum.

.10 Supply sleeves of a water protecting type in accordance with detail found on drawings for installation in following locations:

.1 in Mechanical and Fan Room floor slabs, except where on grade;

.2 in slabs over Mechanical, Fan, Electrical and Telephone Equipment Rooms or closets;

.3 in floors equipped with waterproof membranes.

.11 "Gang" type sleeving to be permitted only with approval of Owner and reviewed with the Consultant.

.12 Terminate sleeves for work which is exposed, so that sleeve is flush at both ends with wall, partition, or slab surface such that sleeve may be covered completely by escutcheon plates.

.13 Sleeves are not required in interior walls and dry area floors where conduit is installed ahead of floor construction.

.14 Seal all openings and sleeves after installation of equipment:

.1 With an approved material to maintain fire rating where sleeves and openings pass through fire separations and floors.

.2 With an approved material to maintain fire rating for sleeves and openings provided for future equipment.

.1 Flash all conduits and systems passing through roof or built into an outside wall, or a waterproof floor.

.2 Provide copper flashing for sleeves passing through exterior walls or waterproof floors.

.15 Provide all flashing and waterproofing for sleeves through roof and exterior walls to the requirements of Division 07.

.16 Firestop sleeves in accordance with the manufacturer's specifications and recommendations.

End of Section

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1 General

1.01 Section Includes

.1 Tested firestop systems used in penetrations for the passage of cables, conduit, and other electrical equipment through fire-rated vertical barriers (walls and partitions), horizontal barriers (floor/ceiling assemblies), and vertical service shaft walls and partitions.

1.02 Related Requirements

.1 Coordinate work of this section with work of other sections as required to properly execute the work and as necessary to maintain satisfactory progress of the work of other sections, including:

.1 Section 07 85 00 – Firestopping and Smoke Seals.

.2 Section 27 05 44 – Sleeves and Sleeve Seals for Communications Pathways and Cabling.

1.03 References

.1 Underwriter's Laboratories (UL) and Underwriters Laboratories of Canada (ULC):

.1 Test Requirements: CAN/ULC-S115:2018, Standard Method of Fire Tests of Firestop Systems.

.2 Underwriters Laboratories of Canada (ULC) runs CAN/ULC-S115:2018 under their designation of ULC-S115:2018 and publishes the results in their "FIRE RESISTANCE RATINGS DIRECTORY" that is updated annually.

.3 Underwriters Laboratories (UL) of Northbrook, IL runs ASTM E-814 under their designation of UL 1479 and publishes the results in their "FIRE RESISTANCE DIRECTORY" that is updated annually. UL tests that meet the requirements of ULC-S115-M are given a cUL listing and are published by UL in their "Products Certified for Canada (cUL) Directory.

.4 CAN/ULC-S102:2018, Standard Test Method for Surface Burning Characteristics of Building Materials and CAN/ULC-S101 Fire Endurance Tests of Building Construction and Materials.

.2 ASTM:

.1 Omega Point Laboratories runs ASTM E-814 and publishes the results annually in their "Omega Point Laboratories Directory".

.2 Inspection Requirements: ASTM E 2174, "Standard Practice for On-site Inspection of Installed Fire Stops.", and ASTM E2393 Standard Practice for On-Site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barriers.

.3 Test Requirements: ASTM E 2307, "Standard Test Method for Determining Fire Resistance of Perimeter Fire Barrier Systems Using Intermediate-Scale, Multi-story Test Apparatus".

.4 ASTM D6904, "Standard Practice for Resistance to Wind Driven Rain for Exterior Coatings Applied on Masonry".

.5 ASTM C 679, "Standard Test Method for Tack-Free Time of Elastomeric Sealants".

.3 International Firestop Council Guidelines for Evaluating Firestop Systems Engineering Judgments.

.4 Ontario Building Code.

.5 Ontario Electrical Safety Code.

1.04 Definitions

.1 Firestopping: Material or combination of materials used to retain integrity of fire-rated construction by maintaining an effective barrier against the spread of flame, smoke, and hot gases through penetrations in fire rated wall and floor assemblies.

1.05 Submittals

.1 Submit Product Data: Manufacturer's specifications and technical data for each material including the composition and limitations, documentation of ULC or cUL firestop systems to be used and manufacturer's installation instructions to comply with Section 01 33 00.

.2 Manufacturer's engineering judgment identification number and drawing details when no ULC or cUL system is available for an application. Engineered judgment must include both project name and contractor's name who will install firestop system as described in drawing.

.3 Submit material safety data sheets provided with product delivered to job-site.

.4 Submit shop drawings in accordance with Section 01 33 00:

.1 Submit complete cUL, ULC, or equivalent approved systems for all applications. Ensure the listing is clearly noted on the submittal.

1.06 Closeout Submittals

.1 On completion of firestopping and smoke sealing installation, submit a Letter of Assurance to the Consultant certifying the firestopping and smoke sealing installation has been carried out throughout the building to electrical service penetrations and that installation has been done in strict accordance with requirements of the Ontario Building Code, any applicable municipal bylaws, ULC requirements, and manufacturer's instructions.

1.07 Quality Assurance

.1 Fire-Test-Response Characteristics: Provide through-penetration fire stop systems and fire-resistive joint systems that comply with specified requirements of tested systems.

.2 Firestop System installation must meet requirements of CAN/ULC-S115 tested assemblies that provide a fire rating as shown in Section 2.1 Clauses 4, 5, 6, and 7 below.

.3 Proposed firestop materials and methods shall conform to applicable governing codes having local jurisdiction.

.4 Firestop Systems do not re-establish the structural integrity of load bearing partitions/assemblies, or support live loads and traffic. Installer shall consult the structural engineer prior to penetrating any load bearing assembly.

.5 For those firestop applications that exist for which no ULC or cUL tested system is available through a manufacturer, a manufacturer's engineering judgment derived from similar ULC or cUL system designs or other tests will be submitted to local authorities having jurisdiction for their review and approval prior to installation. Engineering judgment drawings must follow requirements set forth by the International Firestop Council.

1.08 Installer Qualifications

.1 Engage an experienced Installer who is certified, licensed, or otherwise qualified by the firestopping manufacturer as having the necessary training to install manufacture's products per specified requirements. A supplier's willingness to sell its firestopping products to the Contractor or to an Installer engaged by the Contractor does not in itself confer qualification on the buyer.

.2 Installation Responsibility: assign installation of through-penetration fire stop systems and fire-resistive joint systems in Project to a single sole source firestop specialty contractor.

.3 The work is to be installed by a contractor with at least one of the following qualifications:

.1 FM 4991 approved contractor.

.2 UL approved contractor.

.3 Manufacturer's accredited fire stop specialty contractor.

.4 Installer: Minimum 3 years experience with fire stop installation.

1.09 Delivery, Storage, and Handling

.1 Deliver materials undamaged in manufacturer's clearly labeled, unopened containers, identified with brand, type, and ULC or cUL label where applicable.

.2 Coordinate delivery of materials with scheduled installation date to allow minimum storage time at job-site.

.3 Store materials under cover and protect from weather and damage in compliance with manufacturer's requirements.

.4 Comply with recommended procedures, precautions or remedies described in material safety data sheets as applicable.

.5 Do not use damaged or expired materials.

1.10 Project Conditions

.1 Do not use materials that contain flammable solvents.

.2 Scheduling

.1 Schedule installation of CAST IN PLACE firestop devices after completion of floor formwork, metal form deck, or composite deck but before placement of concrete.

.2 Schedule installation of Drop-In firestop devices after placement of concrete but before installation of the pipe penetration. Diameter of sleeved or cored hole to match the listed system for the device.

.3 Schedule installation of other firestopping materials after completion of penetrating item installation but prior to covering or concealing of openings.

.3 Verify existing conditions and substrates before starting work. Correct unsatisfactory conditions before proceeding.

.4 Weather conditions: Do not proceed with installation of firestop materials when temperatures exceed the manufacturer's recommended limitations for installation printed on product label and product data sheet.

.5 During installation, provide masking and drop cloths to prevent firestopping materials from contaminating any adjacent surfaces.

2 Products

2.01 Performance Requirements

.1 Provide firestopping composed of components that are compatible with each other, the substrates forming openings, and the items, if any, penetrating the firestopping under conditions of service and application, as demonstrated by the firestopping manufacturer based on testing and field experience.

.2 Provide components for each firestopping system that are needed to install fill material. Use only components specified by the firestopping manufacturer and approved by the qualified testing agency for the designated fire-resistance-rated systems.

.3 Provide a round fire-rated cable management device whenever cables penetrate fire rated walls, where frequent cable changes and additions may occur. The fire-rated cable management device shall consist of a corrugated steel tube with zinc coating, contain an inner plastic housing, intumescent material rings, and inner fabric smoke seal membrane. The length of the sleeve shall be 315 mm (12.4 inches). The fire-rated cable management device shall contain integrated intumescent firestop wrap strip materials sufficient to maintain the hourly rating of the barrier being penetrated. The fire-rated cable management device shall contain a smoke seal fabric membrane or intumescent firestop plugs sufficient to achieve the L-Rating requirements of the barrier type. Install device per the manufacturer's published installation instructions.

.4 Penetrations in Horizontal Assemblies: Provide firestopping with ratings determined in accordance with CAN/ULC-S115. For penetrations through a Fire Wall or horizontal Fire Separation provide a firestop system with a "FT" Rating as determined by ULC or cUL which is equal to the fire resistance rating of the construction being penetrated.

.5 W-ratings: in accordance with Section 07 85 00.

.6 Provide a firestop system with an Assembly Rating as determined by CAN/ULC-S115 which is equal to the time rating of construction joint assembly.

.7 Penetrations in Smoke Barriers: Provide firestopping with ratings determined in accordance with CAN/ULC-S115.

.1 L-Rating: Not exceeding 5.0 CFM/sqft of penetration opening at both ambient and elevated temperatures.

.8 Mold Resistance: Provide penetration firestopping with mold and mildew resistance rating of 0 as determined by ASTM G21.

.9 Rain and water resistance: provide perimeter joint sealant tested in accordance with ASTM D 6904 with less than 1 hour tack free time as tested in accordance with ASTM C 679.

2.02 Manufacturers

.1 Manufacturer List:

.1 AD Fire Protection Systems.

.2 Hilti (Canada) Corporation

.3 3M.

.4 Specified Technologies, Inc. (STI).

.5 Tremco, Inc.

.2 Substitutions: Where a specific manufacturer is noted in this Section, equivalent products from the manufacturers listed above may be used, subject to compliance with through penetration firestop systems and joint systems listed in the ULC Fire Resistance Directory – Volume III, or UL Products Certified for Canada (cUL) Directory.

2.03 Materials

.1 Use only firestop products that have been ULC or cUL tested for specific fire-rated construction conditions conforming to construction assembly type, penetrating item type, annular space requirements, and fire-rating involved for each separate instance.

.2 Accessories: provide components for each firestopping and smoke seal systems that are needed to install fill materials. Use only components specified by firestopping material manufacturer, and approved by the qualified testing agency. Accessories include, but are not limited to, the following items:

.1 Permanent forming, damming and backing material.

.2 Temporary forming material.

.3 Pre-formed firestop devices for use with non-combustible and combustible pipes (closed and open systems), conduit and/or cable bundles penetrating concrete floors and/or gypsum walls:

.1 Hilti Tub Box Kit (CP 681) for use with tub installations.

.2 Hilti Cast-In Place Firestop Device (CP 680-PX) for use with XFR pipe.

.3 Hilti Cast-In Place Firestop Device (CP 680-M) for use with non-combustible penetrants.

.4 Hilti Speed Sleeve (CP 653) for use with cable penetrations.

.5 Hilti Firestop Drop-In Device (CFS-DID) for use with non-combustible and combustible penetrants.

.6 Hilti Cast-in Firestop sleeve (CFS-CID MD P) and (CFS-CID MD M) for use with combustible and non-combustible pipes through metal deck.

.7 Hilti Firestop Block (CFS-BL).

.8 STI SpecSeal series SSC Firestop Collars.

.9 STI SpecSeal series LCC Firestop Collars.

.4 Sealants or caulking materials for use with non-combustible items including steel pipe, copper pipe, rigid steel conduit and electrical metallic tubing (EMT).

.1 Hilti Intumescent Firestop Sealant (FS-ONE MAX).

.2 Hilti Fire Foam (CP 620)/CP 660.

.3 Hilti Flexible Firestop Sealant (CP 606).

.4 Hilti Firestop Silicone Sealant Gun Grade (CFS-S SIL GG).

.5 Hilti Firestop Silicone Sealant Self Leveling (CFS-S SIL SL).

.5 Intumescent sealants or caulking materials for use with combustible items (penetrants consumed by high heat and flame) including insulated metal pipe, PVC jacketed, flexible cable or cable bundles and plastic pipe.

.1 Hilti Intumescent Firestop Sealant (FS-ONE MAX).

.6 Foams, intumescent sealants, or caulking materials for use with flexible cable or cable bundles.

.1 Hilti Intumescent Firestop Sealant (FS-ONE MAX).

.2 Hilti Fire Foam (CP 620)/660.

.3 Hilti Flexible Firestop Sealant (CP 606).

.4 Hilti Firestop Silicone Sealant Gun Grade (CFS-S SIL GG).

.5 Hilti Firestop Silicone Sealant Self Leveling (CFS-S SIL SL).

.7 Firestop Putty Pads: Intumescent, non-hardening putty pads to be installed on metallic and non-metallic electrical switch and receptacle boxes to reduce horizontal separation between boxes to less than 610 mm (24 in):

.1 STI SpecSeal Series SSP Firestop Putty Pads.

.2 Hilti Firestop Putty Pad (CP 617).

.8 Materials used for large size/complex penetrations made to accommodate cable trays, multiple steel and copper pipes, electrical busways in raceways.

.1 Hilti Firestop Block (CFS-BL).

.2 Hilti Composite Sheet (CFS-COS).

.3 Hilti Firestop Mortar (CP 637).

.4 Hilti Fire Foam (CP 620)/660.

.5 Hilti Firestop Board (CP 675T).

.9 Non-curing, re-penetrable materials used for large size/complex penetrations made to accommodate cable trays, multiple steel and copper pipes, electrical busways in raceways.

.1 Hilti Firestop Block (CFS-BL).

.2 Hilti Firestop Board (CP 675T).

.10 Re-penetrable, round cable management devices for use with new or existing cable bundles penetrating gypsum or masonry walls.

.1 Hilti Speed Sleeve (CP 653) with integrated smoke seal fabric membrane.

.2 Hilti Firestop Cable Collar (CFS-CC).

.3 Hilti Firestop Sleeve (CFS-SL SK).

.4 Hilti Retrofit Sleeve (CFS-SL RK) for use with existing cable bundles.

.5 Hilti Gangplate (CFS-SL GP) for use with multiple cable management devices.

.6 Hilti Gangplate Cap (CFS-SL GP CAP) for use at blank openings in gangplate for future penetrations.

.11 For blank openings made in fire-rated wall or floor assemblies, where future penetration of pipes, conduits, or cables is expected.

.1 Hilti CFS-BL Firestop Block (for walls and floors).

.2 Hilti CFS-PL Firestop Plug (for walls and floors).

.12 Cast-In-Place Firestop Device: Single component molded firestop device installed on forms prior to concrete placement with totally encapsulated, tamper-proof integral firestop system and smoke sealing gasket. Device shall allow for a concrete floor thickness of minimum 63 mm (2-1/2 in) up to 914 mm (36 in) without the use of field applied extension tubing:

.1 STI SpecSeal CID Cast-In Firestop Device.

.2 Hilti CP 680 Cast-In Place Firestop Device (for floors only).

.13 For single or cable bundles up to one inch diameter penetrating gypsum, masonry, concrete walls or wood floor assemblies.

.1 Hilti CFS-D Firestop Cable Disc.

3 Execution

3.01 Installers

.1 Labour Use to Install Firestop Systems

.1 To ensure complete harmony on the project site, the installation of each scope of work is to be performed jurisdictionally correct per existing trade agreements.

3.02 Preparation

.1 Verification of Conditions: Examine areas and conditions under which work is to be performed and identify conditions detrimental to proper or timely completion.

.1 Verify penetrations are properly sized and in suitable condition for application of materials.

.2 Surfaces to which firestop materials will be applied shall be free of dirt, grease, oil, rust, laitance, release agents, water repellents, and any other substances that may affect proper adhesion.

.3 Provide masking and temporary covering to prevent soiling of adjacent surfaces by firestopping materials.

.4 Comply with manufacturer's recommendations for temperature and humidity conditions before, during and after installation of firestopping.

.5 Do not proceed until unsatisfactory conditions have been corrected.

3.03 Coordination

.1 Coordinate construction of openings, penetrations to ensure that the fire stop systems are installed according to specified requirements.

.2 Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate through-penetration fire stop systems.

.3 Coordinate fire stopping with other trades so that obstructions are not placed in the way prior to the installation of the fire stop systems.

.4 Do not cover up through-penetration fire stop and joint system installations that will become concealed behind other construction until each installation has been examined by the building inspector.

3.04 Installation

.1 Regulatory Requirements: Install firestop materials in accordance with ULC Fire Resistance Directory or UL Products Certified for Canada (cUL) Directory or Omega Point Laboratories Directory.

.2 Manufacturer's Instructions: Comply with manufacturer's instructions for installation of through-penetration and construction joint materials.

.1 Seal all holes or voids made by penetrations to ensure an air and water-resistant seal.

.2 Consult with mechanical engineer, project manager, and damper manufacturer prior to installation of ULC or cUL firestop systems that might hamper the performance of fire dampers as it pertains to duct work.

.3 Protect materials from damage on surfaces subjected to traffic.

3.05 Field Quality Control

.1 Examine sealed penetration areas to ensure proper installation before concealing or enclosing areas.

.2 Keep areas of work accessible until inspection by applicable code authorities.

.3 Inspection of through-penetration firestopping shall be performed in accordance with ASTM E 2174, "Standard Practice for On-Site Inspection of Installed Fire Stops", or other recognized standard.

.4 Perform under this section patching and repairing of firestopping caused by cutting or penetrating of existing firestop systems already installed by other trades.

.5 Manufacturer's Field Services: During Installation, provide periodic destructive testing inspections to assure proper installation/application. After installation is complete, submit findings in writing indicating whether or not the installation of the tested system identified was installed correctly.

3.06 Identification and Documentation

.1 The firestop contractor is to supply documentation for each single application addressed. This documentation is to identify each penetration location on the entire project.

.2 The Documentation Form for through penetrations is to include:

.1 A Sequential Location Number.

.2 The Project Name.

.3 Date of Installation.

.4 Detailed description of the penetration location.

.5 Tested System or Engineered Judgment Number.

.6 Type of assembly penetrated.

.7 A detailed description of the size and type of penetrating item.

.8 Size of opening.

.9 Number of sides of assemblies addressed.

.10 Hourly rating to be achieved.

.11 Installer's Name.

.3 Copies of these documents are to be provided to the general contractor at the completion of the project.

.4 Identify through-penetration firestop systems with pressure-sensitive, self-adhesive, preprinted vinyl labels. Attach labels permanently to surfaces of penetrated construction on both sides of each firestop system installation where labels will be visible to anyone seeking to remove penetrating items or firestop systems. Include the following information on labels:

.1 The words: "Warning-Through Penetration Firestop System-Do Not Disturb. Notify Building Management of Any Damage."

.2 Contractor's Name, address, and phone number.

.3 Through-Penetration firestop system designation of applicable testing and inspecting agency.

.4 Date of Installation.

.5 Through-Penetration firestop system manufacturer's name.

.6 Installer's Name.

3.07 Adjusting and Cleaning

.1 Remove equipment, materials and debris, leaving area in undamaged, clean condition.

.2 Clean all surfaces adjacent to sealed holes and joints to be free of excess firestop materials and soiling as work progresses.

End of Section

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1 General

1.01 Section Includes

.1 This section provides minimum acceptance requirements for vibration isolation for all electrical equipment, conduit, and piping.

1.02 Related Requirements

.1 Concrete work is described in Division 03.

1.03 Submittals

.1 All vibration isolation systems shall be by one manufacturer.

.2 All outdoor mounted equipment shall be restrained for the highest wind speed as specified by the project's structural engineer, the governing building code(s) or the authority having jurisdiction.

.3 Submit shop drawings for all devices specified herein and as indicated and scheduled on the drawings. Submittals shall indicate full compliance with the device specification in Part 2. Any deviation shall be specifically noted and subject to engineer approval. Submittals shall include device dimensions, placement, attachment and anchorage requirements.

1.04 Quality Assurance

.1 Unless otherwise directed by the local authority having jurisdiction, the following codes and standards will apply:

.1 International Building Code 2009.

.2 American Society of Civil Engineers 7-05.

.3 Ontario Building Code, Latest Edition.

.2 Manufacturer's Qualifications: Firms regularly engaged in manufacture of vibration control products of type, size, and capacity required, whose products have been in satisfactory use in similar service for not less than 5 years.

2 Products

2.01 Manufacturers

.1 Vibro-Acoustics.

.2 Kinetics Noise Control.

.3 BVA Systems.

.4 Vibron Limited.

.5 Mason Industries.

2.02 Vibration Isolation

.1 Springs: All springs shall have a minimum additional travel to solid equal to 50% of the rated deflection. All springs except internal nested springs shall have an outside diameter not less than 0.8 of the compressed height of the spring. Ends of springs shall be square and ground for stability. Laterally stable springs shall have kx/ky ratios of at least 0.9. All springs shall be fully color-coded to indicate capacity – color striping is not considered adequate.

.2 Corrosion Protection: All springs shall be powder-coated enamel. Housings shall be hot dipped galvanized, powder-coated enamel, or painted with rust-resistant paint.

.3 Isolators:

.1 Vibration Isolation Pads: Type N – Neoprene pad type isolators, 3/8" (10 mm) minimum thick, ribbed on both sides.

.1 Type NSN – Sandwich neoprene pad type isolators, with 3/8" (10 mm) minimum thick ribbed neoprene pads bonded to each side of a 10 ga (3.5 mm) minimum galvanized metal plate. Isolator pads shall be selected to ensure that deflection does not exceed 20% of isolator free height.

.2 Rubber-in-Shear Floor Mounts: Type RD – "Double-deflection" neoprene isolators, with neoprene-coated metal surfaces, and top and bottom surfaces ribbed. Isolators shall have bolt holes in the base.

.3 Restrained Spring Floor Mounted Isolators: Type CSR – Laterally stable, vertically restrained spring isolators with welded steel housings and heavy top plates for supporting equipment. Springs shall be supported either with a neoprene cup or a metal base plate complete with a ribbed neoprene pad, minimum 1/4" (6 mm) thick, bonded to the base plate. Housings shall include vertically restraining limit stops. Minimum clearance around the restraining bolts and between the housing and the spring shall be 1/2" (13 mm). Top plate and restraining bolts shall be out of contact with the housing during normal operation and neoprene grommets shall be incorporated to minimize short-circuiting of restraining bolts. For outdoor applications, housing must be hot-dip galvanized. For indoor applications, powder-coated finish for the housing is acceptable.

3 Execution

3.01 General

.1 Coordinate size, doweling, and reinforcing of concrete equipment housekeeping pads and piers with vibration isolation manufacturer to ensure adequate space and prevent edge breakout failures. Pads and piers must be adequately doweled in to structural slab.

.2 Coordinate locations and sizes of structural supports with locations of vibration isolators (e.g., roof curbs, cooling towers, air-cooled chillers, etc.).

.3 Isolated equipment, duct and piping located on roofs must be attached to the structure. Intermediate supports between the restraint and structure that are not attached to the structure must be approved by the restraint manufacturer.

3.02 Vibration Isolation

.1 Ensure housekeeping pads have adequate space to mount equipment and isolator housings and shall also be large enough to ensure adequate edge distance for isolator anchors.

.2 Select and locate vibration isolation equipment to give uniform loading and deflection, according to weight distribution of equipment.

.3 Engine-generator set silencers and associated exhaust piping shall be supported with Type SHR isolators with a minimum 40 mm (1-1/2 inch) static deflection.

.4 Equipment Isolation:

						Floor Span								
			Slab on Grade			**Up to 20 ft.**			**20 to 30 ft.**			**30 to 40 ft.**		
Eqmt Type	**HP and Other**	**RPM**	**Base Type**	**Isolator Type**	**Min. Defl., in.**	**Base Type**	**Isolator Type**	**Min. Defl., in.**	**Base Type**	**Isolator Type**	**Min. Defl., in.**	**Base Type**	**Isolator Type**	**Min. Defl., in.**
Transformers and UPS's														
All	All	All	N/A	NSN	0.12	N/A	NSN	0.12	N/A	NSN	0.12	NM	RD/NSN	0.25
Engine-Driven Generators														
All	All	All	N/A	CSR	0.75	N/A	CSR	1.50	N/A	CSR	2.50	N/A	CSR	3.50
Notes: (1) Units that are suspended overhead shall use isolation hangers in place of floor mounted isolators with equal or greater deflection. (2) Floor spans are defined as the distance between structural support columns or walls.														

.5 There shall be no rigid contact of isolated equipment with shaft walls, floor slabs, partitions, or non-flexible conduits connections.

.6 Where recommended by the manufacturer, isolator base plates shall be bolted to the structure or foundation. Bolting shall incorporate neoprene bushings and washers.

3.03 Site Tests and Inspections

.1 After installation, arrange and pay for the vibration isolation product manufacturer, or representative, to visit the site to verify that the vibration isolation systems are installed and operating properly, and shall submit a certificate so stating. Verify that isolators are adjusted, with springs perpendicular to bases or housing, adjustment bolts are tightened up on equipment mountings, and hangers are not cocked.

End of Section

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1 General

1.01 Section Includes

.1 Nameplates and labels.

.2 Wire and cable markers.

.3 Conduit markers.

.4 Receptacle labels.

.5 Signage.

1.02 Related Requirements

.1 Section 27 05 53 – Identification for Communications Systems.

1.03 Submittals

.1 Product Data: Provide catalogue data for nameplates, labels, and markers.

.2 Provide shop drawings of nameplates for Consultant's review prior to fabrication (scale 1:1).

.3 Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under regulatory requirements. Include instructions for storage, handling, protection, examination, preparation and installation of Product.

1.04 Regulatory Requirements

.1 Provide products listed and classified by CSA (Canadian Standards Association) as suitable for the purpose specified and indicated.

2 Products

2.01 Nameplates and Labels

.1 Nameplates:

.1 Engraved three-layer laminated plastic, letters on contrasting background.

.2 Colours to match existing building system, where applicable. If no building system exists, use the following:

.1 347/600 Volt system: White text on Blue Background.

.2 120/208 Volt system: Black text on White Background.

.3 Emergency power system: Red text on White Background.

.4 120/208 Volt Uninterruptable Power Supply (UPS): White text on Orange Background.

.5 Fire alarm system: White text on Red Background.

.6 Communications systems: White text on Green Background.

.7 Access Control, Intrusion Detection, CCTV: White text on Purple Background.

.3 Confirm colours with the Consultant prior to ordering nameplates.

.2 Equipment Nameplates to indicate:

.1 Equipment/Panelboard ID

.2 Ampacity.

.3 Voltage

.4 Number of Phases

.5 Number of wires in system

.6 Interrupting Capacity

.7 Size, number of poles, Panelboard ID, and circuit number of upstream overcurrent protection device.

.1 Location of upstream device if not in the same room.

.3 Coordination Study Labels to Section 26 05 73.16.

.4 Arc Flash Study Labels to Section 26 05 73.19.

.5 Locations:

.1 Distribution panelboards, and individual distribution panelboard branch breakers.

.2 Receptacle panelboards.

.3 Each electrical distribution and control equipment enclosure.

.4 Uninterruptible Power Supply.

.5 Mechanical Equipment.

.6 UPS Receptacles.

.7 Disconnects, starters and contactors: indicate equipment being controlled and voltage.

.8 Terminal cabinets, junction boxes, and pull boxes: indicate system and voltage.

.9 Transformers: indicate capacity, primary and secondary voltages.

.6 Letter Size:

.1 Use 3 mm letters for identifying individual equipment and loads.

.2 Use 6 mm letters for identifying grouped equipment and loads.

.7 Labels:

.1 Mechanically fastened with sheet metal screws, with 5 mm white letters on black background.

.2 White letters on red background for UPS and equipment, and devices downstream of UPS.

.3 Labels: embossed plastic labels with 6 mm high letters unless specified otherwise.

.4 Wording on nameplates and labels to be reviewed by the Consultant prior to manufacturing.

.5 Allow for minimum of twenty-five (25) letters per nameplate and label.

.6 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.

.7 Terminal cabinets and pull boxes: indicate system and voltage.

2.02 Wiring Identification

.1 Identify wiring with permanent indelible identifying markings, numbered, on both ends of phase conductors of feeders and branch circuit wiring.

.2 Maintain phase sequence and colour coding throughout.

.3 Colour coding: to CSA C22.1.

.4 Use colour coded wires in communication cables, matched throughout system.

2.03 Wire Markers

.1 Description: tape, split sleeve, or tubing type wire markers.

.2 Locations: Each conductor at panelboard gutters, pull boxes, outlet and junction boxes and each load connection.

.3 Legend:

.1 Power and Lighting Circuits: Branch circuit or feeder number indicated on drawings.

.2 Control Circuits: Control wire number indicated on shop drawings.

2.04 Conduit and Box Markers

.1 Colour code conduits, boxes and metallic sheathed cables.

.2 Location: Provide markers for each conduit longer than 2 m.

.3 Code with plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor, and at 15 m intervals.

.4 Colours to match equipment nameplate background colour:

.1 347/600 Volt system: Blue.

.2 120/208 Volt system: Black.

.3 120/208 Volt Uninterruptable Power Supply (UPS): Orange.

.4 Emergency Power system: Red/White.

.5 Fire Alarm system: Red.

.6 Communications systems: Green.

.7 Access Control, Intrusion Detection, CCTV: Purple.

.5 Confirm colours with the Consultant prior to commencing rough-in.

2.05 Junction and Pull Boxes

.1 Clearly identify main pull or junction boxes (excluding obvious outlet boxes) by painting outside of covers.

.2 Spray painting: not permitted.

.3 Paint colours to be in accordance with following schedule:

.1 Lighting: yellow.

.2 Normal power: blue.

.3 Emergency power: orange.

.4 Fire alarm: red.

.5 Communications systems including telephone and data: green.

.6 Miscellaneous signals: brown.

.4 In addition to painting miscellaneous signal boxes, clearly identify specific system in which box is installed. Identify source panelboard for power circuits.

2.06 Branch Breaker Labels

.1 General:

.1 Legibly identify every circuit and circuit modification as to its clear, evident, and specific purpose or use. Include sufficient detail to allow each circuit to be distinguished from all others.

.2 Label spare positions that contain unused overcurrent devices or switches.

.3 Do not describe any circuit in a manner that depends on transient conditions of occupancy.

.2 Switchboards, distribution panelboards, enclosed breakers, and disconnect switches:

.1 Locate identification at each switch.

.2 Branch breaker nameplates on switchboards, distribution panelboards and switchboards, and generator load breakers to indicate:

.1 Locate identification at each switch on a switchboard.

.2 Identification of downstream equipment fed from the breaker.

.1 Location of downstream device if not in the same room.

.3 Breaker size and number of poles.

.4 Interrupting Capacity.

.5 Circuit number (where applicable).

.6 Do not describe any circuit in a manner that depends on transient conditions of occupancy.

.3 Lighting and Receptacle Panelboards:

.1 Provide a circuit directory that is located on the face or inside of the panel door.

.2 Do not describe any circuit in a manner that depends on transient conditions of occupancy.

2.07 Receptacle Labels

.1 Label all receptacles with the panelboard ID and circuit number.

.2 Use receptacle labels by electronic labeller Brother P-Touch, model PT-20/25, Dymo-Tape or approved equal.

.3 Location: On receptacle wall plate.

3 Execution

3.01 Equipment Nameplates from Manufacturers

.1 Ensure manufacturer's nameplates, CSA labels and identification nameplates are visible and legible after equipment is installed.

.2 Manufacturers' nameplates and CSA labels are to be visible and legible after equipment is installed. Provide warning signs, as specified, or to meet requirements of Inspection Department, Health and Safety, and the Consultant.

.3 Label power outlets with circuit identification on visible portion of faceplate or surface mounted outlet box.

3.02 Conduit and Box Identification

.1 Locate labels as follows:

.1 At every end of every conduit, duct or cable run, adjacent to item of equipment serviced.

.2 On each exposed conduit, duct or cable passing through a wall, partition or floor (one on each side of such wall partition or floor).

.3 At intervals of 15 m (50'-0") along every exposed conduit, duct or cable run exceeding 15 m (50 feet) in length.

.4 At every access point on concealed conduit duct or cable.

.5 At each junction box.

.2 Place labels so as to be visible from 1500 mm (5'-0") above adjacent floor platform.

3.03 Preparation

.1 Degrease and clean surfaces to receive nameplates and labels.

3.04 Application

.1 Confirm colours prior to start of work.

.2 Install nameplate and label parallel to equipment lines.

.3 Secure nameplate to equipment front using adhesive.

.4 Secure nameplate to inside surface of door on panelboard that is recessed in finished locations.

.5 Identify conduit using field painting.

.6 Paint coloured band on each conduit longer than 2 m.

.7 Paint bands 6 m on centre.

3.05 Labelling

.1 Colour code wiring consistently throughout the installation and generally match colour coding of internal wiring of pre-wired components.

.2 Label wiring with point name using Thomas & Betts 12 character polestar metalized labels with 3 rows of characters per label, or equal by Brady. Label to occur as a minimum at both ends and at pull boxes of the wiring run.

.3 Identify all pull boxes, junction boxes, etc. (installed as part of this project or used by this project) with the exact use of the box. Indelible felt pen marker is acceptable.

.4 Label light control items with point name using Thomas & Betts 12 character label, or equal by Brady. Label to be black lettering on clear backing.

.5 Label relays and controllers inside panels using Thomas & Betts 12 character label, or equal by Brady.

.6 Provide red, 13 mm (1/2 inch) diameter, sticker on emergency light fixture frame. Include circuit number on sticker with thin permanent black mark pen.

3.06 Labels and Signs

.1 Manufacturers' nameplates and CSA labels are to be visible and legible after equipment is installed. Provide warning signs, as specified, or to meet requirements of Inspection Department, Health and Safety, and the Consultant.

.2 Label power outlets with circuit identification on visible portion of faceplate or surface mounted outlet box.

End of Section

1 General

1.01 Section Includes

.1 Provide a coordination study for the electrical distribution system. The basic analysis shall include a protective device evaluation, and a protective device coordination study.

.2 The project shall begin at the point of utility service for the facility and continue down through the system to all downstream distribution and branch panelboards, motor control centres and significant motor locations.

.3 The project shall include any new generators and any associated emergency power distribution equipment, including automatic transfer switches and generator ground fault protection.

1.02 Related Requirements

.1 Section 26 05 73.19 – Arc-Flash Hazard Analysis.

.2 Single Line Diagram.

1.03 Reference Standards

.1 Perform all studies in accordance with the latest applicable IEEE and ANSI standards.

1.04 Submittals

.1 Submit the following in accordance with Section 01 33 00:

.1 Submit for review three copies of the protection coordination study.

.2 Shop drawings for equipment affected by the coordination study will not be reviewed until the coordination study has been submitted and reviewed.

.3 Include a one-line diagram of the system.

.4 Bind the final report in a three-ring binder, as well as a soft copy.

.2 Projection System Coordination

.1 Prepare a graph or coordination curves, prior to manufacture of service entrance and distribution equipment on K & E No. 336E Time-Current characteristic graph paper. Time-current characteristics shall be plotted of the following:

.1 Supply Authorities relays or fuses protecting incoming service (Contractor under this section shall obtain this information).

.2 Main and feeder protective devices at every voltage level used in distribution system.

.3 Protective devices associated with largest motor and/or refrigeration compressor.

.2 Preliminary submission of graph for comment will be accepted. Submit graph to Supply Authority for approval by them as providing satisfactory co-ordination. When curves have been approved by Supply Authority, they shall be submitted for approval. After approval has been obtained, order protective devices and calibrate to conform with these curves.

.3 Each time-current characteristic curve sheet shall include:

.1 A single line diagram for the portion of the system involved.

.2 Transformer damage curves (where applicable).

.3 Cable damage curves (where applicable).

.4 Available fault levels for the portion of the system involved.

.4 Consult manufacturer of the refrigeration compressors and obtain recommendations for settings on starters. Incorporate information in co-ordination curves and submit the associated curves to Compressor Manufacturer and obtain approval from the manufacturer.

.5 Compressor manufacturer and mechanical trade contractor will determine and calibrate proper protection on motor starters and will ensure that it co-ordinates with protective devices on switchboard.

.6 Co-ordination curves, mentioned above, shall be prepared by distribution equipment manufacturers as soon as possible after award of contract.

.7 At the option of this contractor under this section, these co-ordination curves may also be prepared by an independent testing organization. In this case, the independent testing organization shall determine the proper settings of all protective relays and devices and pass them on to the Switchboard manufacturer for incorporation into the switchboards. Include all associated costs in the tender.

.8 Distribution Equipment manufacturers shall examine drawings and specifications prior to award of contract to ensure that relays and devices being supplied by them will co-ordinate satisfactorily to Supply Authority requirements. Payment will not be allowed, after award of contract, for extra charges due to device changes to comply with recommended practices, due to oversight or negligence by distribution equipment manufacturers.

1.05 Closeout Submittals

.1 The Engineer who prepared the report shall visit the site and confirm that the feeder sizes as installed are consistent with the report as submitted.

.2 Submit final version of the report with as-constructed feeder lengths and feeder sizes.

1.06 Quality Assurance

.1 Preparer Qualifications: Firm experienced in the analysis, evaluation, and coordination of electrical distribution systems and similar to the system for this project.

.2 The study shall be prepared in accordance with the latest edition of NETA ATS, the Canadian Electrical Code, as well as manufacturer's recommendations.

.3 Short-Circuit Analysis and Coordination Study shall be performed by a registered Professional Engineer. Study shall be signed and sealed by the Engineer. The Engineer shall have a minimum of eight years experience in the analysis, evaluation, and coordination of electrical distribution systems.

.4 The firm conducting the study shall have one million worth of Professional Liability Insurance in addition to standard general insurance.

2 Products

2.01 Manufacturers

.1 Independent Testing Organizations

.1 AC Tesla.

.2 Brosz and Associates.

.3 C-INTECH.

.4 Eastenghouse.

.5 Enkompass.

.6 G.T. Wood.

.2 Electrical distribution manufacturers:

.1 Eaton.

.2 Schneider Electric.

2.02 Protective Device Coordination Study

.1 Prepare coordination time-current characteristic curves to determine the required settings/sizes of the protective devices to maximize selectivity. The utility upstream protective device feeding the facility shall be maintained as the upper limit for coordination. These settings shall be obtained by the preparer, along with any other protective device setting requirements. The coordination curves shall be prepared on log-log paper and illustrate adequate clearing times between series devices. The curves shall be created through the use of the study software package, but must reflect actual protective devices to be installed. Adequate time-current curves shall be generated to depict coordination. In addition, protective device characteristics shall be suitably determined to reflect calculated short-circuit levels at the location.

.2 A narrative analysis shall accompany each coordination curve sheet and describe the coordination and protection in explicit detail. All curve sheets shall be multi-color for improved clarity. Areas lacking complete coordination shall be highlighted and reasons provided for allowing condition to remain or provide solution to resolve situation. System coordination, recommended ratings, and setting of protective devices shall be accomplished by a registered professional electrical engineer with a minimum of eight years of current experience in the coordination of electrical power systems.

.3 The following information shall be provided on all curve sheets:

.1 Device identification and associated settings/size.

.2 Voltage at which curves are plotted.

.3 Current multiplier.

.4 ANSI frequent fault damage curve.

.5 Cable insulation damage curves.

.6 Transformer inrush point.

.7 Single-line for the portion of the system.

.8 Motor starting profiles (where applicable).

2.03 Single Line Diagram

.1 The final report shall include a multi-color single-line diagram of the electrical distribution system within the scope of the project. The single-line shall include:

.1 Transformer rating, voltage ratio, impedance, and winding connection.

.2 Feeder cable phase, neutral and ground sizes, length of cable, conductor material, and conduit size and type.

.3 Switchgear, switchboards, panelboards, MCC's, fuses, circuit breakers, ATS's and switches continuous current ratings.

.4 Protective relays with appropriate device numbers and CT's and PT's with associated ratios.

.5 Detailed legend indicating device type identification and other significant details.

3 Execution

3.01 Summary

.1 The results of the system studies shall be summarized in a final report.

.2 Where required, copies of the final report shall be submitted to the Supply Authority for their review and approval. Approved copies or the report shall be submitted to the Consultant.

3.02 Adjusting

.1 The contractor shall engage the manufacturer's service group or alternately a qualified independent testing firm to perform field adjustments of the protective devices as required for placing the equipment in final operating condition. The settings shall be in accordance with the approved short circuit study and protective device evaluation / coordination study.

.2 Necessary field settings of devices and adjustments and minor modifications to equipment to accomplish conformance with the approved protective device coordination study, shall be carried out by manufacturer's service group.

.3 Submit a final service report confirming that settings have been completed.

End of Section

1 General

1.01 Section Includes

.1 The contractor shall provide an Arc Flash Hazard Analysis Study per the requirements described in CSA Z462 Standard for Electrical Safety in the Workplace.

.2 The arc flash hazard analysis shall be performed according to the IEEE 1584 equations that are obtained in CSA Z462-08, Annex D, or more recent version of the standard as cited by this Section.

.3 The scope of the studies shall include all existing distribution equipment and all new distribution equipment supplied by the equipment Manufacturer under this contract.

1.02 Related Requirements

.1 Section 26 05 73.16 – Coordination Studies.

.2 Single Line Diagram.

1.03 References

.1 Institute of Electrical and Electronics Engineers, Inc. (IEEE):

.1 IEEE 141 – Recommended Practice for Electric Power Distribution and Coordination of Industrial and Commercial Power Systems.

.2 IEEE 242 – Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems.

.3 IEEE 399 – Recommended Practice for Industrial and Commercial Power System Analysis.

.4 IEEE 241 – Recommended Practice for Electric Power Systems in Commercial Buildings.

.5 IEEE 1015 – Recommended Practice for Applying Low-Voltage Circuit Breakers Used in Industrial and Commercial Power Systems.

.6 IEEE 1584-2018 - Guide for Performing Arc-Flash Hazard Calculations.

.2 American National Standards Institute (ANSI):

.1 ANSI C57.12.00 – Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers.

.2 ANSI C37.13 – Standard for Low Voltage AC Power Circuit Breakers Used in Enclosures.

.3 ANSI C37.010-2016 – Standard Application Guide for AC High Voltage Circuit Breakers Rated on a Symmetrical Current Basis.

.4 ANSI C 37.41 – Standard Design Tests for High Voltage Fuses, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches and Accessories.

.3 Ontario Electrical Safety Code (27th edition/2018).

.4 CSA Z462-15, Workplace electrical safety.

1.04 Submittals

.1 Submit the protective device coordination study to the Consultant prior to receiving final review of the distribution equipment shop drawings and/or prior to release of equipment drawings for manufacturing. If formal completion of the studies may cause delay in equipment manufacturing, approval from the

engineer may be obtained for preliminary submittal of sufficient study data to ensure that the selection of device and characteristics will be satisfactory.

1.05 Closeout Submittals

.1 The results of the protective device coordination and arc flash hazard analysis studies shall be summarized in a final report. Three (3) bound copies of the complete final report shall be submitted. Additional copies of the complete report with input and output data shall be provided on CD in PDF format.

.2 The report shall include the following sections:

.1 Executive Summary.

.2 Descriptions, purpose, basis and scope of the study.

.3 Tabulations of circuit breaker, fuse and other protective device ratings versus calculated short circuit duties.

.4 Protective device time versus current coordination curves, tabulations of relay and circuit breaker trip unit settings, fuse selection.

.5 Fault current calculations including a definition of terms and guide for interpretation of the computer printout.

.6 Details of the incident energy and flash protection boundary calculations.

.7 Recommendations for system improvements, where needed.

.8 Single Line Diagram.

.3 Arc flash labels (refer to CSA Z462 Annex Q) shall be provided in hard copy only.

1.06 Qualifications

.1 Arc flash hazard analysis studies shall be conducted under the supervision and approval of a Registered Professional Electrical Engineer skilled in performing and interpreting the power system studies.

.2 The Registered Professional Electrical Engineer shall be a full-time employee of the equipment manufacturer or an approved engineering firm.

.3 The Registered Professional Electrical Engineer shall have a minimum of eight (8) years of experience in performing power system studies.

.4 The equipment manufacturer or approved engineering firm shall demonstrate experience with Arc Flash Hazard Analysis by submitting names of at least ten actual arc flash hazard analysis it has performed in the past year.

1.07 Computer Analysis Software

.1 The studies shall be performed using the latest revision of the SKM or equivalent.

2 Products

2.01 Manufacturers

.1 Independent Testing Organizations:

.1 AC Tesla.

.2 Brosz and Associates.

.3 C-INTECH.

.4 Eastenghouse.

.5 Enkompass.

.6 G.T. Wood.

.2 Electrical distribution manufacturers:

.1 Eaton.

.2 Schneider Electric.

2.02 Studies

.1 The contractor shall furnish an Arc Flash Hazard Analysis Study per CSA Z462, reference Section 4.1.8.2.2, 4.3.3.

2.03 Data Collection

.1 Contractor shall furnish all data as required by the power system studies. The Engineer performing arc flash hazard analysis studies shall furnish the Contractor with a listing of required data immediately after award of the contract. The Contractor shall expedite collection of the data to assure completion of the studies as required for final approval of the distribution equipment shop drawings and/or prior to the release of the equipment for manufacturing.

.2 Source combination may include present and future motors and generators.

.3 If applicable, include fault contribution of existing motors in the study. The Contractor shall obtain required existing equipment data, if necessary, to satisfy the study requirements.

2.04 Arc Flash Hazard Analysis

.1 The arc flash hazard analysis shall be performed according to the IEEE 1584 equations that are presented in CSA Z462 Annex D.

.2 The flash protection boundary and the incident energy shall be calculated at all significant locations in the electrical distribution system (switchboards, switchgear, panelboards and splitters) where work could be performed on energized parts.

.3 The Arc-Flash Hazard Analysis shall include all significant locations in 240 volt and 208 volt systems fed from transformers equal to or greater than 112.5 kVA where work could be performed on energized parts.

.4 Safe working distances shall be based upon the calculated arc flash boundary considering an incident energy of 1.2 calories per square centimetre.

.5 When appropriate, the short circuit calculations and the clearing times of the phase overcurrent devices will be retrieved from the short-circuit and coordination study model. Ground overcurrent relays should not be taken into consideration when determining the clearing time when performing incident energy calculations.

.6 The short-circuit calculations and the corresponding incident energy calculations for multiple system scenarios must be compared and the greatest incident energy must be uniquely reported for each equipment location. Calculations must be performed to represent the maximum and minimum contributions of fault current magnitude for all normal and emergency operating conditions. The minimum calculation will assume that the utility contribution is at a minimum and will assume a minimum motor

contribution (all motors off). Conversely, the maximum calculation will assume a maximum contribution from the utility and will assume the maximum amount of motors to be operating. Calculations shall take into consideration the parallel operation of synchronous generators with the electric utility, where applicable.

.7 The incident energy calculations must consider the accumulation of energy over time when performing arc flash calculations on buses with multiple sources. Iterative calculations must take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors and generators should be decremented as follows:

.1 Fault contribution from induction motors should not be considered beyond 3-5 cycles.

.8 Fault contribution from synchronous motors and generators should be decayed to match the actual decrement of each as closely as possible (e.g. contributions from permanent magnet generators will typically decay from 10 per unit to 3 per unit after 10 cycles).

.9 For each equipment location with a separately enclosed main device (where there is adequate separation between the line side terminals of the main protective device and the work location), calculations for incident energy and flash protection boundary shall include both the line and load side of the main breaker.

.10 When performing incident energy calculations on the line side of a main breaker (as required per above), the line side and load side contributions must be included in the fault calculation.

.11 Mis-coordination should be checked amongst all devices within the branch containing the immediate protective device upstream of the calculation location and the calculation should utilize the fastest device to compute the incident energy for the corresponding location.

.12 Arc Flash calculations shall be based on actual overcurrent protective device clearing time.

.13 Maximum clearing time will be capped at 2 seconds based on IEEE 1584.

.14 Where it is not physically possible to move outside of the flash protection boundary in less than 2 seconds during an arc flash event, a maximum clearing time based on the specific location shall be utilized.

2.05 Report Sections

.1 Incident energy and flash protection boundary calculations:

.1 Arcing fault magnitude.

.2 Protective device clearing time.

.3 Duration of arc.

.4 Arc flash boundary.

.5 Working distance.

.6 Incident energy.

.7 Hazard Risk Category.

.8 Recommendations for arc flash energy reduction.

3 Execution

3.01 Field Adjustment

.1 Adjust relay and protective device settings according to the recommended settings table provided by the coordination study. Field adjustments to be completed by the engineering service division of the equipment manufacturer under the Startup and Acceptance Testing contract portion.

.2 Make minor modifications to equipment as required to accomplish conformance with short circuit and protective device coordination studies.

.3 Notify Owner in writing of any required major equipment modifications.

3.02 Arc Flash Warning Labels

.1 The contractor of the Arc Flash Hazard Analysis shall provide a 3.5 inch by x 5 inch thermal transfer type label of high adhesion polyester for each work location analyzed.

.2 All labels will be based on recommended overcurrent device settings and will be provided after the results of the analysis have been presented to the owner and after any system changes, upgrades or modifications have been incorporated in the system.

.3 The label shall include the following information, at a minimum:

.1 Location designation.

.2 Nominal voltage.

.3 Flash protection boundary.

.4 Hazard risk category.

.5 Incident energy.

.6 Working distance.

.7 Engineering firm and issue date.

.8 Labels shall be machine printed, with no field markings.

.4 Arc flash labels shall be provided in the following manner and all labels shall be based on recommended overcurrent device settings.

.1 For each 600 volt, and applicable 208 volt panelboard, one arc flash label shall be provided.

.2 For each motor control center, one arc flash label shall be provided.

.3 For each low voltage switchboard, one arc flash label shall be provided.

.4 For each switchgear, one flash label shall be provided.

.5 For medium voltage switches one arc flash label shall be provided.

.5 Arc Flash Warning Label General Instructions:

.1 Only qualified electricians who recognize and avoid the electrical and Arc Flash hazards are allowed to place the arc flash warning labels.

.2 Electricians should wear suitable PPE, such as electrical safety boots, Safety Glasses, etc. while performing labeling.

.3 Generally, arc flash label shall be put on a prominent pre-cleaned place on the front of the electrical equipment (such as switchgear, panel, disconnect switch, generator output breaker). Label should be visible and readable, displayed horizontally, attached flatly and securely, and not allowed to cover other signs or labels on the equipment.

.4 Under the special request of the client, labels could be put on the back of the panel door when the panel is located in clean and finished spaces such as an office area.

.5 When putting a label on small equipment with no space labeling on the wall just beside the equipment is allowed.

.6 Special request may be attached to this General Instruction. For examples, more than one identical label is applied for large equipment; different labels could be applied for different sections of one equipment; for a splitter with several disconnect switches only one label is placed on the splitter for this group.

.7 Take the pictures for each label to indicate both names of the label and equipment and labeling area of the equipment. Email these pictures to the Consultant for quality control and record.

End of Section

1 General

1.01 Section Includes

.1 Electrical connections to equipment specified in other sections.

1.02 Related Requirements

.1 Division 08 – Openings.

.2 Division 11 – Equipment.

.3 Division 14 – Conveying Equipment.

.4 Division 20 – Common Mechanical Requirements.

.5 Division 21 – Fire Suppression.

.6 Division 22 – Plumbing.

.7 Division 23 – Heating, Ventilating, and Air Conditioning.

1.03 References

.1 NEMA WD 1 - General Colour Requirements for Wiring Devices.

.2 NEMA WD 6 - Wiring Devices - Dimensional Requirements.

1.04 Coordination

.1 Coordinate work to Section 01 31 00.

.2 Obtain and review shop drawings, product data, and manufacturer's instructions for equipment provided under other sections.

.3 Determine connection locations and requirements.

.4 Sequence rough-in of electrical connections to coordinate with installation schedule for equipment.

.5 Sequence electrical connections to coordinate with start-up schedule for equipment.

1.05 Submittals

.1 Submit to Section 01 33 00.

.2 Product Data: Provide wiring device manufacturer's catalogue information showing dimensions, configurations, and construction.

.3 Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.

1.06 Regulatory Requirements

.1 Provide products listed and classified by testing firm acceptable to authority having jurisdiction as suitable for purpose specified and shown.

2 Products

2.01 Common Motor Requirements

.1 Motors up to and including 1/3 HP, shall be 1 phase, 60 Hz, 120 volts.

.2 Motors 1/2 HP and above shall be 3 phase, 60 Hz, 575 volts or 208 volts.

2.02 Cords and Caps

.1 Attachment Plug Construction: Conform to NEMA WD 1.

.2 Configuration: NEMA WD 6; match receptacle configuration at outlet provided for equipment.

.3 Cord Construction: NFPA 70, Type SJO multiconductor flexible cord with identified equipment grounding conductor, suitable for use in damp locations.

.4 Size: Suitable for connected load of equipment, length of cord, and rating of branch circuit overcurrent protection.

3 Execution

3.01 Wiring of Equipment Provided Under Other Divisions

.1 Use the following procedure with regard to wiring of motors and equipment provided under other Divisions.

.2 The following equipment shall be responsibility of the trade supplying the equipment unless otherwise noted, in accordance with the requirements laid out in the individual section, or this division:

.1 Motors.

.2 Starters.

.3 Variable Frequency Drives.

.4 Motor Control Centres.

.5 Control wiring.

.3 In every instance, install starter, motor control centre, variable frequency drivers (VFD), etc. and wire to line side of the starter, the Motor Control Centre, or VFD. Extend wiring from starter, motor control centre or VFD to motor as indicated.

.4 Provide all wiring for starters and VFD's from supply to starter to VFD and to motor. Coordinate requirements with the appropriate trade.

.5 Provide 500 mm of liquid tight flexible metal conduit for final connection to motor. Provide disconnect switches where required by code, and as indicated on the drawings.

.6 Where individual starters and controls are grouped together provide a panel for mounting this equipment. Provide a feeder, main fused disconnect and a splitter of adequate size and capacity and wire to line side of the starters on this panel and from starters to motors.

.7 Equipment, General

.1 Ascertain exact locations of starters, motor control centres, motors, etc. from drawings and coordinate exact locations with the supplying trade.

.2 Control wiring shall be the responsibility of the supplying trade.

.1 Control wiring shall be in accordance with Section 26 05 19, and Section 26 05 23.

.2 Control wiring shall be installed in conduit in accordance with Section 26 05 33.13.

.8 Conveying Equipment (e.g. Elevators): in accordance with Section 26 05 83.14.

.9 Plumbing Equipment

.1 Ascertain exact locations of starters, motor control centres, motors, infra-red plumbing fixture controls from Mechanical Drawings and coordinate exact locations with plumbing trade.

.2 Provide branch circuit wiring and an outlet for each infra-red plumbing fixture control.

.3 Control wiring shall be the responsibility of the plumbing trade, as described above.

.10 HVAC Equipment

.1 Ascertain exact locations of starters, motor control centres, motors, motorized dampers, VAV boxes, and heating control valves from HVAC drawings and coordinate exact locations with HVAC Division.

.2 In the case of unit heaters, reheat coils and cabinet unit heaters, terminate wiring on terminals provided. Control wiring, thermostats, or other control devices shall be the responsibility of the HVAC trade, as described above.

.3 Provide branch circuit wiring and an outlet for each motorized damper, variable air volume (VAV) box, or heating control valve. Control wiring shall be the responsibility of the HVAC trade, as described above.

3.02 Examination

.1 Verify that equipment is ready for electrical connection, wiring, and energization.

3.03 Electrical Connections

.1 Provide a local disconnect switch for all equipment, regardless of if a disconnect switch is shown or not shown on the plans.

.2 Make electrical connections to equipment manufacturer's instructions.

.3 Make conduit connections to equipment using flexible conduit. Use liquid-tight flexible conduit with watertight connectors in damp or wet locations.

.4 Make wiring connections using wire and cable with insulation suitable for temperatures encountered in heat producing equipment.

.5 Provide receptacle outlet where connection with attachment plug is indicated. Provide cord and cap where field-supplied attachment plug is indicated.

.6 Provide suitable strain-relief clamps and fittings for cord connections at outlet boxes and equipment connection boxes.

.7 Install disconnect switches, controllers, control stations, and control devices as indicated.

.8 Modify equipment control wiring with terminal block jumpers as indicated.

.9 Provide interconnecting conduit and wiring between devices and equipment where indicated.

.10 Coolers and Freezers: Cut and seal conduit openings in freezer and cooler walls, floor, and ceilings.

End of Section

1 General

1.01 Section Includes

.1 Power service connections, communication service connections, fire alarm signal and emergency power condition signal for elevator car homing relays, fused switches and associated conduit and wire for elevator cab lighting and ventilation and power to elevator sequence controller.

1.02 Related Requirements

.1 Division 14 - Conveying Equipment: Elevators.

.2 Section 26 28 13 – Fuses.

.3 Section 28 46 51.14 – Fire-Alarm Supervised Interface Hardware for Elevators.

1.03 Work Not Described in this Section

.1 Elevator control wiring, down drop cables, and interlock controls and wiring.

1.04 References

.1 Accessibility for Ontarians with Disabilities Act (AODA).

.2 CSA C22.1-18, Canadian Electrical Code, Part 1 (24th Edition), Safety Standard for Electrical Installations.

.3 Ontario Electrical Safety Code (27th edition/2018):

.1 OESC Section 38: Elevators, dumbwaiters, material lifts, escalators, moving walks, lifts for person with physical disabilities, and similar equipment.

.4 Ontario Building Code.

1.05 Delivery, Storage, and Handling

.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 00.

2 Products

2.01 Elevator Power Distribution Centre

.1 600 Volt 3-phase, fused disconnect switches complete with HRC fuses.

.2 600 Volt, 3-phase, splitter gutter assembly complete with remote mounted fused switches complete with HRC fuses individually mounted in NEMA 1 enclosures.

.3 Fused switches to have external rotary operating handle, lockable in "OFF" position.

3 Execution

3.01 Distribution Assemblies

.1 Provide lamacoid nametag indicating function of each device. Coordinate wording with elevator trade.

3.02 Equipment Wiring

.1 Elevator machine room light switch, elevator power disconnect devices, and cab light power disconnect devices placed on lock side of machine room door within elevator machine room.

.2 Coordinate location of lights, machines, and equipment installed in the elevator pits and machine rooms with elevator installer on site.

3.03 Fire Alarm

.1 Provide fire alarm devices as indicated.

.2 Smoke detector in elevator machine room shall be complete with auxiliary contact.

.3 Provide heat detector at top of elevator shaft.

3.04 Branch Circuits for Machine Room or Control Room/Machinery Space or Control Space Lighting and Receptacle(s)

.1 A separate branch circuit shall supply the machine room or control room/machinery space or control space lighting and receptacles.

.2 Required lighting shall not be connected to the load side terminals of a ground fault circuit interrupter.

3.05 Branch Circuit for Hoistway Pit Lighting and Receptacles

.1 At least one 125 V, single-phase, duplex receptacle connected to a 15 A branch circuit shall be provided in the hoistway pit.

.2 A separate branch circuit shall supply the hoistway pit lighting and receptacles.

.3 Required lighting shall not be connected to the load side terminals of a ground fault circuit interrupter receptacle(s).

End of Section

1 General

1.01 Section Includes

.1 Commissioning of all building electrical systems and component including:

.1 Testing and adjustment.

.2 Demonstration and training.

.3 Instructions of all procedures for Owner's personnel.

.4 Updating as-built data.

.5 Co-ordination of Operation and Maintenance material.

.2 Provide labour and material to conduct the commissioning process as outlined in this specification section, including the hiring of an Independent Testing Contractor (ITC) as detailed below.

.3 Provisions of this section shall apply to all sections of Division 26, Division 27, Division 28, and sections related to electrical utilities in Division 33.

1.02 Related Requirements

.1 Testing and commissioning are called for throughout the individual specifications. This does not relieve this trade from providing all testing and commissioning necessary to ensure that systems and equipment operate as required and that they interface with other systems and equipment as required.

.2 Section 26 08 50 – Commissioning of Lighting: additional commissioning requirements for commissioning of lighting and lighting controls.

1.03 Commissioning Process Allocation

.1 The commissioning process shall be allocated a value equal to 5 per cent of the contract. The Electrical Contractor may draw from this allocation as the commissioning process is completed.

.2 The Electrical Contractor shall submit all test and verification forms. The Consultant will use these forms to calculate percentage complete.

.3 The Electrical Contractor may claim up to 3 per cent of the contract from this allocation leading up to performance testing. The remaining 2 per cent shall not be paid out until the performance testing, O&M manuals, and training have been completed satisfactorily.

1.04 Definitions

.1 Cx – Commissioning.

.2 Commissioning Authority

.1 The Commissioning Authority (CxA), also referred to as the Commissioning Consultant, shall be hired by The Owner.

.2 The CxA responsibilities shall include:

.1 preparing the commissioning plan

.2 co-ordinating with the contractor to schedule tests

.3 preparing a test form manual

.4 witnessing selected tests

.5 receiving all test forms

.6 co-ordinating the contractors training

.7 chair the commissioning meetings

.3 The Electrical Contractor shall co-operate with the CxA.

.4 The Electrical Contractor shall provide assistance to the CxA and have personnel available during the performance testing procedure. Each electrical system shall be tested in the operational mode.

1.05 Submittals

.1 Conform to Section 01 33 00 for requirements for shop drawings and record drawings.

.2 A commissioning document shall be prepared by the CxA prior to conducting these activities for use by the Commissioning Team.

.3 The electrical sub-contractor shall be responsible for ensuring all activities are properly documented in this manual and co-ordinated through the General Contractor.

.4 As-built drawings and data books must be available two weeks prior to commissioning for review and use by the consultant and Commissioning Team prior to the start of the commissioning activities.

1.06 Closeout Submittals

.1 Attendance records for all training sessions.

.2 Testing reports for system load balance measurements, infra-red test and harmonics tests.

1.07 Quality Assurance

.1 Provide qualified trades persons, certified testing agencies, factory trained and approved by the Commissioning Team Leader.

.2 Submit the names of all personnel to be used during the Commissioning activities.

1.08 Warranty

.1 Equipment and system warranties shall not begin until the system demonstration and turnover has been conducted successfully and accepted by the Owner.

.2 The Electrical Contractor shall fill out the warranty form listing the equipment and systems and the start and finishing dates for warranty.

.3 Refer to Division 01 and Section 26 05 00 for the requirements during the warranty period.

2 Products

2.01 Equipment

.1 The Contractor and manufacturers shall provide all instrumentation and equipment necessary to conduct the tests specified. The Contractor shall advise the Consultant of instrumentation to be used and the dates the instruments were calibrated.

3 Execution

3.01 The Commissioning Process

.1 The purpose of the commissioning process is to fully test all building systems including architectural, mechanical and electrical components and operating procedures by challenging these systems to realistic operation conditions.

.2 The commissioning process consists of:

.1 Shop Drawings and Record Drawings

.2 Installation inspection and equipment verification

.3 Independent testing contractor

.4 Testing of equipment and systems

.5 Commissioning meetings

.6 Operating and maintenance manuals

.7 Operating training

.8 Commissioning Agent testing

.9 Systems Demonstration and turnover

.10 Testing forms

.11 Warranties

3.02 Preparation

.1 Provide test instruments required for all activities as defined in the commissioning documents.

.2 Verify all systems are in compliance with the requirements of the commissioning documents prior to the pre-commissioning check out operation.

.3 Confirm all scheduled activities have identified personnel available.

.4 Where systems or equipment do not operate as required, make the necessary corrections or modifications, re-test and re-commission.

3.03 System Description

.1 Perform all start-up operations, control adjustment, trouble shooting, servicing and maintenance of each item of equipment as defined in the commissioning documentation.

.2 Owner will provide list of personnel to receive instructions and will co-ordinate their attendance at agreed upon times.

.3 Prepare and insert additional data in the operations and maintenance manuals and update as-built drawings when need for additional data becomes apparent during the commissioning exercise.

.4 Where instruction is specified in the commissioning manual, instruct personnel in all phases of operation and maintenance using operation and maintenance manuals as the basis of instruction.

.5 Conduct presentation on Owner's premises. Owner will provide space.

3.04 Commissioning

.1 Commission the components of the electrical system using the NETA Acceptance Testing Specifications.

.2 Refer to the project commissioning plan prepared by the CxA.

.3 Commissioning activities for the electrical systems must have available up to date as-built drawing information and accurate Operations and Maintenance Manuals. These documents shall be a major part of this activity.

.4 Contractor shall be responsible to update all documentation with information and any changes duly noted during the Commissioning exercise.

.5 Contractor shall arrange for all outside suppliers, equipment manufacturers, test agencies and others as identified in the commissioning sections of this specification. The cost associated with this requirement shall be included as part of the tender price.

3.05 Final Report

.1 This trade shall assemble all testing data and commissioning reports and submit them to the General Contractor for submission to the Owner.

.2 Each form shall bear signature of recorder, and that of supervisor of reporting organizer.

3.06 Schedule of Activities

.1 Commissioning activities shall be conducted based on pre-established schedule with all members of the commissioning team.

.2 In addition, there will be two meetings held through the contract duration to introduce the parties of the commissioning team, establish the schedules and deadlines for the various activities and review the Commissioning Manual.

.3 Adhering to the established schedule is very important as the co-ordination and scheduling of the participants will be difficult to alter once this is established. Close co-ordination of this schedule is important.

.4 In the event project cannot be commissioned in the allotted time slot, the contractor shall pay for all costs associated with assembling the Commissioning Team at a later date. If the contractor has not performed his duties to reach commissioning stage as outlined earlier, he will incur all expenses of other trades and the Commissioning Team due to his non-compliance.

3.07 Installation Inspection and Equipment Verification

.1 The Electrical Contractor shall co-ordinate with the Electrical Consultant who will inspect the electrical installation.

.2 The Electrical Contractor shall complete the equipment verification forms for each piece of equipment. The forms shall be included in the operating and maintenance manual. The equipment data shall include:

.1 Manufacturers name, address and telephone number.

.2 Distributors name, address and telephone number.

.3 Make, model number and serial number.

.4 Voltage and current ratings.

3.08 Independent Testing Contractor

.1 The Independent Testing Contractor (ITC) shall be hired by the contractor and shall issue reports to the Electrical Consultant.

.2 The ITC shall conduct load balancing measurements to verify load balancing performed in accordance with Section 26 05 00.

3.09 Testing of Equipment and Systems

.1 The Electrical Contractor shall be responsible for all tests detailed in this Section, and those tests required by a manufacturer as part of their installation requirements.

.2 The Electrical Contractor shall schedule all tests which shall be witnessed by the Electrical Consultant or the Commissioning Consultant. The contractor shall complete and sign the testing forms.

.3 The Electrical Contractor shall conduct tests on the following equipment as a minimum. Refer to the individual specification sections for test procedures.

.1 Section 26 05 19 – Low-Voltage Electrical Power Conductors and Cables.

.2 Section 26 05 73.16 – Coordination Studies.

.3 Section 26 24 13 – Switchboards.

.4 Section 26 24 16 – Panelboards.

.5 Section 27 51 16 – Public Address Systems.

.6 Section 28 10 00 – Access Control.

.7 Section 28 46 13 – Fire-Alarm Systems.

.4 When all testing has been completed and all mechanical and electrical systems are operational the contractor shall conduct system load balance measurements, infra-red test and harmonics tests.

3.10 Commissioning Meetings and Reporting

.1 The Electrical Contractor shall include the schedule for all tests in the construction schedule.

.2 The Commissioning meetings shall occur during the regular construction meetings. The testing schedules and the results of all tests shall be reviewed.

.3 All testing forms and reports associated with the electrical systems shall be directed to the Electrical Consultant, with copies to the Consultant, Commissioning Consultant, and the Owner.

.4 The forms and reports to be issued shall include:

.1 Shop drawings, issued and accepted

.2 Equipment verification forms

.3 Testing forms

.4 Reports resulting from tests

.5 Testing schedule

.6 Minutes of commissioning meetings

.7 Manufacturers' Certificates

3.11 Operating and Maintenance Manual

.1 Conform to the specification section for the requirements of the O&M manuals.

3.12 Closeout Activities

.1 Conform to section for requirements for instructions to the Building Owner for each system and equipment.

.2 The training shall be provided by qualified technicians or electricians and shall be conducted in a classroom and at the equipment or system.

.3 The training sessions shall be scheduled, co-ordinated and video taped by the Commissioning Consultant.

.4 Each training session shall be structured to cover:

.1 The operating and maintenance manual.

.2 Operating procedures.

.3 Maintenance procedures.

.4 Troubleshooting procedures.

.5 Spare parts.

.5 Submit a course outline to the Electrical Consultant before training commences. Provide course documentation for up to eight people.

.6 The training session shall be scheduled and co-ordinated by the Commissioning Consultant. The Commissioning Consultant shall video tape the sessions.

.7 Training shall be provided for the following systems:

.1 Electrical Systems including distribution and lighting: 8 hour minimum

.2 Section 27 51 16 – Public Address Systems: 1 hour minimum

.3 Section 28 10 00 – Access Control: 1 hour minimum

.4 Section 28 46 13 – Fire-Alarm Systems: 2 hours minimum

.8 The Electrical Contractor shall conduct a walkthrough of the installation. During the walkthrough the Electrical Contractor shall:

.1 Identify equipment.

.2 Identify electrical panels.

.3 Identify starters and disconnects.

.4 Review the electrical power distribution.

.5 Review the light power distribution.

.6 Review the switchgear.

.7 Review the general maintenance procedures.

3.13 The Electrical System Demonstration and Turnover

.1 The system demonstration and turnover to The Owner shall occur when:

.1 The installation is complete.

.2 The acceptance test conducted by the Electrical Consultant has been completed successfully.

.3 Training has been completed.

.4 Equipment Operating and Maintenance Manuals have been accepted.

.5 System operating manuals have been accepted.

.6 Shop-drawings have been updated.

.7 As-built drawings have been completed.

.8 The commissioning process has been completed successfully and system operation accepted by the Electrical Consultant and Commissioning Consultant.

.2 The systems demonstration shall be conducted by the Electrical Contractor and manufacturers. The demonstration shall cover a physical demonstration of equipment installation and operation.

3.14 Testing Forms

.1 The Electrical Contractor and manufacturers shall fill out the forms listed in this section or provide other forms. The forms must be approved by the Electrical Consultant and the Owner before they are used.

End of Section

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1 General

1.01 Section Includes

.1 Common requirements for commissioning of all electric lighting, including interior, exterior, and emergency lighting.

.2 The party responsible for the functional testing shall not be directly involved in either the design or construction of the project.

1.02 Related Requirements

.1 Section 26 09 43 – Network Lighting Controls.

.2 Section 26 51 19 – LED Interior Lighting.

.3 Section 26 52 13.13 – Emergency Lighting.

.4 Section 26 56 19 – LED Exterior Lighting.

1.03 References

.1 ASHRAE

.1 ASHRAE Guideline 0-2005 – The Commissioning Process.

.2 ANSI/ASHRAE/IES 90.1-2013 – Energy Standard for Building Except Low-Rise Residential Buildings.

.2 Illumination Engineering Society (IES)

.1 IES DG-29-11 – Design Guide for the Commissioning Process Applied to Lighting and Control Systems.

.3 Ontario Building Code

.1 Supplementary Standard SB-10: Energy Efficiency Requirements, December 22, 2016 update.

1.04 Action Submittals

.1 Refer to Section 01 33 00.

.2 Submit sample commissioning forms.

1.05 Closeout Submittals

.1 Section 01 78 23 and Section 01 78 39: Submittals for project closeout.

.2 Submit commissioning reports.

.1 Submit a floor plan or spreadsheet table checklist that indicates each local lighting control device, occupancy sensors, daylighting controls, system component.

.2 Submit the system sequence of operation fully describing the equipment components and functionality, including set points and alarm functions.

.3 The detailed sequence of operation shall be provided regardless of the completeness and clarity of the sequences in the controls specification and/or drawings.

.3 The functional testing party shall provide documentation certifying that the installed lighting controls meet or exceed all documented performance criteria.

2 Products – Not Used

3 Execution

3.01 Site Tests and Inspections

.1 Sensor placement and orientation for all sensor types.

.2 Occupancy sensor function, sensitivity, and time delays.

.3 Daylight harvesting sensor calibration.

.4 Automated shade operation.

.5 Manual control placement and operation.

.6 Automated control operation, including scheduled on/off functions and dimming trims and presets.

.7 Override operation, access, and functionality.

.8 Centralized control interfaces and operation.

.9 Client education of operations.

.10 Documentation archived to client.

3.02 Functional Testing

.1 Lighting control devices and control systems shall be tested to ensure that control hardware and software are calibrated, adjusted, programmed, and in proper working condition in accordance with the construction documents and manufacturer's installation instructions.

.2 When occupant sensors, time switches, programmable schedule controls, or photosensors are installed, at a minimum, the following procedures shall be performed:

.1 Confirm that the placement, sensitivity and time-out adjustments for occupant sensors yield acceptable performance, lights turn off only after space is vacated and do not turn on unless space is occupied.

.2 Confirm that time switches and programmable schedule controls are programmed to turn the lights off.

.3 Confirm that photosensor controls reduce electric lights levels based on the amount of usable daylight in the space as specified.

End of Section

1 General

1.01 Section Includes

.1 Materials and installation for contactors for system voltages up to 600 V.

1.02 References

.1 Canadian Standards Association (CSA)

.1 CSA C22.2 No. 14-18, Industrial Control Equipment.

2 Products

2.01 Manufacturers

.1 Allen Bradley "500L" series

.2 Eaton.

.3 Schneider Electric.

.4 Siemens.

2.02 Contactors

.1 Contactors: to CSA C22.2 No. 14.

.2 Electrically held controlled by pilot devices as indicated and rated for type of load controlled. Half size contactors not accepted.

.3 Contactors shall be electrically held 60 Hz, 120 V coil; NEMA Type 1 general purpose enclosure.

.4 Fused switch combination contactor as indicated.

.5 Complete with 2 normally open and 2 normally closed auxiliary contacts unless indicated otherwise.

.6 Mount in CSA Enclosure 1 unless otherwise indicated.

.7 Include following options in cover:

.1 Red indicating lamp.

.2 Hand-Off-Auto selector switch.

.8 Provided complete with control transformer, in contactor enclosure.

3 Execution

3.01 Installation

.1 Install contactors and connect auxiliary control devices.

3.02 Equipment Identification

.1 Provide equipment identification in accordance with Section 26 05 53.

.2 Size 4 nameplate indicating name of load controlled as indicated.

End of Section

1 General

1.01 Section Includes

.1 Metering transformer cabinets.

.2 Meter bases.

.3 Utility Requirements.

.4 A new service will be provided from a new padmount transformer, built to the requirements of the Toronto Hydro as per the Standard Details.

1.02 Related Requirements

.1 Section 26 24 13 – Switchboards: Metering transformer compartment.

1.03 References

.1 CSA C22.1-18, Canadian Electrical Code, Part 1 (24th Edition), Safety Standard for Electrical Installations.

.2 Ontario Electrical Safety Code (27th edition/2018).

.3 CSA C22.2 No. 52 - Underground Service-Entrance Cables.

.4 Ontario Building Code and its referenced standards.

.5 Toronto Hydro Conditions of Service, Reference 5a. Requirements for the Design and Construction of Customer-Owned Structures.

.6 Toronto Hydro Conditions of Service, Reference 5b. Construction Standards referenced in Requirements for the Design and Construction of Customer-Owned Structures.

1.04 Pre-Installation Meetings

.1 Convene one week prior to commencing work of this section.

.2 Review service entrance requirements and details with utility company's representatives.

1.05 Action Submittals

.1 Product Data: Provide ratings and dimensions of transformer cabinets and meter bases.

1.06 Informational Submittals

.1 Submit utility company's prepared drawings.

1.07 Quality Assurance

.1 Perform Work to utility company's written requirements.

.2 Obtain approval from Supply Authority and Inspection Authority on complete service. Coordinate work with Utility.

.3 Maintain one copy of each document on site.

1.08 Regulatory Requirements

.1 Products: Listed and classified by testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

2 Products

2.01 Description

.1 Electric Utility Company: Toronto Hydro Electric System Limited.

.2 System Characteristics: 2000 amps, 600Y/347 volts, 3-phase, 4-wire.

.3 Available Fault Current: To be confirmed in Coordination Study. Ensure the main switchboard is sized for an interrupting capacity of at least 50 kA.

2.02 Metering Transformer Cabinet

.1 Manufacturers: as per electrical utility requirements

.2 Description: Sheet metal cabinet with hinged door, conforming to utility company requirements, with provisions for locking and sealing.

.3 Dimensions: 1220 mm (48 in) wide by 1220 mm (48 in) high by 305 mm (12 in) deep to suit electrical utility requirements.

2.03 Meter Bases

.1 Meter Base: Provided by utility company.

2.04 PT's and CT's

.1 Supplied by the utility for inclusion in main switchboard.

3 Execution

3.01 Verification of Conditions

.1 Verify that field measurements are as indicated on utility company's drawings.

3.02 Preparation

.1 Arrange with utility company to obtain permanent electric service to the project.

3.03 Installation

.1 Local Hydro Authority will provide high voltage cable and transformer. Primary duct bank, transformer vault and pad, secondary duct, secondary cable, grounding etc., to be provided by this Contractor.

.2 Utility Metering (Supplied by Local Hydro Utility)

.1 Current and potential transformers for utility metering shall be in accordance with requirements of Supply Authority.

.2 Equipment manufacturer shall submit complete metering details for approval to utility and obtain their approval prior to manufacture.

.3 Compartment housing utility metering transformers shall be suitable for utility padlocking.

.3 Metering Instruments

.1 A flush mounted voltmeter and a flush mounted ammeter, along with three phase selector switches and associated metering transformers shall be provided.

.4 Work of this and related requirements

.1 Provision of concrete encased primary and secondary ducts, transformer vault to Local Hydro Authority requirements. Provision of fish wire in primary ducts.

.2 Provision of feeder from transformer to main switch.

.3 Grounding installation.

.5 Work by the Local Hydro Authority

.1 Provision of high voltage cable.

.2 Provision of transformer.

.3 Provision of all equipment at property line.

.4 Termination of medium voltage cables at both ends with stress cones.

.5 Termination of secondary cables and ground cable(s) at transformer.

.6 Service Entrance

.1 Connect to service entrance breaker as shown and as specified.

.2 Provide incoming and outgoing cable connections, torque same as required.

.3 Ground equipment as required by Code.

.7 Provide complete shop drawings for all distribution equipment. Local Hydro Authority will provide high voltage cable and transformer. Primary duct, transformer vault, secondary duct, secondary cable, grounding etc., to be provided by this Contractor.

End of Section

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1 General

1.01 Section Includes

.1 Materials and components for dry type transformers up to 600 V primary, equipment identification and transformer installation.

1.02 References

.1 ANSI/ASHRAE/IES Standard 90.1-2013 – Energy Standard for Buildings Except Low-Rise Residential Buildings.

.2 CSA Group:

.1 CSA C22.1-18, Canadian Electrical Code, Part 1 (24th Edition), Safety Standard for Electrical Installations.

.2 Ontario Electrical Safety Code (27th edition/2018).

.3 CSA C22.2 No. 47-13 (R2018), Air-cooled transformers (dry type).

.4 CSA C9-17, Dry-type transformers.

.5 CSA C802.2-18, Minimum Efficiency Values for Dry-Type Transformers.

.3 National Electrical Manufacturers Association (NEMA):

.1 NEMA ST-20-2014, Dry-Type Transformers for General Applications: sound levels.

.4 NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment (published by the International Electrical Testing Association).

.5 Ontario Building Code and its referenced standards.

1.03 Action Submittals

.1 Product Data: Provide outline and support point dimensions of enclosures and accessories, unit weight, voltage, power, and impedance ratings and characteristics, tap configurations, insulation system type, and rated temperature rise.

1.04 Informational Submittals

.1 Test Reports: Indicate loss data, efficiency at 25, 50, 75, and 100 per cent rated load, and sound level.

.2 Submit manufacturer's installation instructions.

.1 Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements.

.2 Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.05 Closeout Submittals

.1 Record actual locations of transformers in project record documents.

1.06 Delivery, Storage, and Handling

.1 Store and handle in strict compliance with manufacturer's instructions and recommendations. Protect from potential damage from weather and construction operations.

.2 Store so condensation will not form on or in the transformer housing and if necessary, apply temporary heat where required to obtain suitable service conditions. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

.3 Handle to manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to transformer internal components, enclosure, and finish.

.4 Handle transformer using proper equipment for lifting and handling, use when necessary lifting eye and/or brackets provided for that purpose.

1.07 Warranty

.1 The transformer shall carry a 1 year warranty from the time of substantial performance.

2 Products

2.01 General

.1 Transformers shall be standard general purpose dry type unless otherwise indicated on drawings as K-Rated or Harmonic Mitigation type.

.2 Use transformers of one manufacturer throughout project and in accordance with CAN/CSA-C22.2 No.47 and CSA C9.

2.02 Manufacturers

.1 Manufacturer List:

.1 Delta Transformer.

.2 Eaton.

.3 Hammond.

.4 Powersmiths.

.5 Rex Power Magnetics.

.6 Schneider Electric.

.7 STI.

.8 Approved equal.

.2 Substitutions: permitted if approved by Consultant prior to Tender closing date.

2.03 Regulatory Requirements

.1 Products: Listed and classified by CSA (Canadian Standards Association).

.2 Efficiency ratings:

.1 Meet or exceed the efficiency levels indicated in CSA C802.2-12, and ASHRAE 90.1-2013, Table 8.1.

2.04 General Purpose Transformers

.1 NEMA ST-20, factory-assembled, air cooled low-inrush dry type transformer, ratings and voltages as indicated on drawings.

.2 Single or three phase as indicated on drawings.

.3 Type: AN/AA Ventilated self-cooled.

.4 Copper windings.

.5 Finish: Final coating to be ASA 61 Grey Epoxy Powder

.6 T-connected transformers are not acceptable.

.7 Isolate core and coil from enclosure using vibration-absorbing mounts.

.8 Impedance: Standard.

2.05 Primary Voltage

.1 600 volts delta, 3 phase;

.2 480 volts delta, 3 phase.

2.06 Secondary Voltage

.1 347/600 volts, 3 phase wye;

.2 277/480 volts, 3 phase wye;

.3 120/208 volts, 3 phase wye.

2.07 Insulation System and Average Winding Temperature Rise

.1 1-15 kVA: Class 185 with 80 degrees C rise.

.2 16-500 kVA: Class 220 with 80 degrees C rise.

.3 Above 500 kVA: Class 220 with 80 degrees C rise.

2.08 Case Temperature

.1 Do not exceed 35 degrees C rise above ambient at warmest point at full load.

2.09 Winding Taps

.1 To NEMA ST-20.

.2 Four full capacity 5 per cent adjustment taps, 2 at 2.5 per cent FCBN (full capacity below nominal) and 2 at 2.5 per cent FCAN (full capacity above nominal).

2.10 Basic Impulse Level

.1 10 kV BIL.

2.11 Grounding

.1 Ground core and coil assembly to enclosure by means of a visible flexible copper grounding strap.

2.12 Mounting

.1 1-15 kVA: suitable for wall mounting.

.2 16-75 kVA: suitable for wall or floor, as shown.

.3 Larger than 75 kVA: suitable for floor mounting.

2.13 Coil Conductors

.1 Continuous windings with terminations brazed or welded.

2.14 Enclosure

.1 NEMA ST-20, CSA, Type 2 ventilated, Sprinkler-proof. Provide lifting eyes or brackets.

2.15 Sound Levels

.1 To NEMA ST-20 for transformers up to 300 kVA:

.1 Up to 9 kVA: 40 dB.

.2 10 – 50 kVA: 45 dB.

.3 51 – 150 kVA: 50 dB.

.4 151 – 300 kVA: 55 dB.

.2 Sound levels 3 db less than NEMA ST-20 for transformers 301 kVA and greater.

.1 301 – 500 kVA: 57 dB.

.2 501 – 700 kVA: 59 dB.

.3 701 – 1000 kVA: 61 dB.

.4 Above 1000 kVA: 3 db less than NEMA ST-20.

2.16 Nameplate

.1 Transformer shall have embossed aluminum or stainless steel nameplate indicating, but not restricted to the following:

.1 kVA rating.

.2 Voltage rating.

.3 Impedance.

.4 Type.

.5 Insulation class.

.6 Temperature rise.

.7 Connection diagram.

.8 Serial number.

2.17 Equipment Identification

.1 Provide equipment identification in accordance with Section 26 05 53.

2.18 Source Quality Control

.1 Production test each unit according to NEMA ST-20.

3 Execution

3.01 Installation

.1 Set transformer plumb and level.

.2 Use flexible conduit, under the provisions of Section 26 05 33.13, 600 mm minimum length, for connections to transformer case. Make conduit connections to side panel of enclosure.

.3 Mount wall-mounted transformers using integral flanges or accessory brackets provided by the manufacturer.

.4 Mount floor-mounted transformers on vibration isolating pads suitable for isolating the transformer noise from the building structure.

.5 Mount trapeze-mounted transformers as indicated.

.6 Provide seismic restraints.

.7 Provide grounding and bonding to Section 26 05 26.

.8 Mount dry type transformers up to 75 kVA, as indicated.

.9 Mount dry type transformers above 75 kVA on floor.

.10 Ensure adequate clearance around transformer for ventilation.

.11 Install transformers in level upright position.

.12 Remove shipping supports only after transformer is installed and just before putting into service.

.13 Loosen isolation pad bolts until no compression is visible.

.14 Make primary and secondary connections in accordance with wiring diagram.

.15 Energize transformers after installation is complete.

3.02 Field Quality Control

.1 Section 01 40 00: Field Inspection, Testing, Adjusting.

.2 Perform inspections and tests listed in NETA ATS, Section 7.2.

3.03 Adjusting

.1 Measure primary and secondary voltages and make appropriate tap adjustments.

End of Section

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1 General

1.01 Section Includes

.1 Distribution Switchboards rated 600 volts and less.

.2 Switchboard accessories.

.3 Provide design and engineering, labor, material, equipment, related services, and supervision required, including, but not limited to, manufacturing, fabrication, erection, and installation for distribution switchboards as required for the complete performance of the work, and as shown on the Drawings and as herein specified.

1.02 Related Requirements

.1 Section 03 30 00 – Cast-in-Place Concrete: Concrete for supporting foundations and pads.

.2 Section 25 96 00 – Integrated Automation Control Sequences for Electrical Systems.

.3 Section 26 21 16 – Low-Voltage Underground Electrical Service Entrance.

.4 Section 26 22 13 – Low-Voltage Distribution Transformers.

.5 Section 26 28 16.02 – Molded Case Circuit Breakers.

.6 Section 26 43 13 – Surge Protective Devices for Low-Voltage Electrical Power Circuits.

.7 Section 26 24 16 – Panelboards.

1.03 References

.1 ANSI C39.1 – Requirements for Electrical Analog Indicating Instruments.

.2 ASTM (ASTM):

.1 ASTM E 329, "Standard Specification for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction."

.3 CSA Group:

.1 CSA C22.1-18, Canadian Electrical Code, Part 1 (24th Edition), Safety Standard for Electrical Installations.

.2 Ontario Electrical Safety Code (27th edition/2018).

.3 CSA C22.2 No. 4-16, Enclosed and dead-front switches.

.4 CSA C22.2 No. 5-16, Molded case circuit breakers, molded case switches, and circuit-breaker enclosures.

.5 CSA C22.2 No. 144.1-16, Ground-fault circuit interrupters.

.6 CSA C22.2 No. 244:19, Switchboards.

.7 CSA C22.2 No. 269.2-17, Surge protective devices – Type 2 – Permanently connected.

.8 CSA Z462-15, Workplace electrical safety.

.9 CSA Z463-18, Maintenance of electrical systems.

.4 Institute of Electrical and Electronics Engineers, Inc. (IEEE):

.1 ANSI/IEEE C57.13, "Standard Requirements for Instrument Transformers" (copyrighted by IEEE, ANSI approved).

.5 InterNational Electrical Testing Association (NETA):

.1 NETA ATS, Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

.6 International Organization for Standardization (ISO):

.1 ISO 9001, Quality Management Systems - Requirements.

.7 National Electrical Contractors Association (NECA):

.1 NECA 400, "Standard for Installing and Maintaining Switchboards" (copyrighted by NECA, ANSI approved).

.8 National Electrical Manufacturers Association (NEMA):

.1 NEMA AB 1 - Molded Case Circuit Breakers, Molded Case Switches, and Circuit - Breaker Enclosures.

.2 NEMA C12.1 - Electric Meters; Code for Electricity Metering.

.3 NEMA EI 21.1, "Instrument Transformers for Revenue Metering (110 kV BIL and Less)."

.4 NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).

.5 NEMA PB 2 - Deadfront Distribution Switchboards.

.6 NEMA PB 2.1 - Instructions for Proper Handling, Installation, Operation and Maintenance of Deadfront Distribution Switchboards Rated 600 Volts or Less.

.7 NEMA 260 - Safety Labels for Pad Mounted Switchgear and Transformers Sited in Public Areas.

.9 Ontario Building Code and its referenced standards.

.10 Underwriters Laboratories, Inc. (UL):

.1 UL 1283, "Standard for Safety for Electro-Magnetic Interference Filters" (copyrighted by UL, ANSI approved).

1.04 Pre-installation Meetings

.1 Conduct pre-installation meeting in accordance with Section 01 31 19.

.2 Prior to commencing the installation, meet at the Project site to review the material selections, installation procedures, and coordination with other trades. Pre-installation conference shall include, but shall not be limited to, the Contractor, the Installer, and any trade that requires coordination with the work. Date and time of the pre-installation conference shall be acceptable to the Owner and the Consultant.

1.05 Action Submittals

.1 Section 01 33 00: Procedures for submittals.

.2 Product Data:

.1 Provide electrical characteristics including voltage, frame size and trip ratings, fault current withstand ratings, and time-current curves of all equipment and components.

.2 Submit product data showing material proposed. Submit sufficient information to determine compliance with the Drawings and Specifications. Submit product data for each type of switchboard, overcurrent protective device, surge protective device, ground-fault protector, accessory, and component indicated. Include dimensions and manufacturer's technical data on features, performance, electrical characteristics, ratings, and finishes.

.3 Shop Drawings:

.1 Indicate front and side views of enclosures with overall dimensions shown; conduit entrance locations and requirements; nameplate legends; size and number of bus bars per phase, and ground; and switchboard instrument details.

.2 Submit shop drawings for each product and accessory required. Include information not fully detailed in manufacturer's standard product data. Submit shop drawings for each switchboard and related equipment.

.3 Indicate front and side enclosure elevations with overall dimensions, conduit entrance locations and requirements, nameplate legends, one-line diagrams, equipment schedule and switchboard instrument details.

.4 Submit mimic-bus diagram.

.5 The following information shall be submitted to the Consultant:

.1 Master drawing index

.2 Front view elevation

.3 Floor plan

.4 Top view

.5 Single line

.6 Schematic diagram

.7 Nameplate schedule

.8 Component list

.9 Conduit entry/exit locations

.10 Assembly ratings including:

.1 Short-circuit rating.

.2 Voltage.

.3 Continuous current.

.11 Major component ratings including:

.1 Voltage.

.2 Continuous current.

.3 Interrupting ratings.

.4 Cable terminal sizes.

.5 Product data sheets.

.12 Where applicable, the following additional information shall be submitted to the Consultant:

.1 Busway connection.

.2 Connection details between close-coupled assemblies.

.3 Composite floor plan of close-coupled assemblies.

.4 Key interlock scheme drawing and sequence of operations.

.6 Wiring Diagrams: Submit wiring diagrams detailing power, signal, and control systems, clearly differentiating between manufacturer-installed wiring and field-installed wiring, and between components provided by the manufacturer and those provided by others.

.7 Quality Control Submittals:

.1 Test Reports: Submit field quality control test reports.

.8 Upon review by the Consultant, submit switchboard shop drawings to the local electrical utility for their review and approval.

1.06 Informational Submittals

.1 Section 01 33 00: Submittals for Information.

.2 The following submittals are informational; responsive action by the Consultant is not required.

.3 Test Reports: Indicate results of factory production tests.

.4 Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

.5 The following information shall be submitted for record purposes:

.1 Final as-built drawings and information for items listed in paragraph 1.04, and shall incorporate all changes made during the manufacturing process

.2 Wiring diagrams

.3 Certified production test reports

.4 Installation information

.5 Seismic certification and equipment anchorage details as specified

1.07 Closeout Submittals

.1 Section 01 78 23: Submittals for Project Closeout.

.2 Operation and Maintenance Data:

.1 Include spare parts listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.

.2 Equipment operation and maintenance manuals shall be provided with each assembly shipped and shall include instruction leaflets, instruction bulletins and renewal parts lists where applicable, for the complete assembly and each major component.

.3 Warranty Documentation: Submit manufacturer's standard warranty documents.

.4 Record Documentation: Record actual locations of switchboard in project record documents.

.5 Training session attendance records.

1.08 Maintenance Material Submittals

.1 To Section 01 78 23.

.2 Spare Parts: Provide four of each key.

1.09 Quality Assurance

.1 Manufacturer Qualifications:

.1 The manufacturer of the assembly shall be the manufacturer of the major components within the assembly.

.2 For the equipment specified herein, the manufacturer shall be ISO 9001 or ISO 9002 certified.

.3 The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of five (5) years. When requested by the Consultant, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

.2 Installer Qualifications:

.1 Installer shall be a firm that shall have a minimum of five years of successful installation experience with projects utilizing switchboards similar in type and scope to that required for this Project.

.3 Inspecting and Testing Agency Qualifications:

.1 To qualify for acceptance, an independent inspecting and testing agency hired by the Contractor or manufacturer to test products shall demonstrate to the Consultant's satisfaction that they are qualified according to ASTM E 329 to conduct testing indicated.

.4 Certifications:

.1 Comply with applicable requirements of the laws, codes, ordinances, and regulations of Federal, State, and local authorities having jurisdiction. Obtain necessary approvals from such authorities.

.2 Comply with applicable requirements of the referenced standards.

1.10 Delivery, Storage, and Handling

.1 Section 01 60 00: Transport, Handle, Store, and Protect Products.

.2 Specify shipping split requirements where unusual obstructions, corridor configurations, or door widths will interfere with switchboard handling at site.

.3 Deliver in 1219 mm (48 inch) maximum width shipping splits, individually wrapped for protection and mounted on shipping skids.

.4 Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

.5 Handle to NEMA PB 2.1 and manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to switchboard internal components, enclosure, and finish.

.6 Deliver materials to the Project site in supplier's or manufacturer's original wrappings and containers, labeled with supplier's or manufacturer's name, material or product brand name, and lot number, if any.

.7 Store materials in their original, undamaged packages and containers, inside a well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.

.8 Equipment shall be handled and stored in accordance with manufacturer's instructions. One copy of these instructions shall be included with the equipment at time of shipment.

1.11 Warranty

.1 Equipment manufacturer warrants that all goods supplied are free of non-conformities in workmanship and materials for one year from date of initial operation, or up to eighteen months from date of shipment.

2 Products

2.01 Manufacturers

.1 Manufacturer List:

.1 Square D by Schneider Electric

.2 Eaton (Cutler-Hammer).

.3 Siemens.

.2 Substitutions: Not permitted.

.3 Product Options: The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety. Products in compliance with the specification and manufactured by others not named will be considered only if pre-approved by the Consultant ten (10) days prior to bid date.

2.02 General Switchboard Requirements

.1 Description: NEMA PB 2 switchboard with electrical ratings and configurations as indicated and specified.

.2 Regulatory Requirements

.1 Products certified by CSA Group, or testing firm acceptable to the Authority Having Jurisdiction as suitable for the purpose specified and indicated.

.3 Ratings:

.1 Voltage: 600 volts.

.2 Configuration: Three phase, three wire, grounded.

.3 Main Bus: As per Single Line Diagrams.

.4 Ground Bus: Extend length of switchboard.

.5 Molded Case Circuit Breakers: To Section 26 28 16.02 – Molded Case Circuit Breakers.

.6 Ground fault trip, zero sequence type ground fault sensor.

.1 Instantaneous trip.

.2 Adjustable short time trip.

.3 Stationary mounting or drawout construction, as applicable.

.4 Include shunt trip where indicated.

.7 Line and Load Terminations: Accessible from the front only of the switchboard, suitable for the conductor materials and sizes indicated.

.8 Ground Fault Sensor: Zero sequence type.

.9 Ground Fault Relay: Adjustable ground fault sensitivity from 200 to 1200 amperes, time delay adjustable from 0 to 15 seconds. Provide monitor panel with lamp to indicate relay operation, TEST and RESET control switches.

.10 Ground Fault Sensor: Zero sequence type.

.11 Ground Fault Relay: Adjustable ground fault sensitivity from 200 to 1200 amperes, time delay adjustable from 0 to 15 seconds. Provide monitor panel with lamp to indicate relay operation, TEST and RESET control switches.

.12 Incoming entry: As noted on plans.

.13 Incoming location: As noted on plans.

.14 Branch Circuit Entry: Top.

.15 Silver Flashed Copper.

.16 Minimum Interrupt Rating: 65 kA.

.17 Bus Bracing Rating: 65 kA.

.18 Solid Bottom Plates.

.19 Box Finish - ASA 61 (Std).

.20 Trim Finish - ASA 61 (Std).

.21 Silver Flashed Copper Ground Bus.

.22 Vermin proof.

.23 Channel Sills.

.24 Refer to Single Line Diagram for additional information.

2.03 Short Circuit Ratings

.1 The assembly shall be rated to withstand mechanical forces exerted during short-circuit conditions when connected directly to a power source having available fault current 65 000 amperes symmetrical at rated voltage or as indicated on the drawings.

.2 Use fully rated overcurrent devices. Series ratings will not be accepted.

2.04 Construction

.1 The entire assembly shall be front accessible and shall consist of main lugs or main device as shown on the plans.

.2 Feeder devices 150 ampere frame through 1200 ampere frame shall be panel-mounted-type construction. Devices over 1200 ampere frame or main devices shall be individually mounted when required.

2.05 Bus

.1 All bus bars shall be silver-plated copper. Main horizontal bus bars shall be mounted with all three phases arranged in the same vertical plane. Bus sizing shall be based on NEMA standard temperature rise criteria of 65 degrees C over a 40 degrees C ambient (outside the enclosure).

.2 A copper ground bus (minimum 1/4 inch by 2 inch), shall be furnished firmly secured to each vertical section structure, and shall extend the entire length of the switchboard.

.3 Copper neutral bus.

.4 All hardware used on conductors shall be high-tensile strength and zinc-plated. All bus joints shall be provided with conical spring-type washers.

2.06 Wiring/Termination

.1 Small wiring, necessary fuse blocks and terminal blocks within the switchboard shall be furnished as required. Control components mounted within the assembly, such as fuse blocks, relays, pushbuttons, switches, etc., shall be suitably marked for identification corresponding to appropriate designations on manufacturer's wiring diagrams.

.2 Mechanical-type terminals shall be provided for all line and load terminations suitable for copper or aluminum cable rated for 90 degrees C of the size as indicated on the drawings.

.3 Lugs shall be provided in the incoming line section for connection of the main grounding conductor. Additional lugs for connection of other grounding conductors shall be provided as indicated on the drawings.

.4 All control wire shall be type SIS, bundled and secured with nylon ties. Insulated locking spade terminals shall be provided for all control connections, except where saddle-type terminals are provided integral to a device. All current transformer secondary leads shall first be connected to conveniently accessible short-circuit terminal blocks before connecting to any other device. All groups of control wires leaving the switchboard shall be provided with terminal blocks with suitable numbering strips. Provide wire markers at each end of all control wiring.

2.07 Enclosure

.1 Provide CSA type 2 steel enclosure complete with sprinklerproof drip shield.

.2 Align sections at front and rear.

.3 Switchboard Height: 2286 mm (90 inches), excluding floor sills, lifting members and pull boxes.

.4 Section depths: as per drawings.

.5 Section widths: as per drawings.

2.08 Enclosure Finish

.1 All exterior and interior steel surfaces of the switchboard shall be properly cleaned and provided with a factory applied rust-inhibiting phosphatized coating. Color and finish of the switchboard shall be ANSI 61 light gray.

.2 Coat internal surfaces with minimum one coat corrosion-resisting paint, or plate with cadmium or zinc.

2.09 Barriers

.1 Provide barriers between adjacent switchboard sections.

2.10 Insulation and Isolation

.1 Provide taped bus for through bus.

2.11 Front Covers

.1 Front covers shall be screw removable with a single tool and doors shall be hinged with removable hinge pins.

2.12 Bus Transition and Incoming Pull Sections

.1 Match and align with basic switchboard.

2.13 Pull Box on Top of Switchboard

.1 Provide adequate ventilation to maintain temperature in pull box within same limits as switchboard.

.2 Set back from front to clear circuit breaker removal mechanism.

.3 Removable covers shall form top, front, and sides. Top covers at rear shall be easily removable for drilling and cutting.

.4 Bottom shall be insulating, fire-resistive material with separate holes for cable drops into switchboard.

.5 Lace cables using industry-approved methods.

2.14 Feeder Entry

.1 Coordinate busway or cable feeder entry requirements with Single Line Diagram.

.2 Provide busway flange to suit busway feeders.

2.15 Future Devices

.1 Equip compartments with mounting brackets, supports, bus connections, and appurtenances at full rating of circuit breaker compartment.

.2 Fully equip spaces for future devices with bussing and bus connections, suitably insulated and braced for short circuit currents. Provide continuous current rating as indicated.

2.16 Metering and Instrumentation

.1 Utility Metering Compartment: Provide fabricated compartment and section complying with utility company's requirements. If separate vertical section is required for utility metering, match and align with basic switchboard.

.2 Instrumentation for Owner's metering:

.1 Instrument Transformers: NEMA EI 21.1, ANSI/IEEE C57.13, and the following:

.1 Potential Transformers: Secondary voltage rating of 120 volts and NEMA accuracy class of 0.3 with burdens of W, X, and Y.

.2 Current Transformers: Ratios shall be as indicated with accuracy class and burden suitable for connected relays, meters, and instruments.

.3 Control Power Transformers: Dry type, mounted in separate compartments for units larger than 3 kV.

.2 Multifunction Digital Metering Monitor: Microprocessor-based unit suitable for three-wire or four-wire systems and with the following features:

.1 Digital Display: Switch-selectable digital display of the following values with maximum accuracy tolerances as indicated:

.2 Phase Currents, Each Phase: ±1 percent.

.3 Phase-to-Phase Voltages, Three-Phase: ±1 percent.

.4 Phase-to-Neutral Voltages, Three-Phase: ±1 percent.

.5 Megawatts: ±2 percent.

.6 Megavars: ±2 percent.

.7 Power Factor: ±2 percent.

.8 Frequency: ±0.5 percent.

.9 Megawatt Demand: ±2 percent; demand interval programmable from 5 to 60 minutes.

.10 Accumulated Energy, Megawatt Hours: ±2 percent. Accumulated values unaffected by power outages up to 72 hours.

.11 Watt-Hour Meters: Flush or semi-flush type, rated 5 amperes, 120 volts, three-phase, three-wire, with three elements, 15 minute-indicating-demand register, and provision for testing and adding pulse initiation.

.12 Recording Demand Meter: Usable as totalizing relay or as indicating and recording maximum demand meter with 15 minute interval. Meter shall count and control a succession of pulses entering two channels.

.13 Mounting: Display and control unit flush or semi-flush mounted in instrument compartment or main device door.

.3 Interface with other systems: Provide BACnet gateway for connection to Building Automation per Section 25 96 00.

2.17 Mimic Bus

.1 Provide an anodized aluminum or plastic engraved plaque. Arrange in single-line diagram format, using symbols and letter designations consistent with final mimic bus diagram. Produce a concise visual presentation of principal switchboard components and connections.

.2 Show bussing, connections and devices in single line form on the front panels of the switchboard using blue colour light metal strips, fastened flat against the panel face with screws or rivets.

2.18 Nameplates

.1 Lamacoid nameplates to Section 26 05 53:

.1 Switchboard nameplate.

.2 Branch circuit nameplates.

.2 Engraved nameplates, mounted on the face of the assembly, shall be furnished for all main and feeder circuits as indicated on the drawings. Nameplates shall be laminated plastic, black characters on white background. Characters shall be 3/16-inch high, minimum. Nameplates shall give item designation and circuit number as well as frame ampere size and appropriate trip rating. Furnish master nameplate giving switchboard designation, voltage ampere rating, short-circuit rating, manufacturer's name, general order number, and item number.

2.19 Ground Fault Protection

.1 Furnish and install in the service equipment and/or switchboard ground fault protection and indication equipment as shown on drawings in accordance with 2018 OESC 14-102. All parts of the systems specified shall be CSA certified. All new ground fault protection and indication equipment shall be factory installed, wired, and tested by the switchboard manufacturer.

2.20 Source Quality Control

.1 Section 01 40 00: Manufacturer quality control.

.2 Shop inspect and test switchboard according to NEMA PB 2.

.3 Allow witnessing of factory inspections and tests at manufacturer's test facility. Notify Consultant at least 7 days before inspections and tests are scheduled.

.4 The following standard factory tests shall be performed on the equipment provided under this section. All tests shall be in accordance with the latest version of ANSI and NEMA standards.

.1 The switchboard shall be completely assembled, wired, adjusted, and tested at the factory. After assembly, the complete switchboard will be tested for operation under simulated service conditions to assure the accuracy of the wiring and the functioning of all equipment. The main circuits shall be given a dielectric test of 2200 volts for one (1) minute between live parts and ground and between opposite polarities. The wiring and control circuits shall be given a dielectric test of 1500 volts for one (1) minute between live parts and ground.

.2 Perform factory and installation tests in accordance with applicable OESC, NEMA and CSA requirements.

.5 The manufacturer shall provide three (3) certified copies of factory test reports.

.6 A certified test report of all standard production tests shall be available to the Consultant upon request.

3 Execution

3.01 Examination

.1 Examine areas and conditions under which the work is to be installed, and notify the Contractor in writing, with a copy to the Owner and the Consultant, of any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected.

.2 Verify that field measurements are as indicated on shop drawings.

.3 Beginning of the work shall indicate acceptance of the areas and conditions as satisfactory by the Installer.

3.02 Preparation

.1 Provide concrete housekeeping pad to Section 03 30 00.

3.03 Installation

.1 General

.1 Preparation and installation shall be in accordance with reviewed product data, final shop drawings, manufacturer's written recommendations, and as indicated on the Drawings.

.2 Install switchboards and accessories according to NEMA PB 2.1 and NECA 400.

.3 Install and anchor switchboards level on concrete bases, 4 inch (102 mm) nominal thickness. Concrete base is specified in Section 26 05 00, and concrete materials and installation requirements are specified in Division 03 - Concrete.

.4 Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from switchboard units and components.

.5 Frame and mount the printed basic operating instructions for switchboards, including, but not limited to, control and key interlocking sequences and emergency procedures. Fabricate frame of finished wood or metal and cover instructions with clear acrylic plastic. Mount on front of switchboards.

.6 Install overcurrent protective devices, surge protective devices, and instrumentation.

.1 Set field-adjustable switches and circuit breaker trip ranges.

.7 Install spare fuse cabinet.

.2 Install switchboard in locations shown on drawings, according to CSA C22.1.

.3 Tighten accessible bus connections and mechanical fasteners after placing switchboard.

.4 Install fuses in each switch.

.5 Install all equipment per the manufacturer's recommendations and the contract drawings.

.6 The assembly shall be provided with adequate lifting means and shall be capable of being moved into installation position and bolted directly to Contractor supplied floor sills to be set level in concrete per manufacturer's recommendations the floor without the use of floor sills providing the floor is level to 1/8 inch per 3 foot distance in any direction. All necessary hardware to secure the assembly in place shall be provided by the Contractor.

.7 Examine substrates and conditions in which units will be installed. Check for clearance that will be required before, during and after equipment installation. Do not proceed with installation until unsatisfactory conditions are corrected.

.8 Strictly comply with manufacturer's instructions and recommendations and NEMA PB 2.1. Coordinate installation with adjacent work to ensure proper sequence of construction, clearances and support.

.9 Install units plumb, level, and rigid without distortion to the switchboard cubicle(s).

.10 Identification

.1 Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Section 26 05 53.

.2 Label each switchboard compartment with engraved metal or laminated plastic nameplate mounted with corrosion-resistant screws.

.3 Arc Flash Warning Labels

.1 Refer to Section 26 05 73.19.

.2 Apply in the field, the arc flash warning label to all switchboards to suit future examination, adjustment, servicing, or maintenance while energized to warn qualified persons of potential electrical arc flash hazards.

3.04 Field Quality Control

.1 Section 01 40 00: Quality Assurance.

.2 Perform inspections and tests listed in NETA ATS, Section 7.1.

.3 Prepare for acceptance tests as follows:

.1 Test insulation resistance for each switchboard bus, component, connecting supply, feeder, and control circuit.

.2 Test continuity of each circuit.

.4 Perform the following field tests and inspections and prepare test reports:

.1 Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Sections 7.1, 7.5, 7.6, 7.9, 7.10, 7.11, and 7.14 as appropriate. Certify compliance with test parameters.

.2 Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

3.05 Protection

.1 Provide final protection and maintain conditions in a manner that shall ensure that the switchboards shall be without damage at time of Substantial Performance.

3.06 Adjusting

.1 Section 01 70 00: adjusting installed work.

.2 Adjust all operating mechanisms for free mechanical movement.

.3 Tighten bolted bus connections to manufacturer's instructions.

.4 Adjust circuit breaker trip and time delay settings to values indicated as instructed by the Consultant.

.5 Coordination Study Labels and Field Adjustment

.1 Refer to Section 26 05 73.16.

.2 The Contractors shall perform field adjustments of the protective devices as required to place the equipment in final operating condition. The settings shall be in accordance with the approved short-circuit study, protective device evaluation study and protective device coordination study.

.3 Necessary field settings of devices, adjustments and minor modifications to equipment to accomplish conformance with an approved short-circuit and protective device coordination study, shall be carried out by the Contractor at no additional cost to the Owner.

3.07 Cleaning

.1 Section 01 74 00: cleaning installed work.

.2 Clean exposed surfaces using manufacturer recommended materials and methods.

.3 Touch-up damaged coatings and finishes using non-abrasive materials and methods recommended by manufacturer. Eliminate all visible evidence of repair.

.4 Touch up scratched or marred surfaces to match original finish.

3.08 Training

.1 The Contractor shall provide a training session for up to five (5) Owner's representatives for normal workdays at a jobsite location determined by the Owner.

.2 A manufacturer's qualified representative shall conduct the training session. The training program shall consist of instruction on the operation of the assembly, circuit breakers, fused switches, meters, and major components within the assembly.

End of Section

1 General

1.01 Section Includes

.1 Power distribution panelboards – Circuit breaker type.

.2 Lighting and Appliance Branch Circuit Panelboards.

1.02 Related Requirements

.1 Section 26 28 16.02 – Molded Case Circuit Breakers.

.2 Section 26 43 13 – Surge Protective Devices for Low-Voltage Electrical Power Circuits.

1.03 References

.1 CSA Group:

.1 CSA C22.1-18, Canadian Electrical Code, Part 1 (24th Edition), Safety Standard for Electrical Installations.

.2 Ontario Electrical Safety Code (27th edition/2018).

.3 CSA C22.2 no. 5-16 – Molded Case Circuit Breakers, molded-case switches, and circuit-breaker enclosures.

.4 CSA C22.2 no. 29-15 – Panelboards and Enclosed Panelboards.

.2 NEMA:

.1 NEMA ICS 2-2000 (R2020) – Industrial Control and Systems: Controllers, Contactors, and Overload Relays Rated 600 Volts.

.2 NEMA KS 1-2013 – Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum).

.3 NEMA PB 1-2011 – Panelboards.

.4 NEMA PB 1.1-2013 – General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less.

.3 NETA ATS – Acceptance Testing Specifications for Electrical Power Distribution Equipment (published by the International Electrical Testing Association).

1.04 Submittals

.1 Submit in accordance with Section 01 33 00.

.2 Shop drawings shall contain overall panelboard dimensions, interior mounting dimensions, and wiring gutter dimensions. The location of the main, branches, and solid neutral shall be clearly shown. In addition, the drawing shall illustrate one line diagrams with applicable voltage systems.

.3 Shop drawings

.1 Indicate the following:

.1 Outline and support point dimensions

.2 Voltage

.3 Main bus ampacity

.4 Integrated short circuit ampere rating

.5 Circuit breaker arrangement, types and sizes.

.2 The following information shall be submitted to the Consultant:

.1 Breaker layout drawing with dimensions indicated and nameplate designation

.2 Component list

.3 Conduit entry/exit locations

.4 Assembly ratings including:

.1 Short-circuit rating

.2 Voltage

.3 Continuous current

.5 Cable terminal sizes

.6 Product data sheets

.3 Where applicable, the following additional information shall be submitted to the Consultant:

.1 Key interlock scheme drawing and sequence of operations

.4 Submittals for Construction

.1 The following information shall be submitted for record purposes:

.1 Installation information

1.05 Closeout Submittals

.1 Refer to Section 01 78 23 and Section 01 78 39.

.2 Record actual locations of panelboards and record actual circuiting arrangements in project record documents.

.3 Maintenance Data: Include spare parts listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.

.4 Final as-built drawings and information shall incorporate all changes made during the manufacturing and installation process.

.5 Include a copy of each panelboard schedule in the Operation and Maintenance manual.

1.06 Maintenance Material Submittals

.1 Manufacturer shall provide installation instructions and NEMA Standards Publication PB 1.1 - Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less.

.2 Equipment operation and maintenance manuals shall be provided with each assembly shipped and shall include instruction leaflets, instruction bulletins and renewal parts lists where applicable, for the complete assembly and each major component.

.3 Provide two of each panelboard key.

.4 Provide final panelboard schedules indicating panelboard data, phasing, breaker sizes, and loads served.

1.07 Quality Assurance

.1 Regulatory Requirements

.1 Products: Listed and classified by CSA (Canadian Standards Association).

.2 Qualifications

.1 Company specializing in manufacturing of panelboard products with a minimum of 20 years' experience.

.2 The manufacturer of the assembly shall be the manufacturer of the major components within the assembly.

.3 For the equipment specified herein, the manufacturer shall be ISO 9001 or 9002 certified.

.4 The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of five (5) years. When requested by the Consultant, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

1.08 Delivery, Storage, and Handling

.1 Inspect and report concealed damage to carrier within their required time period.

.2 Handle carefully to avoid damage to panelboard internal components, enclosure, and finish.

.3 Store in a clean, dry environment. Maintain factory packaging and, if required, provide an additional heavy canvas or heavy plastic cover to protect enclosure(s) from dirt, water, construction debris, and traffic.

.4 Equipment shall be handled and stored in accordance with manufacturer's instructions. One copy of these instructions shall be included with the equipment at time of shipment.

1.09 Manufacturer Warranty

.1 Warrant specified equipment to be free from defects in materials and workmanship for eighteen (18) months from the date of purchase.

2 Products

2.01 General

.1 Description: CSA C22.2 No.29, circuit breaker type.

2.02 Distribution Panelboards – Circuit Breaker Type

.1 Manufacturers:

.1 Square D by Schneider Electric, I-LINE Series.

.2 Eaton Cutler-Hammer, PRL 3 and PRL4 Series.

.3 Equal by Siemens.

.2 The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed above are not relieved from meeting

these specifications in their entirety. Products in compliance with the specification and manufactured by others not named will be considered only if pre-approved by the Consultant ten days prior to bid date.

.3 Panelboard Bus:

.1 Copper, ratings as indicated.

.2 Provide copper neutral bus for panelboards indicated for 4-wire systems.

.3 Provide copper ground bus in each panelboard.

.4 Short Circuit Ratings:

.1 Panelboards rated 600 V shall have minimum integrated short-circuit ratings as shown on the drawings or as herein scheduled, but not less than 65 000 amperes RMS symmetrical.

.2 Distribution panelboards with bolt-on devices contained therein shall have interrupting ratings as specified herein or indicated on the drawings.

.3 Panelboards shall be fully rated.

.4 Where indicated, provide circuit breakers ULC listed for application at 100 per cent of their continuous ampere rating in their intended enclosure.

.5 Minimum integrated short circuit rating: Panelboards rated 240 V shall have minimum integrated short-circuit ratings as shown on the drawings or as herein scheduled, but not less than 10 000 amperes RMS symmetrical.

.6 Molded Case Circuit Breakers: To Section 26 28 16.02.

.7 Circuit Breaker Accessories: Trip units and auxiliary switches as indicated.

.8 Cabinet Front: Surface type, fastened hinge and latch, metal directory frame, finished in manufacturer's standard gray enamel.

.9 Enclosures: CSA type 2 sprinklerproof complete with drip hood, or as noted.

.10 Trims shall be equipped with a flush lock.

.11 Breaker positions labeled as "Spare" or "Space" shall constitute no less than 20 per cent of available breaker positions, whether indicated or not in panelboard schedules.

.12 Each panel shall be complete with a directory which shall be mounted inside door in a metal frame with clear plastic cover and copy in each Data Book. Use final Room Numbers for directories.

2.03 Branch Circuit Panelboards

.1 Manufacturers:

.1 Square D by Schneider Electric, NQ or NQOD Series.

.2 Eaton Cutler-Hammer, POW-R-LINE 1, POW-R-LINE 2, POW-R-LINE 3 Series.

.3 Equal by Siemens.

.2 Description: CSA C22.2 no. 29, circuit breaker type, lighting and appliance branch circuit panelboard.

.3 Panelboard Bus:

.1 Copper, ratings as indicated.

.2 Provide copper neutral bus in each panelboard.

.3 Provide copper ground bus in each panelboard.

.4 Provide insulated ground bus where scheduled.

.4 Minimum Integrated Short Circuit Rating: 10 000 amperes RMS symmetrical for 240 volt panelboards, or as indicated.

.5 Molded Case Circuit Breakers: NEMA AB 1, plug-on type thermal magnetic trip circuit breakers, with common trip handle for all poles, listed as Type SWD for lighting circuits, Type HACR for air conditioning equipment circuits, Class A ground fault interrupter circuit breakers where scheduled. Do not use tandem circuit breakers.

.6 Current Limiting Molded Case Circuit Breakers where indicated: NEMA AB 1, circuit breakers with integral thermal and instantaneous magnetic trip in each pole, coordinated with automatically resetting current limiting elements in each pole. Interrupting rating 100,000 symmetrical amperes, let-through current and energy level less than permitted for same size Class RK-5 fuse.

.7 Cabinet Front: Surface cabinet front with concealed trim clamps, concealed hinge, metal directory frame, and flush lock all keyed alike. Finish in manufacturer's standard gray enamel.

.8 Enclosure shall be CSA type 2 sprinklerproof complete with drip hood, or as noted.

.9 Trims shall be equipped with a flush lock

.10 Breaker positions labeled as "Spare" or "Space" shall constitute no less than 20 per cent of available breaker positions, whether indicated or not in panelboard schedules.

.11 Panelboards: to CSA C22.2 No.29 and product of one manufacturer.

.1 Install circuit breakers in panelboards before shipment.

.2 In addition to CSA requirements manufacturer's nameplate must show fault current that panel including breakers has been built to withstand.

.12 Panelboards rated 240 Vac or less shall have short-circuit ratings as shown on the drawings or as herein scheduled, but not less than 10,000 amperes RMS symmetrical.

.13 Bus and breakers rated for symmetrical interrupting capacity, as indicated.

.14 Sequence phase bussing with odd numbered breakers on left and even on right, with each breaker identified by permanent number identification as to circuit number and phase.

.15 Panelboards: mains, number of circuits, and number and size of branch circuit breakers as indicated.

.16 Two keys for each panelboard and key panelboards alike.

.17 Copper bus with neutral of same ampere rating as mains.

.18 Mains: suitable for bolt-on breakers.

.19 Trim with concealed front bolts and hinges.

.20 Trim and door finish: baked grey enamel.

.21 The minimum short-circuit rating for branch circuit panelboards shall be as specified herein or as indicated on the drawings. Panelboards shall be fully rated.

.22 Bolt-on type, heavy-duty, quick-make, quick-break, single- and multi-pole circuit breakers of the types specified herein, shall be provided for each circuit with toggle handles that indicate when unit has tripped.

.23 Circuit breakers shall be thermal-magnetic type with common type handle for all multiple pole circuit breakers. Circuit breakers shall be minimum 100-ampere frame and through 100-ampere trip sizes shall take up the same pole spacing. Circuit breakers shall be ULC listed as type SWD for lighting circuits.

.1 Circuit breaker handle locks shall be provided for all circuits that supply exit signs, emergency lights, energy management, and control system (EMCS) panels and fire alarm panels.

.24 Circuit breakers shall have a minimum interrupting rating of 10 000 amperes symmetrical at 240 volts, and 14 000 amperes symmetrical at 480 volts, unless otherwise noted on the drawings.

.25 Each panel shall be complete with a directory which shall be mounted inside door in a metal frame with clear plastic cover and copy in each Data Book. Use final Room Numbers for directories.

.26 Lighting and receptacle panels shall be surface or flush-mounting type, as shown.

.27 Panels shall be dead front type in code gauge steel enclosures. All panels shall be sprinkler proof c/w drip hoods as required.

.28 Panels shall have mains of voltage and capacity, and main and branch breakers, as shown on the drawings. Spaces shall include necessary bus work such that Owners, at a later date, need buy only the breakers.

.29 Where branch circuit metering is used on a panelboard, provide 762 mm (30") tub width to accommodate the metering devices within the panelboard.

.30 Where panels exceed 42 circuits, use multi-section panel with main cross-over solid bus bars unless noted otherwise on drawings. Main bus capacity of each section shall be full size to match cross-over bus.

.31 Breakers shall have bolted type connections. Multi-pole breakers shall be common trip type with a single handle, suitable for voltage applied and of same manufacture as single pole breakers.

.32 Panels for 120/208 volt, 3-phase, 4-wire systems shall be complete with full size breakers.

.33 Where shown on drawings or required by code, certain breakers shall include ground fault interrupter.

.34 Provide lighting and receptacle panels, surface or flush-mounting type, as shown.

.35 Provide locking bars on non-switched circuits where panels are used for switching lighting circuits.

.36 Panels for non-linear loads shall be complete with lugs for double neutrals.

.37 Panels shall be given a rust-resistant treatment to both tub and trim.

.38 Flush panels shall have concealed hinges and flush type combination lock latch. Locks shall be chrome plated. Doors shall open minimum 135 degrees. Trims shall have fasteners concealed and shall be prime coated to receive room finish paint.

.39 Surface mounted panels shall have manufacturer's standard surface door trim complete with lock and latch. Finish shall be grey.

.40 Recessed panels shall have standard flush trims.

.41 Co-ordinate panel finish with Room Finish Schedule.

2.04 Molded Case Circuit Breakers

.1 Breakers: to Section 26 28 16.02.

.2 Breakers with thermal and magnetic tripping in panelboards except as indicated otherwise.

.3 Main breaker: separately mounted on top or bottom of panel to suit cable entry. When mounted vertically, down position should open breaker.

.4 Lock-on devices for 10 per cent of 15 A to 30 A breakers installed as indicated. Turn over unused lock-on devices to Owner.

.5 Lock-on devices for fire alarm, security, and sprinkler circuits.

.6 Provide shunt trips, bell alarms, and auxiliary switches as shown on the contract drawings.

.7 Provide breakers for externally mounted Surge Protective Devices in accordance with Section 26 43 13.

2.05 Construction

.1 General:

.1 Interiors shall be completely factory assembled. They shall be designed such that switching and protective devices can be replaced without disturbing adjacent units and without removing the main bus connectors.

.2 Surface trims shall be same height and width as box. Flush trims shall overlap the box by 3/4 of an inch on all sides.

.3 A temporary directory card with a clear plastic cover shall be supplied and mounted on the inside of each door.

.4 All locks shall be keyed alike. Key same as existing.

.2 Branch Circuit Panelboards:

.1 Trims for branch circuit panelboards shall be supplied with a hinged door over all circuit breaker handles. Doors in panelboard trims shall not uncover any live parts. Doors shall have a semi flush cylinder lock and catch assembly. Door-in-door trim shall be provided. Both hinged trim and trim door shall utilize three-point latching. No tools shall be required to install or remove trim. Trim shall be equipped with a door-actuated trim locking tab. Equip locking tab with provision for a screw such that removal of trim requires a tool, at the owner's option. Installation shall be tamper resistant with no exposed hardware on the panelboard trim.

.3 Distribution Panelboards:

.1 Distribution panelboard trims shall cover all live parts. Switching device handles shall be accessible.

2.06 Bus

.1 Lugs: Copper and listed by CSA, or cUL, for use with copper conductors and sized to accept copper conductors of the ampacity specified.

.2 Main bus bars shall be copper sized in accordance with CSA standards to limit temperature rise on any current carrying part to a maximum of 65 degrees C above an ambient of 40 degrees C maximum.

.3 A copper system ground bus shall be included in all panelboards.

.4 Full-size (100 per cent rated) insulated copper neutral bars shall be included for panelboards shown with neutral. Bus bar taps for panels with single-pole branches shall be arranged for sequence phasing of the branch circuit devices. Neutral busing shall have a suitable lug for each outgoing feeder requiring a neutral connection. 200 per cent rated neutrals shall be supplied for panels designated on drawings with oversized neutral conductors.

2.07 Equipment Identification

.1 Provide equipment identification in accordance with Section 26 05 53.

.2 Nameplate for each panelboard size 4 engraved.

.3 Nameplate for each branch circuit in distribution panelboards size 2 engraved.

.4 Complete circuit directory with typewritten legend showing location and load of each circuit.

.5 Provide an engraved nameplate for each panelboard section.

.6 Provide copies of all circuit directories in Manuals.

2.08 Source Quality Control

.1 The following standard factory tests shall be performed on the equipment provided under this section. All tests shall be in accordance with the latest version of NEMA and CSA standards.

3 Execution

3.01 Installation

.1 Install panelboards to CSA C22.1.

.2 Install panelboards plumb.

.3 Height: 1800 mm to top of panelboard; install panelboards taller than 1800 mm with bottom no more than 100 mm above floor.

.4 Provide filler plates for unused spaces in panelboards.

.5 Provide typed circuit directory for each branch circuit panelboard. Revise directory to reflect circuiting changes required to balance phase loads.

.6 Provide engraved plastic nameplates under the provisions of Section 26 05 53.

.7 Ground and bond panelboard enclosure according to Section 26 05 26.

.8 Locate panelboards as indicated and mount securely, plumb, true and square, to adjoining surfaces.

.9 Install surface mounted panelboards on fire rated plywood backboards in accordance with Section 06 10 00. Where practical, group panelboards on common backboard.

.10 Connect loads to circuits.

.11 Connect neutral conductors to common neutral bus with respective neutral identified.

.12 Deliver five (5) duplicate keys for each panel lock to Owner.

.13 Mount electrical panels, where possible, with top of trim at uniform height of 2000 mm.

.14 Cap ends of conduits in accessible locations in ceiling spaces above panels, to allow for future wiring.

.15 The Contractors shall install all equipment per the manufacturer's recommendations and the contract drawings.

.16 Install panelboards in accordance with manufacturer's written instructions, NEMA PB 1.1 and Electrical Code requirements.

.17 After completion of wiring, type directory showing a clear description of each circuit being controlled from panel and place in metal frame inside door.

.18 Provide revised directories for existing panels if revised.

.19 Provide circuit breaker handle locks for all circuits that supply exit signs, emergency lights, energy management, and control system (EMCS) panels and fire alarm panels.

.20 Provide minimum three 27 mm empty conduits from top of lighting, receptacle, telephone, signal and communication panels recessed in walls, to ceiling space.

3.02 Field Quality Control

.1 Perform inspections and tests listed in NETA ATS, Section 7.4 for switches, Section 7.5 for circuit breakers.

.2 Inspect complete installation for physical damage, proper alignment, anchorage, and grounding.

.3 Measure steady state load currents at each panelboard feeder; rearrange circuits in the panelboard to balance the phase loads within 20 per cent of each other. Maintain proper phasing for multi-wire branch circuits.

.4 Check tightness of bolted connections and circuit breaker connections using calibrated torque wrench or torque screwdriver per manufacturer's written specifications.

3.03 Adjusting

.1 Measure steady state load currents at each panelboard feeder; rearrange circuits in the panelboard to balance the phase loads to within 20 percent of each other.

.2 Maintain proper phasing for multi-wire branch circuits.

End of Section

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1 General

1.01 Section Includes

.1 Electrical Cabinets.

.2 Electrical Enclosures.

1.02 Related Requirements

.1 Section 26 27 26 – Wiring Devices.

1.03 References

.1 Canadian Standards Association (CSA):

.1 CSA C22.1-18, Canadian Electrical Code, Part 1 (24th Edition), Safety Standard for Electrical Installations.

.2 Ontario Electrical Safety Code (27th edition/2018).

.3 CSA C22.2 No. 94.2 – Enclosures for Electrical Equipment, Environmental Considerations.

.2 Underwriters Laboratories Inc. (UL):

.1 UL 50 – Enclosures for Electrical Equipment, Non-Environmental Considerations.

.2 UL 50E – Enclosures for Electrical Equipment, Environmental Considerations

1.04 Submittals

.1 Comply with Section 01 33 00.

.2 Product Data: Provide manufacturer's catalogue information showing dimensions, colours, and configurations.

1.05 Quality Assurance

.1 Manufacturer Qualifications: Products shall be free of defects in material and workmanship.

.2 Furnished products shall be listed or classified by third party agencies as suitable for the intended purpose.

1.06 Warranty

.1 Product is warranted free of defects in material and workmanship.

.2 Product is warranted to perform the intended function within design limits.

2 Products

2.01 General

.1 NEMA 12/4X screw cover enclosures

.2 NEMA 12/4X hidden hinge cover enclosures

.3 NEMA 12/4X external hinge cover enclosures.

2.02 Manufacturers

.1 Bel Products.

.2 Hammond Manufacturing.

.3 Hoffman.

.4 Thomas & Betts.

.5 Ralston Metal.

.6 Approved equal.

2.03 Regulatory Requirements

.1 Provide products listed and classified by CSA (Canadian Standards Association).

2.04 Design and Performance Requirements

.1 NEMA 12/4X screw cover enclosures

.1 Enclosure shall be UL listed in accordance with UL-50 and CSA or cUL certified to CSA C22.2 No. 94.

.2 Enclosure shall have CSA enclosure ratings type 1, 2, 3, 3S, 3X, 3SX, 4, 4X and 12.

.3 Body shall be manufactured from a high-impact, corrosion resistant solid engineering thermoplastic material; UV stabilized for outdoor use and complies with UL-94 minimum V-2 requirements.

.4 Cover shall be manufactured from either a high-impact, corrosion resistant solid engineering material, UV stabilized for outdoor use and comply with UL-94 minimum V-2 requirements, or a clear polycarbonate material, UV stabilized for outdoor use and comply with UL-94 minimum V-2 requirements.

.5 Body and cover shall maintain physical properties through overall temperature range of -31°F. to 230°F.

.6 Body shall be an industrial grey colour, and lid shall be either industrial grey or clear.

.7 Cover and body shall be free of rough corners, sharp edges or burrs.

.8 Cover screws (10-32) shall be captive with a slotted stainless steel (type 304) fillister head.

.9 Factory installed brass inserts shall be provided for cover (10-32), mounting flanges (1/4-20), and panel mounting (10-32) screws.

.10 Mounting flanges shall be removable and shall permit vertical or horizontal placement on the body.

.11 Back panel mounting means shall accept standard size back panels.

.12 Interior body corners shall have dovetail to permit panel to be mounted at any depth.

.13 Swing out panel mounts shall be utilized when a second panel is desired, or when access to the rear of the primary panel is desired.

.14 Hardware kit for adjustable panel mounting shall be available.

.15 Hardware kit for swing out panel mounting shall be available.

.16 Enclosure gasket shall be oil resistant continuous closed cell neoprene.

.17 Enclosure body shall have tapered edges to keep liquids away from cover opening.

.18 Back panel shall be available in either 14 gauge steel, painted white, or in 7 mm (1/4") PVC.

.19 Enclosure shall be available as factory assembly or as individual components.

.2 NEMA 12/4X hidden hinge cover enclosures

.1 Enclosure shall be UL listed in accordance with UL-50 and CSA or cUL certified to CSA C22.2 No.94.

.2 Enclosure shall have CSA enclosure ratings type 1, 2, 3, 3S, 3X, 3SX, 4, 4X, and 12.

.3 Body shall be manufactured from a high-impact, corrosion resistant solid engineering thermoplastic material; UV stabilized for outdoor use and comply with UL-94 minimum V-2 requirements.

.4 Cover shall be manufactured from either a high-impact, corrosion resistant solid engineering material, UV stabilized for outdoor use and comply with UL-94 minimum V-2 requirements, or a clear polycarbonate material, UV stabilized for outdoor use and comply with UL-94 minimum V-2 requirements.

.5 Body and cover shall maintain physical properties through overall temperature range of -35 degrees C to 110 degrees C (-31 degrees F to 230 degrees F).

.6 Body shall be an industrial grey colour, and lid shall be either industrial grey or clear.

.7 Cover and body shall be free of rough corners, sharp edges or burrs.

.8 Cover shall be mounted to body with integral hidden non-metallic hinges that shall provide 145° opening.

.9 Cover shall be removable and interchangeable.

.10 Body shall have integral boss for mounting quick release latches.

.11 Quick release (lockable) latches shall be available in either non-metallic, or in type 304 stainless steel.

.12 Cover screws (10-32) shall be captive with a slotted stainless steel (type 304) fillister head.

.13 Factory installed brass inserts shall be provided for cover (10-32), mounting flanges (1/4-20), and panel mounting (10-32) screws.

.14 Mounting flanges shall be removable and shall permit vertical or horizontal placement on the body.

.15 Back panel mounting means shall accept standard size back panels.

.16 Interior body corners shall have dovetail to permit panel to be mounted at any depth.

.17 Swing out panel mounts shall be utilized when a second panel is desired, or when access to the rear of the primary panel is desired.

.18 Hardware kit for adjustable panel mounting shall be available.

.19 Hardware kit for swing out panel mounting shall be available.

.20 Enclosure gasket shall be oil resistant continuous closed cell neoprene.

.21 Enclosure body shall have tapered edges to keep liquids away from cover opening.

.22 Back panel shall be available in either 14 gauge steel, painted white, or in 7 mm (1/4") PVC.

.23 Enclosure shall be available as factory assembly or as individual components.

.3 NEMA 12/4X external hinge cover enclosures

.1 Enclosure shall be UL listed in accordance with UL-50 and CSA or cUL certified to CSA C22.2 No. 94.

.2 Enclosure shall have CSA enclosure ratings type 1, 2, 3, 3S, 3X, 3SX, 4, 4X, and 12.

.3 Body shall be manufactured from a high-impact, corrosion resistant solid engineering thermoplastic material, UV stabilized for outdoor use and comply with UL-94 minimum V-2 requirements.

.4 Cover shall be manufactured from either a high-impact, corrosion resistant solid engineering material, UV stabilized for outdoor use and comply with UL-94 minimum V-2 requirements, or a clear polycarbonate material, UV stabilized for outdoor use and comply with UL-94 minimum V-2 requirements.

.5 Body and cover shall maintain physical properties through overall temperature range of -35 degrees C to 110 degrees C (-31 degrees F to 230 degrees F).

.6 Body shall be an industrial grey colour, and lid shall be either industrial grey or clear.

.7 Cover and body shall be free of rough corners, sharp edges or burrs.

.8 Cover shall be mounted to body with integral external non-metallic hinges that shall provide 240° opening.

.9 Cover shall be removable and interchangeable.

.10 Body shall have integral boss for mounting quick release latches.

.11 Quick release (lockable) latches shall be available in either non-metallic, or in type 304 stainless steel.

.12 Cover screws (10-32) shall be captive with a slotted stainless steel (type 304) fillister head.

.13 Factory installed brass inserts shall be provided for cover (10-32), mounting flanges (1/4-20), and panel mounting (10-32) screws.

.14 Mounting flanges shall be removable and shall permit vertical or horizontal placement on the body.

.15 Back panel mounting means shall accept standard size back panels.

.16 Interior body corners shall have dovetail to permit panel to be mounted at any depth.

.17 Swing out panel mounts shall be utilized when a second panel is desired, or when access to the rear of the primary panel is desired.

.18 Hardware kit for adjustable panel mounting shall be available.

.19 Hardware kit for swing out panel mounting shall be available.

.20 Enclosure gasket shall be oil resistant continuous closed cell neoprene.

.21 Enclosure body shall have tapered edges to keep liquids away from cover opening.

.22 Back panel shall be available in either 14 gauge steel, painted white, or in 7 mm (1/4") PVC.

.23 Enclosure shall be available as factory assembly or as individual components.

3 Execution

3.01 Installation

.1 Install to CSA C22.1.

.2 Install devices plumb and level.

3.02 Cleaning

.1 Clean exposed surfaces to remove splatters and restore finish.

End of Section

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1 General

1.01 Section Includes

.1 Switches, receptacles, wiring devices, cover plates and their installation.

1.02 Related Requirements

.1 Section 26 09 43 – Network Lighting Controls.

.2 Section 26 27 26.13 – Floor Box Assemblies.

1.03 Unit Prices

.1 Refer to Document 00 43 00.26.

.2 Submit with Tender unit prices to provide the following. Include installation in the unit price:

.1 5-15R specification grade duplex receptacle complete with wiring and conduit, based on 10 metre distance from the local panelboard.

.2 5-20R specification grade duplex receptacle complete with wiring and conduit, based on 10 metre distance from the local panelboard.

.3 Unit cost of additional conduit and wire for the above items.

1.04 References

.1 CSA Group:

.1 CSA C22.1-18, Canadian Electrical Code, Part 1 (24th Edition), Safety Standard for Electrical Installations.

.2 Ontario Electrical Safety Code (27th edition/2018).

.3 CSA C22.2 No. 14-13, Industrial control equipment

.4 CSA C22.2 No. 42-10 (R2015), General use receptacles, attachment plugs, and similar devices.

.5 CSA C22.2 No. 42.1-13, Cover plates for flush-mounted wiring devices.

.6 CSA C22.2 No. 55-15 (R2020), Special use switches.

.7 CSA C22.2 No.111-10 (R2015), General-use snap switches.

.8 CSA C22.2 No. 182.1-17, Plugs, receptacles, and cable connectors of the pin and sleeve type

1.05 Informational Submittals

.1 Submit shop drawings and product data in accordance with Section 01 33 00.

.2 Product Data: Provide manufacturer's catalogue information showing dimensions, colours, and configurations.

.3 Submit manufacturer's installation instructions.

2 Products

2.01 Manufacturers

.1 Eaton.

.2 Hubbell Bryant.

.3 Leviton.

.4 Molex.

.5 Pass & Seymour (Legrand).

2.02 Wall Switches

.1 Single pole, double pole, three-way, four-way switches to: CSA C22.2 No.55 and CSA C22.2 No.111.

.2 Description: CSA-C22.2 No.111, Commercial Spec Grade, AC only general-use snap switch.

.3 Local switches shall be 20 ampere, silent, brown coloured, AC type and CSA certified, specification grade. Provide switches rated to suit system voltage 120 V or 347 V.

.4 Manually-operated general purpose AC switches with following features:

.1 Terminal holes approved for 10 AWG wire.

.2 Silver alloy contacts.

.3 Urea or melamine moulding for parts subject to carbon tracking.

.4 Suitable for back and side wiring.

.5 Voltage: 120 volt or 347 volt, AC as indicated.

.6 Current: 20 amperes.

.7 Body and Handle: white plastic with toggle handle. Confirm finish colour prior to ordering.

.8 Toggle operated fully rated for tungsten filament and fluorescent lamps, and up to 80% of rated capacity of motor loads.

.9 Example Products (Decorator style):

.1 120 volt:

.1 Hubbell HBL2121 series.

.2 347 volt:

.1 Pass & Seymour 2601-347 series.

.10 Example Products (Toggle style):

.1 120 volt:

.1 Hubbell HBL1221 (single pole).

.2 Hubbell HBL1222 (double pole).

.3 Hubbell HBL1223 (three-way).

.4 Hubbell HBL1224 (four-way).

.2 347 volt:

.1 Hubbell HBL18221 (single pole).

.2 Hubbell HBL18223 (three-way).

.3 Pass & Seymour PS372030I.

.11 Local switches and receptacles shall be of the same manufacturer throughout except where a specified item is not made by that manufacturer.

2.03 Receptacles

.1 General

.1 Description: CSA C22.2 No. 42, Commercial Spec Grade general use receptacles.

.2 Device Body: white plastic.

.3 Configuration: Type as specified and indicated.

.4 Convenience Receptacle: Type 5-15, 5-20 where indicated.

.5 GFCI Receptacle: Convenience receptacle with integral ground fault circuit interrupter to meet regulatory requirements.

.6 Data Room Receptacle Types: As indicated on drawings.

.7 Receptacles of one manufacturer throughout project.

.2 Receptacles shall be white coloured, specification grade, unless noted otherwise.

.3 Receptacles shall be as listed below:

.1 15 ampere, 120 volt, single phase grounded duplex receptacle shall be NEMA-U- ground type CSA Configuration 5-15R.

.2 20 ampere, 120 volt, single phase grounded duplex receptacle shall be NEMA-U-ground type CSA Configuration 5-20RA

.3 15 ampere, 120 volt, weatherproof receptacles shall be equal to those above but complete with gasketed cast plate and hinged covers.

.4 Other types of receptacles shall be provided as shown on Drawings.

.5 Duplex receptacles, CSA type 5-15 R, 125 V, 15 A, U ground, to: CSA-C22.2 No. 42 with following features:

.1 White urea moulded housing.

.2 Suitable for No. 10 AWG for back and side wiring.

.3 Break-off links for use as split receptacles.

.4 Eight back wired entrances, four side wiring screws.

.5 Triple wipe contacts and riveted grounding contacts.

.6 Single receptacles CSA type 5-15 R, 125 V, 15 A, U ground with following features:

.1 White urea moulded housing.

.2 Suitable for No. 10 AWG for back and side wiring.

.3 Four back wired entrances, 2 side wiring screws.

.7 Other receptacles with ampacity and voltage as indicated.

.8 Example Products (Decorator style duplex 5-15R):

.1 Pass & Seymour 26252 Series.

.2 Hubbell HBL2152 Series.

.9 Ground Fault Circuit Interrupter (GFCI or GFI) Receptacles

.1 Protected by a ground fault circuit interrupter of the Class A type.

.2 Any receptacle within 1.5 m of a sink must be GFCI protected.

.3 Any receptacle located outdoor must be GFCI protected.

.10 Isolated Ground (IG) Receptacles:

.1 Marked as such (green triangle).

.2 Example Products:

.1 Hubbell IG2152 (15A duplex decorator style, orange faceplate).

.11 Tamper-resistant receptacles.

.1 Marked as such (for example "TR").

.2 To be used in the following spaces:

.1 Child care facilities and kindergarten classrooms.

.2 Guest rooms and suites of hotels and motels.

.3 Preschools and elementary education facilities, including kindergarten facilities.

.4 Dwelling units.

.3 Example Products:

.1 Hubbell BR15WHITR (15A duplex decorator style).

.2 Hubbell BR20WHITR (20A duplex decorator style).

.12 Wet location and weatherproof devices:

.1 Receptacles and cover plates suitable for wet locations, cover plates to provide shielding with and without a plug inserted into the receptacle in accordance with OESC rule 26-702. Cover plates to be marked "Extra Duty".

.2 Receptacles shall be 20 A rated, GFI.

2.04 Cover Plates

.1 Cover plates for wiring devices to: CSA C22.2 No. 42.1.

.2 Cover plates from one manufacturer throughout project.

.3 Sheet steel utility box cover for wiring devices installed in surface-mounted utility boxes.

.4 Stainless steel, vertically brushed, cover plates, thickness 2.5 mm for wiring devices mounted in flush-mounted outlet box.

.5 Cast cover plates for wiring devices mounted in surface-mounted FS or FD type conduit boxes.

.6 Weatherproof double lift spring-loaded cast aluminum cover plates, complete with gaskets for duplex receptacles as indicated.

.7 Weatherproof spring-loaded cast aluminum cover plates complete with gaskets for single receptacles or switches.

.8 Decorative Cover Plate: Polycarbonate.

.1 Pass & Seymour TP26W series.

.9 Switch, receptacle, telephone and other plates shall be stainless steel 18-8 chrome metal alloy, Type 302, non-metallic in finished areas and pressed steel in unfinished areas. Finish brush marks shall be run in a vertical direction.

.10 Wet Location and weatherproof devices: receptacles and cover plates shall be suitable for wet locations, and provide shielding with and without a plug inserted into the receptacle in accordance with 2018 OESC rule 26-710.

2.05 Pendant Receptacles

.1 Pendant cord mounted single receptacles complete with strain relief device.

.2 Strain relief system: Hubbell Kellems Grips, Molex, or equal.

2.06 Receptacle Cord Reels

.1 Retractable cable reel, mounted to structure above. 125 V, 5-20R complete with 12 m (40 feet) of cabtire (or equal).

.2 Provide framing bracket to support reel at underside of structure above.

.3 Connect to GFCI breakers.

.4 Manufacturers:

.1 Hubbell HBL-C40-123TT.

.2 Woodhead (Molex) 997 series.

.3 Approved equal.

2.07 Special Wiring Devices

.1 Pilot lights as indicated, with neon type 0.04 W, 125 V lamp and red plastic jewel flush type.

2.08 Pin and Sleeve Devices

.1 Manufacturers:

.1 Crouse-Hinds by Eaton.

.2 Hubbell.

.3 Meltric.

.4 Mennekes.

.5 Russellstoll (Thomas & Betts).

.6 Walther Electric.

.2 Refer to equipment schedule and plans for locations and specific requirements.

2.09 Regulatory Requirements

.1 Provide products listed and classified by CSA (Canadian Standards Association).

3 Execution

3.01 Examination

.1 Verify that outlet boxes are installed at proper height.

.2 Verify that wall openings are neatly cut and will be completely covered by wall plates.

.3 Verify that branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.

3.02 Preparation

.1 Provide extension rings to bring outlet boxes flush with finished surface.

.2 Clean debris from outlet boxes.

3.03 Installation

.1 Install to CSA C22.1.

.2 Mounting heights in accordance with Section 26 05 00.

.3 Install devices plumb and level.

.4 Install switches with OFF position down.

.5 Install wall dimmers to achieve full rating specified and indicated after de-rating for ganging as instructed by manufacturer.

.6 Do not share neutral conductor on load side of dimmers.

.7 Install receptacles with grounding pole on bottom.

.8 Connect wiring device grounding terminal to outlet box with bonding jumper.

.9 Install decorative plates on switch, receptacle, and blank outlets in finished areas.

.10 Connect wiring devices by wrapping conductor around screw terminal.

.11 Use jumbo size plates for outlets installed in masonry walls.

.12 Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface mounted outlets.

.13 Switches:

.1 Install single throw switches with handle in "UP" position when switch closed.

.2 Install switches in gang type outlet box when more than one switch is required in one location.

.14 Receptacles:

.1 Install receptacles in gang type outlet box when more than one receptacle is required in one location.

.2 Where split receptacle has one portion switched, mount vertically and switch upper portion.

.3 Connect receptacle grounding terminal to the outlet box with an insulated green ground strap.

.4 Receptacles for maintenance of HVAC and similar equipment located on rooftops.

.1 Provide weatherproof GFI 5-20R receptacles on roof, installed at 750 mm (30 inches) above finished roof level, complete with wet location cover plate.

.2 Locate within 7500 mm (25 feet) of new HVAC equipment, and at least 2000 mm (6.5 feet) away from roof line.

.3 Refer to 2018 OESC rules 2-316, 26-708, and 26-710, and OESC bulletin 26-27-0, or latest edition.

.15 Cover plates:

.1 Protect stainless steel cover plate finish with paper or plastic film until painting and other work is finished.

.2 Install suitable common cover plates where wiring devices are grouped.

.3 Do not use cover plates meant for flush outlet boxes on surface-mounted boxes.

.4 Do not install plates until final painting of room or area is completed. Remove protective covering.

.16 Circuit identification: in accordance with Section 26 05 53.

3.04 Field Quality Control

.1 Inspect each wiring device for defects.

.2 Operate each wall switch with circuit energized and verify proper operation.

.3 Verify that each receptacle device is energized.

.4 Test each receptacle device for proper polarity.

.5 Test each GFCI receptacle device for proper operation.

3.05 Adjusting

.1 Adjust devices and wall plates to be flush and level.

3.06 Cleaning

.1 Clean exposed surfaces to remove splatters and restore finish.

End of Section

1 General

1.01 Summary

.1 Section Includes

.1 In-slab and poke-through style floor monuments for electrical, communications, and audio/video purposes.

.2 Related Requirements

.1 Section 26 27 26 – Wiring Devices.

.2 Section 27 15 13 – Communications Copper Horizontal Cabling.

1.02 Reference Standards

.1 Except as modified by governing codes and by the Contract Documents, comply with the latest applicable provisions and latest recommendations of the following:

.1 UL Standard #514.

1.03 Submittals

.1 Submit manufacture's catalog cuts and specifications for all floor boxes, and accessories.

2 Products

2.01 Manufacturers

.1 Canadian Electric Raceways.

.2 Hubbell.

.3 Wiremold.

.4 Wellmark.

.5 Steel City.

2.02 Floor Monuments, General

.1 Power: two duplex 5-20R receptacles.

.2 Data: up to four voice/data drops.

.3 Audio/Video:

.1 VGA

.2 PC Audio.

.4 Power and Low Voltage Divider.

.5 Monument lid should be flush with finished floor, and be able to accept a cut-to-fit carpet or vinyl tile.

2.03 Floor Boxes

.1 Floor Boxes: CSA C22.2 No. 18, fully adjustable, 38 mm deep.

.2 Material: Cast metal.

.3 Shape: Rectangular.

.4 Service Fittings: As specified in Section 26 27 26.

.5 Cast aluminum boxes for devices installed below raised floor or on side of overhead cable tray for computer room

3 Execution

3.01 Coordination

.1 Coordinate exact pathways of conduits to suit structural conditions.

.2 Confirm exact conduit sizes with communications trade.

.3 Install dedicated conduits for each floor box. Do not daisy chain conduits between floor boxes.

3.02 Installation

.1 Contractor to verify the thickness of the floor and select the through floor component that fits floor thickness.

.2 Install floor box so that cover plates are flush with top of finished floor.

.3 The electrical documents shall not be used for the purpose of establishing locations of floor outlets. The location of such outlets shall be established by the Architect.

End of Section

1 General

1.01 Submittals

.1 Provide submittals in accordance with Section 01 33 00.

.2 Product Data:

.1 Provide fuse performance data characteristics for each fuse type and size above 200 amps. Performance data to include: average melting time-current characteristics.

.3 Shop Drawings:

.1 Provide shop drawings in accordance with Section 01 33 00.

1.02 Delivery, Storage, and Handling

.1 Ship fuses in original containers.

.2 Do not ship fuses installed in switchboard.

.3 Store fuses in original containers in storage cabinet.

.4 Waste Management and Disposal:

.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 00.

1.03 Maintenance Material Submittals

.1 Provide maintenance materials in accordance with Section 01 78 23.

.2 3 spare fuses of each type and size installed above 600 A.

.3 6 spare fuses of each type and size installed up to and including 600 A.

2 Products

2.01 Manufacturers

.1 Bussman by Eaton.

.2 GEC.

.3 Littelfuse.

.4 Mersen.

.5 Substitutions: not permitted.

2.02 Fuses - General

.1 Fuse type references L1, L2, J1, R1, etc. have been adopted for use in this specification.

.2 Fuses: product of one manufacturer.

.3 Fuses shall be sized as shown, time delay type, and of the same type throughout.

.4 Fuses shall be CSA certified Class-J for 1-600A or Class-L for 650 Amps and above.

2.03 Fuse Types

.1 Class J fuses.

.1 Type J1, time delay, capable of carrying 500 per cent of its rated current for 10 seconds minimum.

.2 Type J2, fast acting.

.2 Class L fuses.

.1 Type L1, time delay, capable of carrying 500 per cent of its rated current for 10 seconds minimum.

.2 Type L2, fast acting.

.3 Class R fuses.

.1 Type R1, (UL Class RK1), time delay, capable of carrying 500 per cent of its rated current for 10 seconds minimum, to meet UL Class RK1 maximum let-through limits.

.2 Type R2, time delay, capable of carrying 500 per cent of its rated current for 10 seconds minimum.

.3 Type R3, (UL Class RK1), fast acting Class R, to meet UL Class RK1 maximum let-through limits.

2.04 Fuse Requirements

.1 Dimensions and Performance: CSA C22.2 No. 248 Series, Class as specified or indicated.

.2 Voltage: Provide fuses with voltage rating suitable for circuit phase-to-phase voltage.

.3 Power Load Feeder Switches: HRC-1 Class J time delay type.

.4 Other Feeder Switches: HRC-1 Class J time delay type.

2.05 Spare Fuse Cabinet

.1 Description: Wall-mounted sheet metal cabinet, suitably sized to store spare fuses and fuse pullers specified.

.2 Doors: Hinged, with hasp for Owner's padlock.

.3 Finish: Prime finish for field painting.

.4 Dimensions: Minimum 914 mm (36 in) by 914 mm (36 in) by 305 mm (12 in).

3 Execution

3.01 Installation

.1 Install fuses to manufacturer's instructions.

.2 Install fuse with label oriented such that manufacturer, type, and size are easily read.

.3 Install spare fuse cabinet in electrical room.

.4 Provide a complete set of fuses in each fusible device supplied under this Division and provide 3 spare fuses for each size used in spare fuse cabinet.

End of Section

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1 General

1.01 Section Includes

.1 Materials for Molded-Case Circuit Breakers (MCCB).

.2 Accessories

1.02 Related Requirements

.1 Section 26 24 13 – Switchboards.

.2 Section 26 24 16 – Panelboards.

1.03 References

.1 CSA C22.1-18, Canadian Electrical Code, Part 1 (24th Edition), Safety Standard for Electrical Installations.

.2 Ontario Electrical Safety Code (27th edition/2018).

.3 CSA C22.2 No. 5-16, Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures.

.4 NEMA AB1 - Molded Case Circuit Breakers, Molded Case Switches, and Circuit - Breaker Enclosures.

.5 NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment (published by the International Electrical Testing Association).

1.04 Submittals

.1 Submit product data in accordance with Section 01 33 00.

.2 Include time-current characteristic curves for breakers with ampacity of 400 A and above, or with interrupting capacity of 22,000 A symmetrical (rms) and over at system voltage.

.3 Include termination temperature rating in degrees C.

.4 Certificate of Origin

.1 Prior to any installation of circuit breakers in either a new or existing installation, Contractor must submit three (3) copies of a certificate of origin from the manufacturer, duly signed by the factory and the local manufacturer's representative, certifying that all circuit breakers come from this manufacturer, they are new and they meet standards and regulations. These certificates must be submitted to the Consultant for review.

.2 A delay in the production of the certificate of origin won't justify any extension of the contract and additional compensation.

.3 Any work of manufacturing, assembly or installation should begin only after acceptance of the certificate of origin by the Consultant. Unless complying with this requirement, Consultant reserves the right to mandate the manufacturer listed on circuit breakers to authenticate all new circuit breakers under the contract, and that, to Contractor's expense.

.4 In general, the certificate of origin must contain:

.1 The name and address of the manufacturer, and the person responsible for authentication. The responsible person must sign and date the certificate;

.2 The name and address of the licensed dealer, and the person of the distributor responsible for the Contractor's account.

.3 The name and address of the Contractor, and the person responsible for the project.

.4 The name and address of the local manufacturer's representative. The local representative must sign and date the certificate.

.5 The name and address of the building where circuit breakers will be installed:

.1 Project title

.2 End user's reference number

.3 The list of circuit breakers

2 Products

2.01 General

.1 Molded-case circuit breakers, Circuit breakers, and Ground-fault circuit-interrupters, Fused circuit breakers, and Accessory high-fault protectors: to CSA C22.2 No. 5

.2 Bolt-on Molded case circuit breaker: quick- make, quick-break type, for manual and automatic operation with temperature compensation for 40 degrees C ambient.

.3 Plug-in Molded case circuit breakers: quick-make, quick-break type, for manual and automatic operation with temperature compensation for 40 degrees C ambient.

.4 Common-trip breakers: with single handle for multi-pole applications.

.5 Magnetic instantaneous trip elements in circuit breakers to operate only when value of current reaches setting.

.1 Trip settings on breakers with adjustable trips to range from 3-8 times current rating.

.6 Circuit breakers with interchangeable trips.

2.02 Interrupting Capacity

.1 Protective devices shall be fully rated, for required available fault current. Series rated shall not be used on this installation.

.2 Refer to panelboard and switchboard Specification Sections.

2.03 Molded Case Circuit Breakers – General

.1 Molded case circuit breaker to operate automatically by means of thermal and magnetic tripping devices to provide inverse time current tripping and instantaneous tripping for short circuit protection.

.2 NEMA AB 1, circuit breakers with integral thermal and instantaneous magnetic trip in each pole.

.3 Provide circuit breakers UL listed as Type HACR for air conditioning equipment branch circuits.

.4 1-, 2-, or 3-pole bold on, single-handle common trip voltage as indicated on drawings.

.5 Overcentre toggle-type mechanism, quick-make, quick-break action. Trip indication is by handle position.

.6 Calibrate for operation in 40 degree C ambient temperature.

2.04 Molded Case Circuit Breakers – Up to 150 Ampere

.1 Permanent trip unit containing individual thermal and magnetic trip elements in each pole, unless noted otherwise on drawings.

2.05 Molded Case Circuit Breakers – 151 to 399 Ampere

.1 Variable magnetic trip elements. Provide push-to-trip button on cover of breaker for mechanical tripping.

2.06 Molded Case Circuit Breakers – 400 Ampere and Above

.1 Electronic trip type with adjustments for long-time, instantaneous and short-time functions.

.2 Provide ground fault function for breakers greater than 400 Amps.

.3 1000 Amp and Above:

.1 Modbus Communications

.1 Breaker status.

.1 Open.

.2 Closed.

.3 Tripped.

.2 Cause of trip.

.3 Time of trip.

.4 Current at time of trip.

.5 RMS currents per phase and ground.

.6 Peak demand.

.7 Present demand.

.8 Energy consumption.

.4 1200 Amp and Above:

.1 Provide handle mechanisms that are lockable in the open (off) position.

2.07 Additional Features

.1 Provide as indicated on drawings:

.1 Shunt trip

.2 Auxiliary switch

.3 Motor-operated mechanism.

.4 Under-voltage release

.5 On-off locking device

.6 Handle mechanism

3 Execution

3.01 Installation

.1 Install circuit breakers as per related sections.

End of Section

1 General

1.01 Section Includes

.1 Fusible and non-fusible enclosed low-voltage disconnect switches from 30 to 800 amps.

1.02 Related Requirements

.1 Section 26 28 13 – Fuses.

1.03 References

.1 Canadian Standards Association

.1 CSA C22.1-18, Canadian Electrical Code, Part 1 (24th Edition), Safety Standard for Electrical Installations.

.2 Ontario Electrical Safety Code (27th Edition/2018).

.3 CAN/CSA-C22.2 No. 4-16 – Enclosed and Dead-Front Switches.

.4 CSA C22.2 No. 248 series – Low-voltage fuses.

.2 NETA (International Electrical Testing Association) ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

1.04 Submittals

.1 Product Data: Provide switch ratings, and enclosure dimensions.

1.05 Closeout Submittals

.1 Record actual locations of enclosed switches in project record documents.

2 Products

2.01 Manufacturers

.1 Eaton Cutler-Hammer.

.2 Siemens.

.3 Square D by Schneider Electric.

2.02 Regulatory Requirements

.1 Products: Listed and classified by CSA or testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

2.03 Disconnect Switches

.1 Provide dedicated disconnect switches at electrical equipment.

.2 Fused or un-fused disconnect or safety switches: Type "A", quick-make, quick-break construction with provision for padlocking switches in either "ON" or "OFF" position.

.1 Quick-make, quick-break.

.2 Heavy duty industrial type.

.3 Lockable with up to 3 padlocks.

.4 Cover interlocked with switch mechanism.

.5 Viewing window for viewing blades.

.3 Fused switches equipped with fuse clips designed for Class "J" fuses and designed to reject standard NEC fuses.

.4 Enclosure: CSA Type 1 sprinkler-proof, or as noted.

.5 Switches throughout project of same manufacturer.

3 Execution

3.01 Installation

.1 Provide fused or un-fused safety or disconnect switches as shown and as required by Code.

.2 Install disconnect switches complete with fuses, if applicable, to CSA C22.1.

.3 Apply neatly typed adhesive tag on inside door of each fusible switch indicating NEMA fuse class and size installed.

.4 Coordinate fuse ampere rating with installed equipment. Fuse ampere rating variance between original design information and installed equipment, size in accordance with Bussmann Fusetron 40 degree C recommendations. Do not provide fuses of lower ampere rating than motor starter thermal units.

End of Section

1 General

1.01 Summary

.1 Section Includes

.1 These specifications describe pertinent material requirements and installation practices for externally mounted, Low Voltage AC Power Panel Surge Protective Devices (SPDs). Furnish and install the SPDs equipment having the electrical characteristics, ratings and modifications as specified herein and as shown on the contract drawings.

.2 The specifications in this section describe the electrical and mechanical requirements for a protection system provided by high-energy Surge Protective Devices. The specified system shall provide effective, high-energy surge current diversion and be suitable for application in ANSI/IEEE C62.41 Category A, B, and C environments (as tested by ANSI/IEEE C62).

.2 Applicability

.1 SPDs shall be fully applicable for the purpose of protecting all facility AC electrical circuits from the hazardous effects of transient voltages. These transients may be generated externally by lightning induced energies, utility load factor corrections, and substation switching, or they can be internally generated due to inductive and/or capacitive load switching.

.3 Suitability

.1 SPDs shall be suitable for all service entrance switchboards, panelboards and motor control centres as indicated on the electrical layouts and single line diagrams. Products are to be configured for parallel installation - no series designs shall be considered acceptable. Design products to allow installation as a stand-alone device allowing mounting adjacent to switchboards, panelboards, and motor control centres. Installation is to be accomplished by a qualified electrical contractor.

1.02 Related Requirements

.1 Section 26 24 13 – Switchboards.

.2 Section 26 24 16 – Panelboards.

.3 Section 26 28 16.02 – Molded Case Circuit Breakers.

1.03 References

.1 CSA Group:

.1 CSA C22.1-18, Canadian Electrical Code, Part 1 (24th Edition), Safety Standard for Electrical Installations.

.2 Ontario Electrical Safety Code (27th edition/2018).

.3 CSA C22.2 No. 269.2-17 – Surge Protective Devices - Type 2 - Permanently Connected.

.2 Institute of Electrical and Electronics Engineers (IEEE):

.1 IEEE C62.41.1-2002 - IEEE Guide on the Surge Environment in Low-Voltage (1000 V and less) AC Power Circuits.

.2 IEEE C62.41.2-2002 - IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits.

.3 IEEE C62.45-2002, Guide on Surge Testing for Equipment Connected to Low-Voltage AC Power Circuits.

.4 IEEE C62.62-2010, Standard Test Specifications for Surge Protective Devices.

.5 IEEE 142-2007, Recommended Practice for Grounding of Industrial and Commercial Power Systems - Green Book.

.6 IEEE 1100-2005, Recommended Practice for Powering and Grounding Electronic Equipment - Emerald Book.

.3 National Electrical Manufacturers Association (NEMA):

.1 NEMA LS-1. Document rescinded in entirety August 19, 2009. No replacement document has been issued.

.4 Ontario Building Code and its referenced standards.

.5 Underwriters Laboratories Inc. (UL):

.1 UL 1283 (4th Edition) - 2005, Standard for Electromagnetic Interference Filters.

.6 Other relevant standards:

.1 MIL-STD-220C, Method of Insertion-Loss Measurement.

1.04 Definitions

.1 Surge Protective Device: A device composed of at least one non-linear component and intended for limiting surge voltages on equipment by diverting or limiting surge current and is capable of repeating these functions as specified. SPDs were previously known as Transient Voltage Surge Suppressors (TVSS) or secondary surge arresters.

.2 SPD Types:

.1 Type 1 – Permanently connected device installed before or after the service disconnect overcurrent device and intended to be installed with no external overcurrent protective device

.2 Type 2 – Permanently connected Type 2 SPDs are intended for installation on the load side of the service equipment overcurrent device, including SPDs located at the branch panel.

.3 Type 3 – Point of use SPDs that are installed with a minimum of 30 feet of conductor length from the service panel. These 30 feet of conductor length does not include conductors used to attach the SPD. Some examples of Type 3 SPDs are cord connected, direct plug-in and receptacle type SPDs.

.4 Type 4 — component assemblies.

.5 Type 5 — components.

.3 L-G: measurements from phase to equipment grounding conductor as line terminals of utilization equipment.

.4 L-L: measurements from phase to phase in a polyphase system, or from one line to another line in a single phase system.

.5 L-N: measurement from phase(s) to neutral for both single and three phase systems.

.6 N-G: measurements from neutral to equipment grounding conductor at line terminal of utilization equipment.

.7 Externally mounted SPD: Surge Protective Device (SPD) mounted outside of the power panel as a separate component.

1.05 Submittals

.1 Submit in accordance with Section 01 33 00.

.2 Shop Drawings:

.1 Line drawings or catalog sheets detailing dimensions and weight of enclosure, lifting and support points, and enclosure details.

.2 Internal wiring diagram illustrating all modes of protection in each type of SPD required.

.3 Wiring diagram showing all field connections and manufacturer's recommended wire size, recommended circuit breaker or fuse size, required overcurrent protection type, and maximum lead length.

.3 Provide the following product data:

.1 Voltage Protection Ratings (VPRs), I-nominal ratings, Short Circuit Current Ratings, SPD type designations, dimensions showing construction, per mode and per phase peak surge current, modes of discrete suppression circuitry, warranty period, and replacement terms.

.2 List and detail all protection systems such as fuses, disconnecting means, and protective features.

.4 Submit product data for all components and accessories.

.5 Manufacturer's Installation Instructions:

.1 Indicate application conditions and limitations of use stipulated by product testing agency specified under Regulatory Requirements.

.2 Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.

.6 Test reports:

.1 Submit cover sheet of test report from a recognized independent testing laboratory certifying compliance with CSA C22.2 No. 269.2.

.2 Provide verification that the SPD complies with CSA C22.2 No. 269.2.

.3 Provide spectrum analysis of each unit based on MIL-STD-220C test procedures between 10 kHz and 100 kHz verifying the devices noise attenuation equals or exceeds values indicated in this section.

.4 Documentation verifying Short Circuit Current Rating (SCCR).

.5 Proof of UL 1283 listing for EMI filters.

.7 Upon request, present unencapsulated but complete SPD for visual inspection; proprietary technology included. MOV type and quantity shall reflect kA ratings on cut sheets, verification of monitoring, thermal, overcurrent protection, etc.

.8 Include the following information:

.1 Data for each suppressor type indicating conductor sizes, conductor types, and connection configuration and lead lengths.

.2 Manufacturer's certified test data indicating the ability of the product to meet or exceed requirements of this specification.

.3 Drawings, with dimensions, indicating SPD mounting arrangement and lead length configuration, and mounting arrangement of any optional remote diagnostic equipment and assemblies.

.4 List and detail all protection systems such as fuses, disconnecting means and protective materials.

.5 Indicate SPD wiring, bonding, and grounding connections on wiring diagrams for each system. Include installation details demonstrating mechanical and electrical connections to equipment to be protected.

.6 Wiring diagram of SPD diagnostic indicators.

1.06 Closeout Submittals

.1 Maintenance data: submit operation and maintenance data, and engineering data for incorporation into manual specified in Section 01 78 23.

.2 Warranty document.

1.07 Environmental Requirements

.1 Operating temperature range: -40 degrees C to 70 degrees C (-40 degrees F to 160 degrees F).

.2 Elevation: Operation up to 3 658 m (12 000 feet) above sea level.

.3 Generate no appreciable magnetic fields.

1.08 Delivery, Storage, and Handling

.1 Deliver, store, and handle in accordance with Section 01 60 00.

.2 Store materials in dry, secure location and protect from weather.

.3 Protect from moisture and humidity.

.4 Store in accordance with manufacturer's written instructions.

.5 Waste management and disposal in accordance with Section 01 74 00.

1.09 Manufacturer Warranty

.1 Five-year warranty.

.2 Since "Acts of Nature" or similar statements typically include the threat of lightning to which the SPD shall be exposed, any such clause limiting warranty responsibility in the general conditions of this specification shall not apply to this section. This is, the warranty shall cover the effects of lightning, single phasing, and all other electrical anomalies. The warranty shall cover the entire device, not just various components, such as modules only.

1.10 Manufacturer Qualifications

.1 Manufacturer regularly engaged in the design, manufacturing and testing of SPD's of the types and ratings required for a period of not less than five years. Manufacturers requesting product approval must meet or exceed the written specification contained herein. Manufacturers requesting approval must receive written verification of product acceptance by the Consultant ten days prior to the bid date.

1.11 Quality Assurance

.1 All SPDs manufactured by a single ISO 9001 registered company normally engaged in the design, development and manufacture of such devices for electrical and electronic system equipment protection.

.2 Manufacturer regularly engaged in the manufacture of surge suppression products for the specified categories for minimum of ten years.

.3 Manufacturer shall offer repair or replacement service for all materials and components incorporated in the Surge Protective Devices.

.4 Technical assistance (no cost to customer) provided by manufacturer through a factory representative or a local distributor and a factory staffed toll-free technical hotline.

.5 Manufacturer shall provide a toll-free customer service phone number to facilitate all inquiries regarding product returns, warranty claims, purchasing requirements and payment or credit issues.

.6 Listed to most recent edition of CSA C22.2 No. 269.2.

.7 Products certified by a recognized testing agency accredited by the Standards Council of Canada, and bear a certification mark from that agency indicating acceptance to Canadian standards.

.1 Equipment certification by one of the following bodies:

.1 Listed by Underwriters Laboratories, Inc. and exhibit the cUL Listing Mark for the category "Surge Protective Devices" or SPD. Provide UL Listing Card under category VZCA7 (SPDs certified for Canada) to confirm compliance to CSA C22.2 No. 269.2, and assigned Voltage Protection Ratings.

.2 Listed by ETL.

.3 Certified by CSA Group.

.2 SPD to be labeled with no less than a 100 kA Short Circuit Current Rating (SCCR).

2 Products

2.01 Outdated and Defunct Specification Criteria

.1 Selection of SPD is not be made, solely, or in part, based upon any of the following ambiguous specifications, and obsolete terminology. These terms are no longer recognized by ANSI, NEMA, IEEE, or IEC standards as bonafide suppressor performance parameters. Submittals bearing reference to any of the following will be rejected.

.1 A1 ringwave: removed in 2002 revisions of IEEE C62 documents.

.2 Joule ratings: there is no recognized standard for SPD joule ratings.

.3 NEMA LS-1: document rescinded by NEMA.

.4 Response time: not endorsed by IEEE, NEMA, or UL as a valid SPD rating parameter.

.5 Suppressed Voltage Ratings (SVR): terminology deprecated with UL 1449 third and subsequent editions.

2.02 Manufacturers

.1 Manufacturer List

.1 Asco.

.2 Citel.

.3 Current Technology.

.4 Mersen.

.5 Raycap Electrical Protection Systems.

.6 Total Protection Solutions.

.2 Substitution Limitations: No unit will be accepted as an "approved equal" unless it meets the warranty, strength, safety features, performance ratings, and all other requirements of this specification.

.3 Product Options:

.1 The inclusion of a manufacturer in the following list does not indicate the manufacturer meets all the requirements in this specification. Likewise, the omission of a manufacturer is not indicative of any lack of qualification. The manufacturer and product must meet all the requirements of this specification.

.2 The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety. Products in compliance with the specification and manufactured by others not named will be considered only if pre-approved by the Consultant ten (10) days prior to bid date.

2.03 Surge Protection Devices – General

.1 Obtain all surge suppression devices through one source from a single manufacturer.

.2 SPD separate from panelboards. Integral SPDs not acceptable.

.3 The SPD listed by recognized testing agency accredited by the Standards Council of Canada, and bear a certification mark from that agency indicating acceptance to Canadian standards, and to UL's 1283 and UL's 1449 standards (latest edition, latest revision), and not merely the components or modules. Label all SPDs as a Type 2 for use in Type 1 and Type 2 locations.

.4 Protect all modes L-G, L-N, L-L, and N-G, have discrete suppression circuitry in L-G, L-N, and N-G, and have bidirectional, positive, and negative impulse protection. Line-to-neutral-to-ground protection is not acceptable where line-to-ground is specified, and accordingly reduced mode units with suppression circuitry built into only four modes are not acceptable. In delta systems, line-to-ground-to-line protection is not acceptable where line-to-line is specified.

.5 If a disconnect switch is specified, the disconnect switch and the SPD as a system shall be capable of interrupting up to a minimum 100 kA symmetrical fault current with 600 VAC applied.

.6 Suppression Components:

.1 Metal Oxide Varistors (MOVs).

.2 Gas tubes, silicon avalanche diodes, or selenium cells: not permitted.

.3 Every suppression component of every mode, including N-G, shall be protected by internal overcurrent and thermal overtemperature controls, such as through the use of Thermally Protected MOVs (TPMOVs).

.4 Where SPD is not equipped with overtemperature controls, pack all surge components, current carrying paths and fusing in fuse grade silica sand or epoxy potting for arc quenching capability, minimization of smoke and contaminates in the event of failure.

.7 Internal Fusing - Overcurrent Protection

.1 Individually fuse each suppression component for safety and performance.

.2 Fusing shall be present in every mode, including Neutral-to-Ground.

.3 All overcurrent protection must be included within the device, and not require external overcurrent protection.

.8 Surge Current Rating

.1 Service Entrance: 200 kA per phase.

.2 Distribution: 100 kA to 200 kA per phase.

.3 Point of Use: 100 kA per phase.

.9 Short Circuit Current Rating (SCCR), sometimes referred to as fault current rating: minimum 100 kA.

.10 Nominal Discharge Current (In, or I-nominal):

.1 UL labelled with a minimum 10 kA I-nominal.

.11 Maximum Continuous Operating Voltage (MCOV): The maximum continuous operating voltage (MCOV) of all components not less than 125 per cent for a 120 V system, 120 per cent for 220 and 240 V systems, and 115 per cent for 347 and 600 V systems.

.1 277 V systems: 320 V MCOV.

.2 480 V systems: 552 V MCOV.

.12 Voltage Protection Ratings (VPRs) to not exceed the following:

Voltage	**L-N**	**L-G**	**N-G**
208Y/120	800 V	800 V	800 V
480Y/277	1200 V	1200 V	1200 V
600Y/347	1500 V	1500 V	1500 V
Voltage	**L-L**	**L-G**	
480 Delta	1800 V	1800 V	
600 Delta	2500 V	2500 V	

.13 Minimum EMI/RFI filtering of -50 dB at 100 kHz.

.14 SPD enclosure:

.1 Minimum NEMA type 12 rating in indoor applications.

.2 Minimum NEMA type 4 in outdoor applications.

.15 Diagnostics and Monitoring:

.1 Visual LED diagnostics to indicate failure of a suppression component. Monitor every suppression component of every mode, including N-G.

.2 Form C dry contacts (NO or NC) for remote monitoring capability to indicate the failure of any MOV in the unit.

2.04 Service Entrance and Transfer Switch SPDs

.1 CSA certified and labeled as a Type 2 device.

.2 SPDs relying on an external breaker or fuse as supplemental overcurrent protection do not meet the intent of this specification and will be rejected.

.3 CSA certified listed and labeled with a minimum I-nominal rating of 20 kA.

.4 An approved disconnect switch provided as a means of service disconnect if a 60 A breaker is not available.

.5 Connect SPD using the manufacturer's breaker/wire recommendations. If recommendations are not available, use a 60 amp breaker and 6 AWG cable with full size ground.

.6 Minimum Surge Current Rating: 200 kA per phase (100 kA per mode).

2.05 Distribution Panelboard and Motor Control Centre SPDs

.1 CSA certified listed and labeled as a Type 2 device.

.2 SPDs relying on an external breaker or fuse as supplemental overcurrent protection do not meet the intent of this specification and will be rejected.

.3 CSA certified listed and labeled with a minimum I-nominal rating of 20 kA.

.4 SPD connected using the manufacturer's breaker/wire recommendations. If recommendations are not available a 60 A breaker and 6 AWG with full size ground will be used.

.5 Minimum Surge Current Rating: 100 kA per phase (50 kA per mode).

2.06 Lighting and Receptacle Branch Circuit Panelboard SPDs

.1 CSA certified listed and labeled as a Type 2 device.

.2 SPDs relying on an external breaker or fuse as supplemental overcurrent protection do not meet the intent of this specification and will be rejected.

.3 CSA certified listed and labeled with a minimum I-nominal rating of 10 kA.

.4 SPD connected using the manufacturer's breaker/wire recommendations. If recommendations are not available a 60 A breaker and 6 AWG will be used.

.5 Minimum Surge Current Rating: 100 kA per phase (50 kA per mode).

3 Execution

3.01 Pre-Installation Meetings

.1 Pre-installation meetings: conduct pre-installation meeting one week prior to commencing work of this Section and on-site installations to verify project requirements, substrate conditions and co-ordination with other building sub-trades, to review manufacturer's installation instructions and warranty requirements.

3.02 Field Quality Control

.1 Have manufacturer of products supplied under this Section review Work involved in the handling, installation, application, protection, and cleaning of its products. Submit written reports in acceptable format to verify compliance of Work with Contract in accordance with Section 01 33 00 and Section 01 78 23.

.2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

.3 Schedule site visits to review work at stages listed:

.1 After delivery and storage of products, and when preparatory work on which the work of this Section depends is complete, but before installation begins.

.2 Twice during progress of work at 66 per cent and 99 per cent complete.

.3 Upon completion of the work, after cleaning is carried out.

.4 Obtain reports within three (3) days of review and submit immediately to Consultant.

3.03 Examination

.1 Verify service and separately derived system Neutral to Ground bonding jumpers.

3.04 Installation

.1 Do complete installation in accordance with CSA C22.1, CSA C22.2 No. 0, ANSI/IEEE C62.41, and all other applicable codes.

.2 Manufacturer's instructions

.1 Install SPD in accordance with manufacturer's installation instructions with lead lengths as short and as straight as practically possible. Lead lengths no greater than 600 mm (24 inches). Gently twist conductors together.

.2 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions.

.3 Connect SPD to service panel being protected via a circuit breaker for each phase, based on the number of poles and the connecting wire size, with a 100 A maximum.

.4 Follow the SPD manufacturer's recommended installation practice as outlined in the equipment installation manual. Ensure that all neutral conductors are bonded to the system ground at the service entrance or the serving isolation transformer prior to installation of the associated SPD.

.5 Installation position of SPD:

.1 Locate SPD adjacent to the panelboard, in a position as close as possible to the neutral and ground lugs. Rearrange breaker positions for SPDs to minimize the length of the phase, neutral, and ground conductors.

.2 Mount SPD as close as possible to panel being protected in a position that will minimize lead lengths between suppressor and control breaker(s) to which suppressor connects. Utilize conduit, preferably metallic, to accomplish these connections with a recommended minimum wire size of 10 AWG, a maximum wire size of 4 AWG (for ease of dressing), or as noted on the single line diagram. Do not extend suppressor leads beyond manufacturer's recommended maximum length without specific engineering approval. The rationale for this is the longer connecting leads between the SPD and the power panel, the higher the residual transient voltage.

.3 Locate surge suppressors as indicated and mount securely, plumb, true, and square to adjoining surfaces.

.4 Install surface mounted surge suppressors on fire-retardant plywood backboards as recommended in manufacturer's written instructions. Where practical, group SPDs on common backboard with other equipment.

.5 Mount housings and enclosures on fire-retardant plywood backboard with top not higher than 1.8 m (6 feet) above finished floor.

.6 Wiring:

.1 Install units on a breaker, sized, where indicated, that meets or exceeds the fault current rating of the switchgear or panelboard.

.2 Connect SPD to service panel being protected via a circuit breaker for each phase, based on the number of poles and the connecting wire size. Connect SPD using the manufacturer's breaker/wire recommendations.

.1 If recommendations are not available, a 60 A breaker and 6 AWG phase, neutral, and ground conductors will be used.

.2 If the SPD is supplied with lead wires, match the overcurrent protection to the 75 degree C ampacity of the wiring as described in Ontario Electrical Safety Code, Table 2; i.e. a 30 A breaker to suit 10 AWG lead wires.

.3 Install SPD in a neat, workmanlike manner. Dress leads as short and as straight as possible and be consistent with recommended industry practices for the application on which these units are installed. Bind phase, neutral, and ground conductors tightly (one twist per 30 cm) over entire run, from suppressor to service panel, and always use the shortest length of connecting cable possible.

.4 If the SPD is supplied by the manufacturer with lead wires, cut excess lead length.

End of Section

1 General

1.01 Section Includes

.1 Solid state, light emitting diode (LED) source interior luminaires.

.2 New, fully integrated luminaires for indoor applications.

1.02 Related Requirements

.1 Section 26 09 43 – Network Lighting Controls.

.2 Section 26 52 13.13 – Emergency Lighting.

1.03 References

.1 Canadian Standards Association (CSA)

.1 CSA C22.1-18, Canadian Electrical Code, Part 1 (24th Edition), Safety Standard for Electrical Installations.

.2 Ontario Electrical Safety Code (27th edition/2018).

.3 CSA C22.2 No. 250.0 - Luminaires (Bi-National Standard, with UL 1598).

.2 DesignLights Consortium (DLC).

.1 Technical Requirements Table v4.4, or latest edition.

.2 Where the specifications do not explicitly call for DLC qualified LED luminaires, the technical criteria provided in the DLC Technical Requirements provide the basis of the requirements for this section of the Specification.

.3 Energy Star

.1 Program Requirements for Luminaires - Eligibility Criteria, Version 1.2, or latest edition.

.4 Illuminating Engineering Society (IES)

.1 IES HB-10-11 – The Lighting Handbook, 10th Edition.

.2 IES LM-79-08 – Approved Method: Electrical and Photometric Measurements of Solid-State Lighting Products.

.3 IES LM-80-08 – IES Approved Method for Measuring Lumen Maintenance of LED Light Sources.

.4 IES TM-21-11 – IES Technical Memorandum on Projecting Long Term Lumen Maintenance of LED Light Sources.

.5 National Electrical Manufacturer's Association (NEMA)

.1 SSL-1-10 – Electronic Drivers for LED Devices, Arrays, or Systems.

.2 WD 6 - Wiring Devices - Dimensional Requirements.

1.04 Definitions

.1 CCT: Correlated colour temperature.

.2 CRI: Colour-rendering index.

.3 LED: Light Emitting Diode.

.4 Lumen: Measured output of lamp and luminaire, or both.

.5 Luminaire: Complete lighting fixture, including ballast housing if provided.

1.05 Action Submittals

.1 Refer to Section 01 33 00.

.2 Product submittals shall be accompanied by product specification sheets or other documentation that includes the designed parameters as detailed in this specification. These parameters include (but not limited to):

.1 Maximum power in Watts.

.1 If a transformer is used in conjunction with a driver (for example on some 347 volt lighting circuits), the maximum power shall include the transformer losses.

.2 L70 in hours, when extrapolated for the worse case operating temperature. TM-21 report shall be submitted to demonstrate this.

.3 Product submittals shall be accompanied by performance data that is derived in accordance with appropriate IESNA testing standards and tested in a laboratory that is NVLAP accredited for Energy Efficient Lighting Products.

1.06 Informational Submittals

.1 Installation instructions.

1.07 Closeout Submittals

.1 Section 01 78 23: Submittals for project closeout.

.2 Submit manufacturer's operation and maintenance instructions for each product.

.3 Warranty information.

1.08 Qualifications

.1 Manufacturer: Company specializing in manufacturing the products specified in this section with minimum five years documented experience.

1.09 Regulatory Requirements

.1 Products shall be listed and classified by CSA (Canadian Standards Association), ULC (Underwriter's Laboratories of Canada), or certified by recognized independent testing organizations that test to CSA standards.

.2 Products shall be certified by a recognized testing agency accredited by the Standards Council of Canada and bear a certification mark from that agency.

.3 All luminaires shall be listed and labeled for installation in fireproof or non-fireproof construction, dry, damp, or wet locations as required.

.4 Recessed fixtures mounted in an insulated ceiling shall be listed for use in insulated ceilings.

1.10 Delivery, Storage, and Handling

.1 Deliver, store and handle materials in accordance with Section 01 60 00.

.2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

1.11 Extra Stock Materials

.1 Refer to Section 01 78 23.

.2 Provide the following additional equipment as listed herein.

.1 Provide an additional 2 per cent spare luminaires of each new type to be provided.

.2 Provide 1 per cent of each plastic lens type.

.3 Provide three of each type of any special tools required for system use and maintenance.

1.12 Warranty

.1 Refer to Section 01 78 23 and Section 26 05 00.

.2 The manufacturer shall provide a warranty against loss of performance and defects in materials and workmanship for the luminaires for a period of 5 years after acceptance of the luminaires. Warranty shall cover all components comprising the luminaire.

.3 All warranty documentation shall be provided to customer prior to the first shipment.

.4 LED Luminaires shall have a manufacturer's warranty for a period of not less than five years.

.5 LED boards, drivers and associated components shall have a warranty of 5 years on the LEDs, 5 years on the driver, 10 years on the paint finish.

2 Products

2.01 Manufacturers

.1 As noted on Lighting Fixture Schedule.

2.02 Indoor LED Luminaires, General

.1 Initial delivered lumens – thermal losses should be less than 10 per cent when operated at a steady state at an average ambient operating temperature of 25 degrees C, and optical losses should be less than 15 per cent.

.2 Average Delivered Lumens – Average delivered lumens over 50 000 hours should be minimum of 85 per cent of initial delivered lumens.

.3 All luminaires shall be tested per LM79/80 and published L70 data.

.4 Available in 3500 K correlated colour temperature, CRI greater than or equal to 80, or as indicated.

.5 Accessibility and Maintenance:

.1 All LED luminaires shall be field serviceable, with LED arrays, LED modules, drivers, etc. fully serviceable and easily accessible. In the case of recessed ceiling mounted, and in the case of surface mounted ceiling fixtures, these components must be accessible from below. Luminaires in which any of these components are accessible only from above are not acceptable.

.2 Ballasts, drivers, LED arrays, LED modules, and lamps shall be serviceable while the fixture is in its normally installed position. Ballasts or drivers shall not be mounted to removable reflectors or wireway covers unless so specified. In the case of ceiling mounted luminaires, the serviceable components must be accessible from below.

.6 Housings:

.1 Formed to prevent warping and sagging. Housing, trim and lens frame shall be true, straight (unless intentionally curved), and parallel to each other as designed.

.2 Sheet steel housings to be minimum 20 gauge.

.3 Wireways and fittings: free of burrs and sharp edges, and shall accommodate internal and branch circuit wiring without damage to the wiring.

.4 When installed, any exposed fixture housing surface, trim frame, door frame, and lens frame shall be free of light leaks.

.5 Hinged door frames shall operate smoothly without binding. Latches shall function easily by finger action without the use of tools.

.6 Drivers shall not be mounted to removable reflectors or wireway covers unless so specified.

.7 Mechanical Safety: Lighting fixture closures (lens doors, trim frame, hinged housings, etc.) shall be retained in a secure manner by captive screws, chains, aircraft cable, captive hinges, or fasteners such that they cannot be accidentally dislodged during normal operation or routine maintenance.

.8 Metal Finishes:

.1 Fixture finish and construction to meet ULC listings and CSA certifications related to intended installation.

.2 All metal components of fixtures shall be painted after fabrication to mitigate raw metal edges, and thus prevent premature corrosion.

.3 The manufacturer shall apply standard finish (unless otherwise specified) over a corrosion-resistant primer, after cleaning to free the metal surfaces of rust, grease, dirt and other deposits. Edges of pre-finished sheet metal exposed during forming, stamping or shearing processes shall be finished in a similar corrosion resistant manner to match the adjacent surface(s). Fixture finish shall be free of stains or evidence of rusting, blistering, or flaking, and shall be applied after fabrication.

.4 Interior light reflecting finishes shall be white with not less than 85 per cent reflectance, except where otherwise shown on the drawing.

.9 Wiring:

.1 Lighting fixtures shall have a specific means for grounding metallic wireways and housings to an equipment grounding conductor.

.2 Supplied complete with a luminaire disconnect plug.

2.03 Drivers, General

.1 Electronic LED drivers shall be integral to the luminaire, and be designed to be accessible in the field for replacement and servicing.

.2 Input Voltage:

.1 Driver with a voltage range of (120-277) +/- 10% or (347-480) +/- 10%.

.2 Refer to lighting fixture schedule.

.3 For luminaires connected to a 347 volt circuit and utilizing a natively 120-277 volt driver, provide an appropriately sized step down transformer.

.3 Input frequency 60 Hz.

.4 Load regulation: +/- 1 per cent from no load to full load.

.5 Output ripple less than 10 per cent.

.6 Output should be isolated.

.7 Case temperature: rated for -40 degrees C through +80 degrees C.

.8 Overheat protection, self-limited short circuit protection and overload protected.

.9 Primary fused.

.10 Driver life rating not less than 50 000 hours

.11 Power Factor and Total Harmonic Distortion

.1 Power factor of greater than or equal to 0.9 at full load.

.2 THD of less than or equal to 20 per cent at full load.

.12 Dimming Control:

.1 Coordinate with Section 26 09 43.

.2 0-10 V dimming control typical for all fixtures unless otherwise noted.

.3 Control range: 10 per cent to 100 per cent typical, unless noted otherwise.

.4 Provide a mock-up to demonstrate the luminaire is free of flicker throughout the dimming range when used with the dimming controllers described in related sections.

2.04 Interior Wall-Wash LED Luminaires

.1 Minimum Light Output: 575 lm.

.2 Zonal lumen density:

.1 Minimum 60 per cent between 0 degrees and 90 degrees from nadir.

.2 Minimum 60 per cent of the lumens must be produced in the "forward" hemisphere, towards the wall.

.3 Minimum luminaire efficacy: 45 lumens per watt.

.4 Correlated Colour Temperature (CCT): 3500 K

.5 Colour Rendition Index (CRI): 80 CRI minimum.

.6 Minimum L70 lumen maintenance to occur at 50 000 hours in accordance with LM-80 testing data and TM-21 extrapolation.

2.05 Track or Mono-Point Directional LED Luminaires

.1 Minimum Light Output: 250 lm.

.2 Zonal lumen density:

.1 Minimum 85 per cent between 0 degrees and 90 degrees from nadir.

.3 Minimum luminaire efficacy: 45 lumens per watt.

.4 Correlated Colour Temperature (CCT): 3500 K

.5 Colour Rendition Index (CRI): 80 CRI minimum.

.6 Minimum L70 lumen maintenance to occur at 50 000 hours in accordance with LM-80 testing data and TM-21 extrapolation.

2.06 Downlight Luminaires

.1 Minimum Light Output: 500 lm.

.2 Zonal lumen density: Minimum 75 per cent between 0 degrees and 60 degrees from nadir.

.3 Minimum luminaire efficacy: 45 lumens per watt.

.4 Correlated Colour Temperature (CCT): 3500 K

.5 Colour Rendition Index (CRI): 80 CRI minimum.

.6 Minimum L70 lumen maintenance to occur at 50 000 hours in accordance with LM-80 testing data and TM-21 extrapolation.

2.07 Nominal 610 mm by 610 mm (2 foot by 2 foot) Luminaires for Ambient Lighting of Interior Spaces

.1 Minimum Light Output: 2 000 lm.

.2 Zonal lumen density:

.1 Minimum 75 per cent between 0 degrees and 60 degrees from nadir.

.3 Spacing Criteria:

.1 0 degrees to 180 degrees: 1.0 to 2.0

.2 90 degrees to 270 degrees: 1.0 to 2.0

.4 Minimum luminaire efficacy: 85 lumens per watt.

.5 Correlated Colour Temperature (CCT): 3500 K

.6 Colour Rendition Index (CRI): 80 CRI minimum.

.7 Minimum L70 lumen maintenance to occur at 50 000 hours in accordance with LM-80 testing data and TM-21 extrapolation.

2.08 Nominal 305 mm by 1220 mm (1 foot by 4 foot) Luminaires for Ambient Lighting of Interior Spaces

.1 Minimum Light Output: 1 500 lm.

.2 Zonal lumen density:

.1 Minimum 75 per cent between 0 degrees and 60 degrees from nadir.

.3 Spacing Criteria:

.1 0 degrees to 180 degrees: 1.0 – 2.0

.2 90 degrees to 270 degrees: 1.0 – 2.0

.4 Minimum luminaire efficacy: 85 lumens per watt.

.5 Correlated Colour Temperature (CCT): 3500 K

.6 Colour Rendition Index (CRI): 80 CRI minimum.

.7 Minimum L70 lumen maintenance to occur at 50 000 hours in accordance with LM-80 testing data and TM-21 extrapolation.

2.09 Nominal 610 mm by 1220 mm (2 foot by 4 foot) Luminaires for Ambient Lighting of Interior Spaces

.1 Minimum Light Output: 3 000 lm.

.2 Zonal lumen density:

.1 Minimum 75 per cent between 0 degrees and 60 degrees from nadir.

.3 Spacing Criteria:

.1 0 degrees to 180 degrees: 1.0 – 2.0

.2 90 degrees to 270 degrees: 1.0 – 2.0

.4 Minimum luminaire efficacy: 85 lumens per watt.

.5 Correlated Colour Temperature (CCT): 3500 K

.6 Colour Rendition Index (CRI): 80 CRI minimum.

.7 Minimum L70 lumen maintenance to occur at 50 000 hours in accordance with LM-80 testing data and TM-21 extrapolation.

2.10 Linear Ambient Luminaires: Indirect

.1 Minimum Light Output: 500 lm per foot.

.2 Zonal lumen density:

.1 Minimum 50 per cent between 90 degrees and 150 degrees from nadir.

.3 Minimum luminaire efficacy: 85 lumens per watt.

.4 Correlated Colour Temperature (CCT): 3500 K

.5 Colour Rendition Index (CRI): 80 CRI minimum.

.6 Minimum L70 lumen maintenance to occur at 50 000 hours in accordance with LM-80 testing data and TM-21 extrapolation.

2.11 Linear Ambient Luminaires: Indirect/Direct

.1 Minimum Light Output: 500 lm per foot.

.2 Zonal lumen density:

.1 Minimum 25 per cent between 0 degrees and 60 degrees from nadir.

.2 Minimum 50 per cent between 90 degrees and 150 degrees from nadir.

.3 Minimum luminaire efficacy: 85 lumens per watt.

.4 Correlated Colour Temperature (CCT): 3500 K

.5 Colour Rendition Index (CRI): 80 CRI minimum.

.6 Minimum L70 lumen maintenance to occur at 50 000 hours in accordance with LM-80 testing data and TM-21 extrapolation.

2.12 Linear Ambient Luminaires: Direct/Indirect

.1 Minimum Light Output: 500 lm per foot.

.2 Zonal lumen density:

.1 Minimum 40 per cent between 0 degrees and 60 degrees from nadir.

.2 Minimum 35 per cent between 90 degrees and 150 degrees from nadir.

.3 Minimum luminaire efficacy: 85 lumens per watt.

.4 Correlated Colour Temperature (CCT): 3500 K

.5 Colour Rendition Index (CRI): 80 CRI minimum.

.6 Minimum L70 lumen maintenance to occur at 50 000 hours in accordance with LM-80 testing data and TM-21 extrapolation.

2.13 Linear Ambient Luminaires: Direct

.1 Minimum Light Output: 375 lm per foot.

.2 Zonal lumen density:

.1 Minimum 40 per cent between 0 degrees and 60 degrees from nadir.

.3 Minimum luminaire efficacy: 85 lumens per watt.

.4 Correlated Colour Temperature (CCT): 3500 K

.5 Colour Rendition Index (CRI): 80 CRI minimum.

.6 Minimum L70 lumen maintenance to occur at 50 000 hours in accordance with LM-80 testing data and TM-21 extrapolation.

2.14 High-Bay Luminaires for Commercial and Industrial Buildings

.1 Minimum Light Output: 10 000 lm.

.2 Zonal lumen density:

.1 Minimum 30 per cent between 20 degrees and 50 degrees from nadir.

.3 Minimum luminaire efficacy: 80 lumens per watt.

.4 Correlated Colour Temperature (CCT): 4000 K

.5 Colour Rendition Index (CRI): 70 CRI minimum.

.6 Minimum L70 lumen maintenance to occur at 35 000 hours in accordance with LM-80 testing data and TM-21 extrapolation.

2.15 Low-Bay Luminaires for Commercial and Industrial Buildings

.1 Minimum Light Output: 5 000 lm.

.2 Zonal lumen density:

.1 Minimum 30 per cent between 20 degrees and 50 degrees from nadir.

.3 Minimum luminaire efficacy: 80 lumens per watt.

.4 Correlated Colour Temperature (CCT): 4000 K

.5 Colour Rendition Index (CRI): 70 CRI minimum.

.6 Minimum L70 lumen maintenance to occur at 35 000 hours in accordance with LM-80 testing data and TM-21 extrapolation.

2.16 High-Bay Aisle Luminaires

.1 Minimum Light Output: 10 000 lm.

.2 Zonal lumen density:

.1 Minimum 30 per cent between 0 degrees and 20 degrees from nadir.

.2 Minimum 50 per cent between 20 degrees and 50 degrees from nadir.

.3 Minimum luminaire efficacy: 80 lumens per watt.

.4 Correlated Colour Temperature (CCT): 4000 K

.5 Colour Rendition Index (CRI): 70 CRI minimum.

.6 Minimum L70 lumen maintenance to occur at 35 000 hours in accordance with LM-80 testing data and TM-21 extrapolation.

3 Execution

3.01 Verification of Conditions

.1 Coordinate the lighting system installation with the relevant trades so as to eliminate interferences with hangers, mechanical ducts, sprinklers, piping, steel, etc.

3.02 Installation

.1 Install lighting equipment, including but not limited to luminaires, controls, auxiliary devices and the integration of same in strict conformance with all manufacturers' recommendations and instructions the securing of which shall be the responsibility of the Contractor.

.2 Integrate luminaires with controls in accordance with respective luminaire manufacturers' and controls manufacturers' recommendations and instructions and to provide a complete, trouble-free operation without compromising safety, code and CSA requirements.

.3 Seal all luminaires for wet locations (i.e. all knock-outs, all pipe and wire entrances, etc.) as is standard industry practice to prevent water from entering luminaires.

.4 Luminaire Alignment

.1 Locate recessed ceiling luminaires as indicated on reflected ceiling plan. Install recessed luminaires to permit removal from below. Include accessories and materials to meet applicable codes and regulatory requirements.

.2 Align luminaires mounted in continuous rows to form straight uninterrupted line.

.3 Align luminaires mounted individually parallel or perpendicular to building grid lines.

.4 Install surface mounted luminaires plumb and adjust to align with building lines and with each other. Secure to prevent movement.

.5 Locate and install luminaires as indicated. Mounting heights and configuration of the luminaires shall be as specified in the Luminaire Schedule portion of the Specification or indicated on the drawings, and where conflicts exist, as approved by the Consultant.

.6 Installed all luminaires plumb and true and level as viewed from all directions unless specifically identified otherwise in the Lighting Fixture Schedule. Luminaires shall remain plumb and true without continual adjustment or visibly obvious means beyond what is shown on luminaire submittal drawings.

.7 For installation in suspended ceilings, ensure that the luminaires are supported such that there is no resultant bowing or deflection of the ceiling system greater than 1/360 of the length of the total span of the ceiling member.

.5 Install recessed luminaires using accessories and firestopping materials to meet regulatory requirements for fire rating.

.6 Whenever a luminaire or its hanger canopy is installed directly to a surface mounted junction box, use a finishing ring painted to match the ceiling to conceal the junction box.

.7 Suspended Luminaires:

.1 Install suspended luminaires and exit signs using pendants supported from swivel hangers. Provide pendant length required to suspend luminaire at indicated height.

.2 Suspended luminaires shall be installed plumb and true and level unless specifically identified otherwise in the Luminaire Schedule portion of this Specification and at a height from finished floor as specified on the drawings, details and Luminaire Schedule. In cases where this is impractical, refer to the Consultant for a decision. All appurtenances shall be consistently organized for a neat, uniform appearance.

.8 Install wall mounted luminaires at height as indicated.

.9 Accessories:

.1 Reflector cones, louvers, baffles, lenses, trims and other decorative elements shall be installed after completion of ceiling tile installation, plastering, painting and general cleanup.

.2 Install accessories provided with each luminaire.

.3 All accessories shall be properly installed and adjusted by Contractor in accordance with specification and installation instructions. Any spare items shall be clearly labeled (indicate type of accessory and associated luminaire types).

3.03 Testing and Adjustment

.1 As required, all adjustable luminaires shall be aimed, focused, locked, etc., by the Contractor under the observation of the Consultant. As aiming and adjusting is completed, locking setscrews and bolts and nuts shall be tightened securely by the Contractor.

.2 All ladders, scaffolds, lifts, etc. required for aiming and adjusting luminaires shall be furnished by the Contractor.

.3 Where possible, units shall be focused during the normal working day. However, where daylight interferes with seeing lighting effects, aiming shall be accomplished at night.

3.04 Luminaire Supports

.1 Provide adequate support to suit ceiling system.

.2 Support luminaires independently of ceiling framing, unless ceiling is certified by the manufacturer to support weight of installed devices. Confirm if T-bar ceilings are metric or imperial and provide luminaires to suit ceiling dimensions.

.3 Provide chain hangers for new and existing luminaires.

.4 Install clips to secure recessed grid-supported luminaires in place.

.5 Fixtures supported by suspended ceiling systems shall be securely fastened to the ceiling framing member by mechanical means, such as bolts, screws, or rivets. Ceiling framing members must be securely attached to each other and to the building structure as required by all applicable codes and standards. Use of integral clips is not acceptable.

3.05 Wiring

.1 Use SPC90 conductors for final connections to luminaires (including 0-10 V dimming conductors for applicable luminaires).

.2 Install luminaire disconnect plugs on all new luminaires not provided as such from the manufacturer.

.3 Connect luminaires to branch circuit outlets provided under Section 26 05 33.13 using flexible conduit.

.4 Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within luminaire.

.5 Bond products and metal accessories to branch circuit equipment grounding conductor.

3.06 Field Quality Control

.1 Operate each luminaire after installation and connection. Inspect for proper connection and operation.

.2 Make wiring connections to the branch circuit using building wire with insulation suitable for temperature conditions within luminaire.

.3 Occupancy Sensors.

.1 Locate and aim sensors in the correct location required for complete and proper volumetric coverage within the range of coverage(s) of controlled areas.

.2 Rooms shall have 90 per cent to 100 per cent coverage to completely cover the controlled area to accommodate all occupancy habits of single or multiple occupants at any location within the room.

.3 Exercise proper judgment in executing the work to ensure the best possible installation in the available space and to overcome local difficulties due to space limitations or interference of structural components.

3.07 Cleaning

.1 Thoroughly clean all luminaires and accessories after installation. All fingerprints, dirt, tar, smudges, drywall mud, dust, etc. shall be removed by the Contractor from the luminaire bodies, reflectors, trims, and lens or louvers prior to final acceptance. All reflectors shall be free of paint other than factory-applied, if any. All reflectors, cones and lenses shall be cleaned only according to manufacturers' instructions.

.2 Clean electrical parts to remove conductive and deleterious materials.

.3 Remove dirt and debris from enclosures.

.4 Clean photometric control surfaces as recommended by manufacturer.

.5 Clean finishes and touch up damage.

.6 Luminaire finishes which are disturbed in any way during construction shall be touched up or refinished in a manner satisfactory to the Consultant.

3.08 Commissioning

.1 In accordance with Section 26 08 50.

End of Section

1 General

1.01 Summary

.1 This section includes general luminaires connected to emergency lighting circuits.

.2 Battery unit requirements for selected spaces as required by CSA C282.

1.02 Related Requirements

.1 Section 26 32 13.16 – Gas-Engine-Driven Generator Sets.

.2 Section 26 36 23.13 – Bypass-Isolation Automatic Transfer Switches.

.3 Section 26 51 19 – LED Interior Lighting.

.4 Section 26 52 13.16 – Exit Signs.

1.03 References

.1 Canadian Standards Association (CSA):

.1 CSA C22.1-18, Canadian Electrical Code, Part 1 (24th Edition), Safety Standard for Electrical Installations.

.2 Ontario Electrical Safety Code (27th edition/2018).

.3 CSA C22.2 No. 141-15 (R2020), Emergency lighting equipment.

.4 CSA C282-15 – Emergency Electrical Power Supply for Buildings.

.2 Ontario Building Code

.3 Underwriters Laboratories, Inc. (UL):

.1 UL924 – Standard for Safety of Emergency Lighting and Power Equipment

1.04 Closeout Submittals

.1 Operation and Maintenance Data: submit operation and maintenance data for emergency lighting for incorporation into manual.

.2 Perform a lighting level test (lux readings) of the emergency lighting system.

1.05 Quality Assurance

.1 Manufacturer Qualifications: Products free of defects in material and workmanship.

.2 Furnished products are listed and/or certified by third party agencies as suitable for the intended purpose.

.3 All units will be certified that they have been tested prior to shipping.

1.06 Delivery, Storage, and Handling

.1 Deliver, store, and handle materials in accordance with manufacturer's written instructions.

.2 Delivery and acceptance requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and handling requirements:

.1 Store materials off ground indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect emergency lighting from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

2 Products

2.01 Emergency Battery Units

.1 Provide Emergency Battery Units in the following locations with sufficient capacity to provide 2 hours duration in the following locations in accordance with CSA C282 clause 6.11.1:

.1 Generator room or generator enclosure, as applicable.

.2 Automatic Transfer Switch Room.

.2 Minimum illumination in the noted areas to be 50 lx.

.3 Include automatic self-diagnostic circuitry, and a transient voltage surge suppressor on the supply site of power to the unit.

.4 Lamps: Two LED MR16 lamps, minimum 540 lumens per lamp, max 6 watts per lamp.

.5 Manufacturers:

.1 Lumacell MGR12A-48-2LD10-AT (basis of design).

.2 Aimlite.

.3 Emergilite.

.4 Beghelli.

.5 Stanpro.

3 Execution

3.01 Examination

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for emergency lighting installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of Owner.

.2 Inform Owner of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Owner.

3.02 Installation

.1 Installation in accordance to the electrical code and manufacturer's instructions.

3.03 Identification

.1 Provide red adhesive indicator on fixture, or immediately adjacent to fixture to suit site conditions, to identify luminaires connected to emergency power.

.2 For luminaires installed in lay-in acoustic ceilings, provide indicator on nearest tee intersection.

3.04 Cleaning

.1 Progress Cleaning: Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

3.05 Protection

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by emergency lighting installation.

3.06 Verification

.1 Perform a lighting level test (lux readings) of the emergency lighting system.

.2 Submit report with closeout documents.

3.07 Testing and Commissioning

.1 When installation of emergency lighting system is complete, contractor shall commission and test the entire system and adjust if necessary.

.2 Contractor is responsible for providing a verification test of emergency illumination levels.

.1 Verification test shall be performed with a lux/footcandle meter at 1 m intervals along all paths of egress throughout the space, and record light level readings on floor plans provided by the consultant.

.2 The contractor shall also provide consultant with a letter stating the recorded emergency lighting levels meet the OBC requirements of 10 lx (1 fc) average with minimum readings not less than 1 lx (0.1 fc) on the path of egress.

.3 Testing shall be performed during non-daylight hours. Contractor shall aim all remotes to optimise illumination on the floor and stair.

.4 Contractor shall certify in writing to the consultant that the system is complete, installed per CSA C282, has been tested.

.5 Contractor shall notify Owner and consultant at least ten days prior to proposed testing date and schedule testing at time and date acceptable to the Owner.

.6 Installation shall be in accordance to the electrical code.

.7 The Contractor is to submit a letter on Contractor's letterhead confirming the criteria specified above is met, including light levels, and include a copy of the plans with light levels recorded.

3.08 Testing, Maintenance, and Warranty Service

.1 Provide complete instructions for the operation and care of the emergency power supply or unit equipment that shall specify testing at least once every month to ensure security of operation. Instructions to be framed under glass.

.2 OBC testing obligations: Owner's facility maintenance personnel are required to document one manual test of the battery units each month and conduct one full discharge test once a year per OBC / CSA C22.2 No. 141 requirements.

.3 Annual Maintenance: The manufacturer recommends maintenance to be performed by a qualified service provider. Contact the manufacturer for any warranty service.

End of Section

1 General

1.01 Section Includes

.1 Internally illuminated "Running Man" exit sign units for ordinary location use.

1.02 Related Requirements

.1 Section 26 52 13.13 – Emergency Lighting: Emergency Battery Units.

1.03 References

.1 CSA Group:

.1 CSA C22.1-18, Canadian Electrical Code, Part 1 (24th Edition), Safety Standard for Electrical Installations.

.2 Ontario Electrical Safety Code (27th edition/2018).

.3 CSA C22.2 No. 141-15 (R2020), Emergency lighting equipment.

.4 CAN/CSA-C860-11 (R2020), Performance of Internally Lighted Exit Signs.

.2 International Organization for Standardization (ISO)

.1 ISO 7010:2011 – Graphical symbols – Safety colours and safety signs.

.2 ISO 3864-1:2011 – Graphical symbols -- Safety colours and safety signs -- Part 1: Design principles for safety signs and safety markings

.3 Ontario Building Code.

.4 Underwriters Laboratories of Canada (ULC)

.1 ULC/ORD-924-02, Standard for Emergency Lighting and Power Equipment.

.2 CAN/ULC-S572-10, First Edition Standard for Photoluminescent and Self-Luminous Exit Signs and Path Marking Systems.

1.04 Submittals

.1 Provide submittals in accordance with Section 01 33 00.

.2 Product Data: Submit manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence, cleaning procedures and maintenance.

1.05 Extra Materials

.1 Allow the cost for material and for installation of an additional five exit signs, single face or dual face, to be installed as directed by the Consultant during construction. Include 15.24 m (50 feet) of wire and conduit per exit sign.

1.06 Quality Assurance

.1 Exit signs units shall be ULC Listed and/or CSA Certified to CSA C22.2 No 141 and C860.

.2 Furnished products are listed and/or certified by third party agencies as suitable for the intended purpose.

.3 Manufacturer Qualifications: Products shall be free of defects in material and workmanship.

.4 All units will be certified that they have been tested prior to shipping.

1.07 Delivery, Storage, and Handling

.1 In accordance with Section 01 60 00.

1.08 Waste Management and Disposal

.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 00.

1.09 Warranty

.1 Product is warranted free of defects in material and workmanship for a minimum of one year from substantial completion.

2 Products

2.01 Exit Signs, General

.1 Manufacturers

.1 Lumacell (basis of design).

.2 Aimlite.

.3 Beghelli.

.4 Emergi-Lite.

.5 Stanpro.

.6 Other manufacturers as indicated in Section 26 52 13.13.

.2 Substitution Limitations:

.1 Manufacturer of exit signs to be the same as manufacturer of emergency lighting battery units and remote heads specified in Section 26 52 13.13.

.2 No manufacturer substitutions.

.3 Description

.1 Green and White LED Pictogram "Running Man" exit sign.

.2 The pictogram sign shall be certified as CSA 22.2 No. 141, and meet ISO 3864-1 and ISO 7010.

.3 The pictogram legend shall have a minimum illuminated dimension of 5.9" high and 11.13" with ISO 3864-1 and ISO 7010 pictogram printed on a pure-acrylic panel.

.4 The sign shall include a standard single face with optional double-faceplate included.

.5 Not acceptable:

.1 Red LED EXIT signs.

.2 Externally illuminated photoluminescent, or non-electrical radioluminescent type of pictogram signs are unacceptable.

.4 Mounting

.1 The canopy shall universal to allow for wall, end, or ceiling mount.

.5 Electrical

.1 The LED light source shall be long-life white Light-Emitting Diodes and shall provide uniform illumination of the pictogram in normal and emergency operation.

.2 The sign shall operate with universal 2-wire AC input voltage of 120 to 347 Vac at less than 3 Watts, and universal 2-wire DC input voltage from 6 to 24 Vdc at less than 2.5 Watts for single and double face legends with a single arrow either left or right.

.3 If arrow left and arrow right is required for T intersection, the contractor shall supply and install two separate pictogram signs.

.4 The pictogram edge-lit exit sign in a self-powered configuration shall use a sealed Nickel-Cadmium battery of 2.4 V nominal voltage and shall stay illuminated during emergency operation for at least two hours upon AC failure.

2.02 Extruded Aluminum Pictogram Exit Signs

.1 Manufacturers

.1 Lumacell LA series.

.2 Equivalent products from manufacturers as described in Article 2.01 of this specification.

.2 Materials

.1 The housing assembly shall be constructed of extruded aluminum in factory white colour.

.2 The housing shall be constructed of rugged extruded aluminum and have a maximum depth of 2-1/2".

.3 The faceplate(s) shall be constructed of extruded aluminum and shall incorporate a protective clear poly-carbonate panel.

.4 Each face plate shall come standard with two legend films for pictogram and directional indicators.

2.03 Die-Cast Edge-Lit Pictogram Exit Signs for Surface or Recessed Mounting Applications

.1 Manufacturers

.1 Lumacell LDE series.

.2 Equivalent products from manufacturers as described in Article 2.01 of this specification.

.2 Materials

.1 Surface mount:

.1 When specified for surface mount, the unit shall come standard with a trim plate, trim ring, back box and canopy made of die-cast aluminum with black finish.

.2 The trim plate shall have an angular profile and allow for wall or ceiling mount installation.

.2 Recessed ceiling mount:

.1 When specified for recessed ceiling-mount, the unit shall come standard with a flat trim plate of die-cast aluminum with black finish, a back box of galvanized steel, and a hardware kit for back box installation between ceiling joists. The back box shall be provided with conduit knock-outs at the top, back and end.

.3 The legend shall be printed on a pure-acrylic panel.

.4 The panel shall come standard with double-face legend, for single-face and double-face applications.

2.04 All-Climate, Harsh Environment Pictogram Exit Sign

.1 Manufacturers

.1 Lumacell LN Series

.2 Equivalent products from manufacturers as described in Article 2.01 of this specification.

.2 Materials

.1 The equipment shall be certified for NEMA- 4X and designed specifically for high abuse areas, wet location, and cold weather applications.

.2 The equipment frame shall be of industrial grade polyvinyl chloride with a gasket around lenses and canopy. The faceplate(s) shall be constructed of heavy-duty vandal resistant polycarbonate and feature an even illuminated legend.

.3 Finish colour: white.

3 Execution

3.01 Installation

.1 Install exit lights to manufacturer's recommendations, listing requirements, CSA standard and local regulatory requirements.

.2 Ensure exit signs are not obscured. Where an exit sign is to be installed in an area with no ceiling, provide a suitable pendant mount.

.3 Connect fixtures to exit light emergency power supply circuits.

.4 Ensure that emergency lighting circuit breaker is locked in ON position.

.5 If arrow left and arrow right is required for T intersection, the contractor shall supply and install two separate pictogram signs.

3.02 Field Quality Control

.1 Comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.03 Cleaning

.1 Proceed in accordance with Section 01 74 00.

.2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

3.04 Testing and Commissioning

.1 When installation of emergency lighting equipment is complete, contractor shall commission and test the entire system and adjust if necessary.

.2 Contractor shall certify in writing to the consultant that the system is complete, installed per CSA C22.2 No. 141, has been tested, and operates for the specified battery run time.

.3 Contractor shall notify owner and consultant at least ten days prior to proposed testing date and schedule testing at time and date acceptable to the owner.

.4 Installation shall be in accordance to the electrical code and manufacturer's instructions.

.5 Provide breaker lock on emergency lighting circuit at source panelboard.

3.05 Protection

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by exit sign installation.

End of Section

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1 General

1.01 Section Includes

.1 Materials and installation for steel lighting poles.

.2 Cast-in-place architectural concrete bases.

1.02 Related Requirements

.1 Section 03 30 00 – Cast-in-Place Concrete.

.2 Section 26 27 26 – Wiring Devices: receptacles at pole bases.

.3 Section 26 56 19 – LED Exterior Lighting.

.4 Section 28 20 00 – Video Surveillance: CCTV camera brackets.

.5 Section 31 00 00 – Earthwork.

1.03 References

.1 CSA C22.2 No. 206-17, Lighting poles.

1.04 Coordination

.1 Ensure shop drawings are submitted promptly to ensure adequate time for Consultant's review and to permit timely release of anchor bolts.

.2 Coordinate the installation of all light poles with the work of other trades. This includes but is not limited to placement of poles in conjunction with civil work such as sidewalks, roadways, parking lots, landscaping and building exteriors.

1.05 Submittals

.1 Submit product data in accordance with Section 01 33 00.

.2 Product Data: For each pole, accessory, luminaire-supporting and lowering device, arranged as indicated on the plans and as required.

.1 Include data on construction details, profiles, effective projected area (EPA), cable entrances, materials, dimensions, weight, rated design load, and ultimate strength of individual components.

.2 Include finishes for lighting poles and luminaire-supporting devices.

.3 Anchor bolts.

.4 Manufactured pole foundations.

.5 Manufacturer cut sheets indicating pole catalog number selections with highlighted selections. Include pole designations that match the project designations if applicable.

.6 All distinct poles required on the project shall be submitted in one single submittal so all poles can be reviewed at one time.

.3 Shop Drawings:

.1 Anchor-bolt templates keyed to specific poles and certified by manufacturer.

.2 Include plans, elevations, sections, and mounting and attachment details.

.3 Include details of equipment assemblies, indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

.4 Detail fabrication and assembly of poles and pole accessories.

.5 Foundation construction details, including material descriptions, dimensions, anchor bolts, support devices, and calculations, signed and sealed by a professional engineer licensed in the jurisdiction of the project site.

.6 Method and procedure of pole installation. Include manufacturer's written installation instructions.

.4 Delegated Design Submittals:

.1 Soil test report prepared by a Geotechnical Engineer licensed in the jurisdiction of the project site.

.2 Provide pole base details using the submitted poles and luminaires, sealed by a Structural Engineer licensed in the jurisdiction of the project site.

.3 Contractor is responsible for hiring geotechnical and structural engineers as part of base bid.

1.06 Closeout Submittals

.1 In accordance with Section 01 78 23.

.2 Include soil reports and sealed base details in O&M manual.

.3 Reviewed shop drawings.

.4 Warranty documentation.

1.07 Delivery, Storage, and Handling

.1 Protect products from moisture and dust by storing them in a clean, dry location remote from areas involved in construction operations. Provide additional protection in accordance with manufacturer's instructions.

.2 Store poles on decay-resistant skids at least 305 mm (12 in) above grade and vegetation. Support poles to prevent distortion and arrange to provide free air circulation.

.3 Retain factory-applied pole wrappings on metal poles until immediately before pole installation. Handle poles with web fabric straps.

.4 Protect pole finishes prior and during install by applying a strippable, temporary protective covering as required.

1.08 Warranty

.1 Special Warranty: Manufacturer agrees to repair or replace components of pole(s) that fail in materials or workmanship; that corrode; or that fade, stain, perforate, erode, or chalk due to effects of weather or solar radiation within a specified warranty period. Manufacturer may exclude lightning damage, hail damage, vandalism, abuse, or unauthorized repairs from special warranty period.

.1 Warranty Period: Five (5) years from date of Substantial Completion.

.2 Warranty Period for Corrosion Resistance: Five (5) years from date of Substantial Completion.

.3 Warranty Period for Color Retention: Five (5) years from date of Substantial Completion.

2 Products

2.01 Cast-In-Place Architectural Concrete Bases

.1 Use single-use Concrete Forms.

.2 Provide cast-in-place architectural concrete bases for lighting poles, bollards, floodlights, flagpoles, signs, columns fence posts, and other applications as noted.

.3 Provide bases in styles, sizes, and profiles indicated. Depth of bases to be in accordance with Structural Engineer's detail.

.4 Reinforce bases with vertical steel reinforcing rods and horizontal steel reinforcing ties as noted on the drawings.

.5 Coordinate installation of conduit at bases for lighting poles, bollards, floodlights and signs.

.6 Cast and cure bases in accordance with requirements of Section 03 30 00.

.7 Install self-locking, vandal-resistant, wraparound aluminum color accent band around finished bases, where indicated.

.8 Manufacturers:

.1 ArtFORMS International Inc. (basis of design).
Tel: 905 642-3225, Fax: 905-642-3227, Email: ArtFORMS@ArtFORMSConcreteBases.com.

2.02 Painted Galvanized Steel Poles

.1 Galvanized steel poles: to CSA C22.2 No. 206 designed for underground wiring and:

.1 Suitable for mounting on concrete anchor base.

.2 Monotube style, minimum 3.0 mm thick, straight or tapered, round or square as indicated.

.3 Access handhole 300 mm (12 inches) above pole base for wiring connections, with welded-on reinforcing frame and bolted-on cover.

.4 Galvanized anchor bolts complete with galvanized double nuts and galvanized washers, and plastic bolt covers.

.5 Two lugs: one for grounding and one for bonding.

.6 Two-piece aluminium base cover to suit pole.

.7 Manufacturer's standard flat pole cap.

.8 For poles noted with other services including CCTV cameras or other extra low voltage equipment, provide a conduit or suitable voltage divider in the pole.

.9 Effective Projected Area (EPA) rating to meet or exceed the requirement of luminaires, mounting brackets, etc.

.10 Finishes:

.1 Polyester powder coat finish.

.11 Manufacturer's nameplate indicating manufacturer's name, model number of pole, and date of manufacture with a permanent, stamped/printed or engraved label.

.2 Manufacturers:

.1 Aluminous Lighting Products.

.2 Dynapole.

.3 LSI Industries.

.4 Lumec.

.5 Polefab.

.6 Spina.

.7 Valmont West Coast Engineering.

2.03 Pole Accessories

.1 Duplex Receptacle: Only where required of particular project scope, a 120 V, 15 A, specification grade receptacle in a weatherproof assembly complying with Section 26 27 26, ground-fault circuit-interrupter type.

.1 Surface mounted, a minimum of 300 mm (12 inches) above finished grade, or at the height indicated on the plans.

.2 Nonmetallic polycarbonate, weatherproof, while-in-use cover.

.3 With cord opening allowing for use while the cover is pad locked.

2.04 Luminaire Mounting Brackets

.1 Mounting brackets for specified luminaires:

.1 Single, twin, and quad brackets as indicated.

2.05 Luminaires

.1 In accordance with Section 26 56 19.

3 Execution

3.01 Examination

.1 Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

.2 Examine poles, luminaire-mounting devices, lowering devices, and pole accessories before installation. Components that are scratched, dented, marred, wet, moisture damaged, or visibly damaged are considered defective.

.3 Examine roughing-in for foundation and conduit to verify actual locations of installation.

.4 Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 Base Installation

.1 Install specified below-grade fiber form, reinforcing steel, ducts, etc. to required grade.

.2 Place form on top of empty fiber form. Position vertical seams in desired direction.

.3 Pour specified concrete through open top of form into fiber form below. Avoid contact with inside surface. Bring concrete to top of formwork.

.4 Mechanically vibrate concrete with small vibrator, and vigorously hand tap outside surface of formwork.

.5 Place and centre anchor bolt assembly (or post, etc.) into concrete. Trowel-finish top surface of concrete.

.6 Base Stripping:

.1 Strip concrete form within 24 hours of pouring of base.

.2 Cut steel bands. Strip form in two halves. Pry open at the two vertical seams with flat-bladed hand-tool e.g. ice-scraper or square-nose shovel. Insert blade and separate form at top, middle, and bottom of first seam. Repeat for second seam.

.3 Wire brush any traces of form material remaining on finished concrete base.

.4 Use rubbing stone to make smooth any rough concrete edges around top of base and along vertical seams.

.5 If there is risk of damage by construction equipment to exposed base, protect base by tie-wiring or duct taping the two formwork halves back in place around base until safe to remove protection.

.6 Install color accent band(s), where applicable, in horizontal reveal(s) around finished base.

3.03 Pole Installation

.1 Alignment: Align pole foundations and poles for optimum directional alignment of luminaires and their mounting provisions on the pole.

.2 Raise and set poles using web fabric slings (not chain or cable) at locations indicated by manufacturer.

.3 Install poles true and plumb, complete with brackets in accordance with manufacturer's instructions.

.4 Mount standards on bases plumb and true utilizing shims as required and then securely anchor standards to anchor bolts. Touch up all chips and scratches on poles upon completion.

.5 Provide label on each pole to allow for individual identification of each pole, minimum 125 mm (5 inch) text height of contrasting colour to that of pole finish, installed at approximately 3048 mm (10 feet) above finished grade.

.6 Install luminaires on pole.

.7 Check luminaire orientation, level, and tilt.

.8 Connect luminaires to lighting circuits.

End of Section

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1 General

1.01 Section Includes

.1 Pole mounted, wall mounted, and canopy mounted solid state, light emitting diode (LED) source exterior luminaires.

1.02 Related Requirements

.1 Division 04 – Masonry: brick grinding requirements for wall mounted luminaires.

.2 Section 26 09 43 – Network Lighting Controls.

.3 Section 26 56 13 – Lighting Poles and Standards.

1.03 References

.1 CSA Group:

.1 CSA C22.1-18, Canadian Electrical Code, Part 1 (24th Edition), Safety Standard for Electrical Installations.

.2 Ontario Electrical Safety Code (27th edition/2018).

.3 CSA C22.2 No. 9.0 – General Requirements for Luminaires.

.4 CSA C22.2 No. 250.0 – Luminaires (Bi-National Standard, with UL 1598).

.5 CAN/CSA-C22.2 No. 250.13 – Light Emitting Diode (LED) equipment for lighting applications.

.2 DesignLights Consortium (DLC):

.1 Technical Requirements v5.1, or latest edition.

.2 Where the specifications do not explicitly call for DLC qualified LED luminaires, the technical criteria provided in the DLC Technical Requirements provide the basis of the requirements for this section of the Specification.

.3 Illuminating Engineering Society (IES)

.1 IES HB-10-11 – The Lighting Handbook, 10th Edition.

.2 IES LM-79-08 – Approved Method: Electrical and Photometric Measurements of Solid-State Lighting Products.

.3 IES LM-80-08 – IES Approved Method for Measuring Lumen Maintenance of LED Light Sources.

.4 IES TM-21-11 – IES Technical Memorandum on Projecting Long Term Lumen Maintenance of LED Light Sources.

.4 National Electrical Manufacturer's Association (NEMA)

.1 SSL-1-10 – Electronic Drivers for LED Devices, Arrays, or Systems.

.2 WD 6 - Wiring Devices - Dimensional Requirements.

.5 Underwriters Laboratories Inc. (UL):

.1 ANSI/UL 1449, (4th Edition), Standard for Safety, Surge Protective Devices.

1.04 Action Submittals

.1 Submit product data in accordance with Section 01 33 00.

.2 Manufacturer reports: Provide a point-by-point photometric analysis of the site, in accordance with the procedures laid out in IES RP-8-18, for review by the Consultant. Include point-by-point calculation zones along the property line. The designer shall lay out a grid of points on the pavement at a maximum spacing of one-third the light fixture mounting height, commencing within one-half the grid spacing from the perimeter boundary.

.3 Product specification sheets or other documentation that includes the designed parameters as detailed in this specification. These parameters include (but are not limited to):

.1 Luminaire cut sheets.

.1 Highlight all parameters of the complete luminaire part number, including lumen package, correlated colour temperature, IES distribution type, and driver information.

.2 Highlight the input watts of the luminaire and the B-U-G rating.

.3 Cut sheet to document L70 lumen maintenance data, in hours, when extrapolated for the worse case operating temperature.

1.05 Informational Submittals

.1 Instructions for installation and maintenance.

1.06 Closeout Submittals

.1 Section 01 78 23: Submittals for project closeout.

.2 The Contractor shall be responsible for obtaining from the supplying lighting manufacturers, for each luminaire, a recommended maintenance manual including:

.1 Vendor and local representative's contact information.

.2 Tools required.

.3 Maintenance instructions.

.4 Types of cleaners to be used.

.5 Replacement parts identification lists.

.6 Equipment product data (high-quality reproducible copies).

.3 Complete warranty information including manufacturer's warranty conditions, including driver, luminaire, and accessories.

.4 Light level measurements demonstrating the installation is consistent with the photometric analysis.

1.07 Quality Assurance

.1 Luminaires tested to IES LM-79.

.2 Design Qualification Testing performed by a National Voluntary Laboratory Accreditation Program (NVLAP) testing facility. Such testing may be performed by the manufacturer, or an independent testing lab hired by the manufacturer on new luminaire designs, and when a major design change has been implemented on an existing design. A major design change is defined as a design change (electrical or

physical) which changes any of the performance characteristics of the luminaire, results in a different circuit configuration for the power supply, or changes the layout of the individual LED's in the module.

.3 Products certified by a recognized testing agency accredited by the Standards Council of Canada, and bearing a certification mark from that agency. Certification shall include wet location rating.

1.08 Warranty

.1 Manufacturer Warranty against loss of performance and defects in materials and workmanship for the luminaires for a period of 5 years after acceptance of the luminaires. Warranty to cover all components comprising the luminaire.

2 Products

2.01 Manufacturers

.1 As noted on Lighting Fixture Schedule.

2.02 Outdoor LED Luminaires, General

.1 Maximum nominal luminaire input wattage as specified for each luminaire type as indicated on the Luminaire schedule.

.2 Luminaires designed for ease of component replacement and end-of-life disassembly.

.3 Input Voltage:

.1 As indicated on Luminaire schedule.

.2 Driver to be compatible with system voltage without use of a step-down transformer. If the manufacturer's standard product offering cannot achieve this, clearly indicate on the shop drawings and clearly indicate location of transformer.

.4 Surge Protection

.1 UL 1449 recognized surge protective device that is wired in front of the driver(s) and protects the luminaire to a minimum Category C Low (per ANSI/IEEE C62.41.2).

.5 Power Factor and Total Harmonic Distortion

.1 Power factor of greater than or equal to 0.9.

.2 THD of less than or equal to 20 per cent.

.6 0-10 V dimming, or as indicated on drawings.

.7 Driver rated for minimum 50 000 hours.

.8 Gasket: neoprene seal between refractor and housing.

.9 Light Distributions:

.1 Fixtures available with IES distribution types I, II, III, IV, V, and other distributions, as noted.

.2 Pole mounted luminaire shall have an available option for low-profile house-side shield.

.10 Self-locking latches of stainless steel and aluminum.

.11 Factory wired including integral driver, terminated at terminal block.

.12 Luminaires with cast aluminum weatherproof housing.

.13 Ingress protection: sealed against moisture and environmental contaminants to IP65 rating or better for both light engines/optics and overall luminaire.

.14 Finishes

.1 Housing and heat sink finished in polyester powder coat paint, minimum 2.5 mil nominal thickness.

.2 Standard finish colours to include black, bronze, grey, white, dark platinum and graphite metallic.

.3 RAL and custom color matches to be available as indicated on the luminaire schedule.

2.03 Outdoor Pole/Arm Mounted Area and Roadway LED Luminaires

.1 Pole mounted luminaires suitable for the EPA rating of the pole.

.2 Pole finish colour to match that of luminaire.

.3 Source: Light Emitting Diode (LED).

.1 Zonal Lumen Density:

.1 100 per cent between 0 degrees and 90 degrees from nadir.

.2 Less than or equal to 10 per cent between 80 degrees and 90 degrees from nadir.

.2 Minimum luminaire efficacy: 105 lumens per watt.

.3 Correlated Colour Temperature (CCT): 3000 K.

.4 Colour Rendition Index (CRI): 70 CRI minimum.

.5 Minimum L70 lumen maintenance to occur at 50 000 hours in accordance with LM-80 testing data and TM-21 extrapolation. LM-80 testing is to utilize 10 000 hour testing data.

2.04 Outdoor Wall Mounted Area LED Luminaires

.1 Source: Light Emitting Diode (LED).

.1 Zonal Lumen Density:

.1 100 per cent between 0 degrees and 90 degrees from nadir.

.2 Less than or equal to 10 per cent between 80 degrees and 90 degrees from nadir.

.2 Minimum luminaire efficacy: 105 lumens per watt.

.3 Correlated Colour Temperature (CCT): 3000 K

.4 Colour Rendition Index (CRI): 70 CRI minimum.

.5 Minimum L70 lumen maintenance to occur at 50 000 hours in accordance with LM-80 testing data and TM-21 extrapolation. LM-80 testing is to utilize 10 000 hour testing data.

2.05 Fixture Mounted Controls Provision

.1 Provide NEMA 7-pin receptacle on all pole mounted luminaires, complete with shorting cap.

.1 Shorting Cap, Locking-Type Mounting:3-prong locking-type plug connector. It is used with luminaries with a photocontrol receptacle to complete circuit when a photocontrol is not required.

.2 Basis of design: Intermatic K4500 series.

3 Execution

3.01 Installation

.1 Install lighting equipment, including but not limited to luminaires, controls, auxiliary devices and the integration of same in strict conformance with all manufacturers' recommendations and instructions the securing of which shall be the responsibility of the Contractor.

.2 Luminaires shall be integrated with controls in accordance with respective luminaire manufacturers' and controls manufacturers' recommendations and instructions and to provide a complete, trouble-free operation without compromising safety, code and UL/CSA/NOM requirements.

.3 Contractor shall be responsible for sealing all outdoor luminaires for wet locations (i.e. all knock-outs, all pipe and wire entrances, etc.) as is standard industry practice to prevent water from entering luminaires.

.4 All luminaires shall be installed plumb and true and level as viewed from all directions unless specifically identified otherwise in the Luminaire Schedule portion (Section 2.12) of this Specification. Luminaires shall remain plumb and true without continual adjustment or visibly obvious means beyond what is shown on luminaire submittal drawings.

.5 Luminaire finishes which are disturbed in any way during construction shall be touched up or refinished in a manner satisfactory to the Consultant.

.6 Whenever a luminaire or its hanger canopy is installed directly to a surface mounted junction box, a finishing ring painted to match the ceiling, shall be used to conceal the junction box.

.7 All accessories shall be properly installed and adjusted by Contractor in accordance with specification and installation instructions. Any spare items shall be clearly labeled (indicate type of accessory and associated luminaire types).

.8 Install luminaires on poles in accordance with Section 26 56 13.

.9 For wall mounted luminaires:

.1 Provide a smooth grinding of brick, including type such as split face, to ensure a flush contact between luminaire and wall in accordance with Division 04 requirements.

.2 Provide a silicone seal around the luminaire.

.10 Connect luminaire to lighting circuit.

3.02 Site Tests and Inspections

.1 Perform lighting system commissioning in accordance with Section 26 08 50.

.2 Perform light meter testing at night and report values to the Consultant.

3.03 Adjusting

.1 As required, all adjustable luminaires shall be aimed, focused, locked, etc., by the Contractor under the observation of the Consultant. As aiming and adjusting is completed, locking setscrews and bolts and nuts shall be tightened securely by the Contractor.

.2 All ladders, scaffolds, lifts, etc. required for aiming and adjusting luminaires shall be furnished by the Contractor.

.3 Where possible, units shall be focused during the normal working day. However, where daylight interferes with seeing lighting effects, aiming shall be accomplished at night.

3.04 Cleaning

.1 All luminaires and accessories shall be thoroughly cleaned after being installed. All fingerprints, dirt, tar, smudges, drywall mud and dust, etc. shall be removed by the Contractor from the luminaire bodies, reflectors, trims, and lens or louvers prior to final acceptance. All reflectors shall be free of paint other than factory-applied, if any. All reflectors, cones and lenses shall be cleaned only according to manufacturers' instructions.

End of Section

1 General

1.01 Conditions and Requirements

.1 Refer to the General Conditions, Supplementary General Conditions, and General Requirements.

.2 Provisions of this Section shall apply to all Sections of Division 27.

.3 Refer to Consultant's drawings for exact location of electrical equipment and devices. Refer to Designer drawings for additional notes which complement these specifications.

.4 The Division 26 specification documents shall be followed in conjunction with the specification in this section.

.5 Coordinate with the Division 26 contractor (hereafter referred to as the "electrical contractor").

1.02 Related Divisions

.1 Division 25 – Integrated Automation.

.2 Division 26 – Electrical.

.3 Division 28 – Electronic Safety and Security.

1.03 Intent

.1 Include all material, labour, equipment, and plant construction as necessary to make a complete installation as shown and specified hereinafter. Sections of this specification are not intended to delegate functions nor to delegate work and supply to any specific Trade. It shall be your responsibility to ensure that the systems specified hereafter are complete and operative.

1.04 Codes and Standards

.1 The equipment, material and installation shall conform to the latest version of the applicable Codes, Standards (including technical service bulletins and addenda) and regulations of authorities having jurisdiction.

.2 BICSI

.1 Telecommunications Distribution Methods Manual

.2 Cabling Installation Manual

.3 Outside Plant Manual

.3 Canadian Standards Association (CSA)

.1 CSA C22.1 – Canadian Electrical Code, Part 1

.2 CSA T529 – Commercial Building Telecommunications Cabling Standard (ANSI/EIA/TIA-568-B).

.3 CSA T530 – Commercial Building Standard For Telecommunications Pathways And Spaces (TIA/EIA 569-A).

.4 CSA T528 – Administration Standard For The Telecommunications Infrastructure Of Commercial Buildings (ANSI/EIA/TIA-606).

.5 CSA T527 – Commercial Building Grounding And Bonding Requirements For Telecommunications (ANSI/EIA/TIA-607).

.6 CSA C22.2 No. 214 – Communications Cables.

.7 CSA C22.2 No. 232-M – Fibre Optic Cables.

.8 CSA C22.2 No. 182.4-M90 – Plugs, Receptacles, and Connectors for Communication Systems.

.4 TIA

.1 TIA/EIA-568-B.1 – Commercial Building Telecommunications Cabling Standard

.2 TIA/EIA-568-B.2 – Balanced Twisted Pair Cabling Components

.3 TIA/EIA-568-B.3 – Optical Fibre Cabling Components Standard

.5 ISO

.1 ISO/IEC IS 11801A – Generic Cabling for Customer Premises.

.6 CENELEC EN 50173 – Performance Requirements for Generic Cabling Schemes.

.7 IEC

.1 IEC 603-7, PART 7 – Detailed Specification For Connectors, 8-Way, Including Fixed And Free Connectors With Common Mating Features.

.2 IEC 807-8 – Rectangular Connectors For Frequencies Below 3 MHz, Part 8: Detailed Specification For Connectors, Four-Signal Contacts And Earthing Contacts For Cable Screens, First Edition.

.8 FIPS PUB 174 – Commercial Building Telecommunications Wiring Standard. Federal Information Standard Publication.

.9 UL 444 and 13 – Adopted Test and Follow-Up Service Requirements For the Optional Qualification of 100Ω Twisted-Pair (Cables).

.10 NEMA WC 63 – Performance Standard For Field Testing Of Unshielded Twisted-Pair Cabling System.

.11 ANSI/EIA/TIA

.1 ANSI/EIA/TIA-492AAAA – Detailed Specification For 62.5µm Core Diameter / 125µm Cladding Diameter Class 1a Multimode, Graded-Index Optical Waveguide fibres.

.2 ANSI/EIA/TIA-492BAAA – Detailed Specifications For Class Iva Dispersion-Unshifted Singlemode Optical Waveguide Fibres Used In Communication Systems.

.3 ANSI/EIA/TIA-472CAAA – Detailed Specifications For All Dielectric (Construction 1) Fibre optic Communications Cable For Indoor Plenum Use, Containing Class 1a, 62.5µm Core Diameter / 125µm Cladding Diameter Fibre optic(s).

.4 ANSI/EIA/TIA-472DAAA – Detailed Specifications For All Dielectric Fibre optic Communications Cable For Outdoor Plant Use, Containing Class 1, 62.5µm Core Diameter / 250µm Cladding Diameter Fibre optic(s).

.5 ANSI/EIA/TIA-455 – Test Procedures For Fibre optics, Cables And Transistors.

.6 ANSI/EIA/TIA-598 – Colour Coding of Fibre Optic Cables.

.7 ANSI/EIA/TIA-604-3 – FOCIS 3 Fibre Optic Connector Intermateability Standard.

.8 ANSI/EIA/TIA-606 – Administration Standard for the Telecommunications Infrastructure of Commercial Buildings.

.9 ANSI/EIA/TIA-607 – Commercial Building Grounding and Bonding Requirements for Telecommunications.

.12 ANSI Z136.2 – American Standards For The Safe Operation of Fibre optic Communication Systems Utilizing Laser Diode And LED Sources.

.13 ANSI/CEA

.1 ANSI/ICEA S-83-640 – Fibre Optic Outside Plant Communications Cable.

.2 ANSI/ICEA S-83-596 – Fibre Optic Premises Distribution Cable.

1.05 Work Sequence

.1 Prior to start of each work period in occupied area, temporary protection shall be installed to prevent damage to any personal property or furnishing. Coordinate with Owner's representative if any furniture must be relocated to facilitate work.

.2 Owner's representative shall approve temporary protection plan prior to use.

.3 Necessary steps shall be taken by contractor to ensure that required fire fighting apparatus is accessible at all times. Flammable materials shall be kept in suitable places outside the building.

1.06 Inspections

.1 The Engineer and/or the Project Manager will carry out inspections and prepare deficiency list for action by the Contractor, during and on completion of project.

1.07 Drawings and Specifications

.1 The drawings and specifications are complementary each to the other and what is called for by one to be binding as if called for by both. Should any discrepancy appear between the drawings and specifications which leaves the Contractor in doubt as to the true intent and meaning of plans and specifications, a ruling is to be obtained from the Engineer in writing before submitting Tender. If this is not done, the maximum, the most expensive alternate or option will be provided in base tender bid.

.2 All drawings and all Divisions of these specifications shall be considered as a whole and work of this Division shown anywhere therein shall be furnished under this Division.

.3 Drawings are diagrammatic and indicate the general arrangement of equipment and pathways. Most direct routing of cabling is not assured. Exact requirements shall be governed by architectural, structural, and mechanical conditions of the job. Consult all other drawings in preparation of the bid. Extra lengths of wiring or addition of pull and junction boxes, etc. necessitated by such conditions shall be included in the bid. Check all information and report and apparent discrepancies before submitting the bid.

.4 Contractor shall determine the exact locations of equipment and rough-ins, and the exact routing of pathways so as to best fit the layout of the job.

.5 Scaling off the drawings will not be sufficient or accurate for determining these locations. Where job conditions require reasonable changes in indicated arrangement and locations, such changes shall be made by the Contractor at no additional cost to the Owner.

.6 Before ordering any conduit, cable tray, cables, fittings, etc., this Contractor shall verify all pertinent dimensions at the job site and be responsible for their accuracy.

1.08 Material

.1 This contractor is responsible to ensure that all items submitted meet all requirements of the drawings and specification, and fits in the allocated space. The final determination of a product being acceptable shall be determined by the Engineer.

1.09 Testing Data

.1 The contractor shall provide a complete testing report utilizing a testing device as specified in the applicable TIA/EIA standard with the correct adapter and test. All copper tests shall be compliant to the current TIA/EIA standards: Perm Link or Channel.

.2 The Summary report shall provide be provided to the end user in a universal format so that there is no need to purchase any software to read and print the report.

.1 Utilizing Adobe Acrobat is an acceptable manner.

1.10 Painting and Finishes

.1 Minor damages to finish on factory finished equipment shall be touched up to the Engineer's satisfaction. Items suffering major damage to finish shall be replaced at the direction of the Consultant. Protect work so that finishes will not be damaged or marred during construction. Maintain the necessary protection until completion of the work.

1.11 Safety

.1 The Contractor shall be responsible for the safety of his workmen and the equipment on the project in accordance with all applicable safety legislation passed by Federal, Provincial, and local authorities governing construction safety. The more stringent regulations shall prevail.

1.12 Warranty

.1 Submit a written performance warranty to the Owner for one year for the complete installation for a period of no less than five years from the date of testing and acceptance. The system warranty shall be based on industry standards.

.2 The contractor shall also provide a one year labour warranty on the installation.

2 Products

2.01 Material Approval

.1 The design, manufacture and testing of electrical equipment and materials shall conform to or exceed the latest applicable CSA, IEEE, and ANSI standards.

.2 All materials must be new and be ULC or CSA listed. Any materials not covered by the aforementioned listing standards shall be tested and approved by an independent testing laboratory, Technical Inspection Services, or other government agency.

2.02 Shop Drawings

.1 Before delivery to site of any item of equipment, the electrical contractor shall submit 6 copies of shop drawings c/w all data, pre-checked and stamped accordingly, for approval to the Engineer. Indicate project name on each brochure or sheet. Submit shop drawings within 1 week after award of contract, for the following:

.1 Copper Cabling

.2 Fibre Optic Cabling

.3 Fabric Innerduct

.4 Racks, managers

.5 Patch Panels

.6 Telecommunications Outlets, Faceplates

.7 Fibre Optic Routing System

.8 Rack Power Distribution Units

2.03 As-Built Drawings

.1 To Section 01 78 39.

.2 Red lines, mark-ups by this contractor.

2.04 Operation and Maintenance Manuals

.1 Refer to Division 01.

3 Execution

3.01 Workmanship and Contractor's Qualifications

.1 Only first class workmanship will be accepted, not only in regards to durability, efficiency and safety, but also in regards to neatness of detail. Present a neat and clean appearance on completion to the satisfaction of the Engineer. Any unsatisfactory workmanship will be replaced at no extra cost.

.2 Conform to the best practices applicable to this type of work. Install all equipment and systems in accordance with the manufacturer's recommendations, but consistent with the General Requirements of this Specification. This Contractor will be held responsible for all damage to the work of his own or any other trade, resulting from the execution of his work. Store all equipment and materials in dry locations.

.3 Provide foreman in charge of this work at all times.

.4 The contractor shall be fully liable to provide and maintain in force during the life of this Contract, such insurance, including Public Liability Insurance, Product Liability Insurance, Auto Liability Insurance, Worker's Compensation, and Employer's Liability Insurance.

3.02 Coordination

.1 Coordinate work with other trades.

.2 Verify equipment dimensions and requirements with provision specified under this Section. Check actual job conditions before fabricating work. Report all necessary changes in time to prevent needless work. Changes or additions subject to additional compensation, which are made without written authorization and an agreed price, shall be at Contractor's risk and expense.

.3 Read specifications and drawings of other trades and conform with their requirements before proceeding with any work specified in this Division related to other trades. Cooperate with all other trades on the job, so that all equipment can be satisfactorily installed, and so that no delay is caused to any other Trades.

3.03 Manufacturers' Instructions

.1 Where the specifications call for an installation to be made in accordance with Manufacturer's recommendations, a copy of such recommendations shall be at all times be kept on the job site and be available to the Owner's Representative.

.2 Follow manufacturer's instructions where they cover points now specifically indicated on the drawings and specifications. If they are in conflict with the drawings and specifications obtain clarification from the Consultant before starting work.

3.04 Quality Assurance

.1 See General Provisions of the Contract.

.2 The specifications contained herein are set forth as the minimum acceptable requirements. This does not relieve the Contractor from executing other quality assurance measures to obtain a complete operating system within the scope of this project.

.3 The Contractor shall ensure that all workmanship, all materials employed, all required equipment and the manner and method of installation conforms to accepted construction and engineering practices, and that each piece of equipment is in satisfactory working condition to satisfactorily perform its functional operation.

.4 Provide quality assurance tests and operational check on all components of the electrical distribution system, all lighting fixtures, and communication systems.

3.05 Labels and Signs

.1 Labelling shall be as per TIA/EIA-606.

3.06 Adjust and Clean-Up

.1 The Contractor and associated sub trades, at all times during construction, to keep the site free of all debris, boxes, packing, etc., resulting from work of this Trade. At the completion of this work, the installation is to be left in a clean and finished condition to the satisfaction of the Engineer.

3.07 Tests and Acceptance

.1 The operation of the equipment does not constitute an acceptance of the work by the Owner. The final acceptance is to be made after the Contractor has adjusted his equipment and demonstrated that it fulfils the requirements of the drawings and the specifications.

.2 Testing of all systems shall be performed in the presence of the Owner's designated representative. The contractor shall give 72 hours advance notice to the Owner before beginning the tests.

.3 Upon completion of the installation, the Contractor shall furnish certificates of approval from all authorities having jurisdiction, as applicable. Contractor shall demonstrate that work is complete and in perfect operating condition. In the presence of the Owner, the Contractor shall demonstration the proper operation of all miscellaneous systems.

End of Section

1 General

1.01 Description

.1 This section specifies general grounding and bonding requirements of telecommunication installations for equipment operations.

.2 "Grounding electrode system" refers to all electrodes required by Electrical Code, as well as including made, supplementary, telecommunications system grounding electrodes.

.3 The terms "connect" and "bond" are used interchangeably in this specification and have the same meaning.

1.02 Related Requirements

.1 Section 26 05 26 – Grounding and Bonding for Electrical Systems.

.2 Section 27 11 16 – Communications Cabinets, Racks, Frames, and Enclosures.

1.03 References

.1 Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by the basic designation only.

.2 American Society for Testing and Materials (ASTM):

.1 B1-2001 - Standard Specification for Hard-Drawn Copper Wire

.2 B8-2004 - Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft

.3 Institute of Electrical and Electronics Engineers, Inc. (IEEE):

.1 81-1983 - IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System

.4 Canadian Standards Association (CSA):

.1 CSA C22.1-12 - Canadian Electrical Code, Part I (22nd Edition), Safety Standard for Electrical Installations.

.2 Ontario Electrical Safety Code (25th Edition / 2012).

.5 Telecommunications Industry Association, (TIA)

.1 J-STO-607-A - Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications

.6 Underwriters Laboratories, Inc. (UL):

.1 44-2005 - Thermoset-Insulated Wires and Cables

.2 83-2003 - Thermoplastic-Insulated Wires and Cables

.3 467-2004 - Grounding and Bonding Equipment

.4 486A-486B-2003 - Wire Connectors

1.04 Submittals

.1 Submit in accordance with Section 01 33 00.

.2 Shop Drawings:

.1 Sufficient information, clearly presented, shall be included to determine compliance with drawings and specifications.

.2 Include the location of system grounding electrode connections and the routing of aboveground and underground grounding electrode conductors.

.3 Test Reports: Provide certified test reports of ground resistance.

.4 Certifications: Two weeks prior to substantial performance, submit four copies of the following:

.1 Certification that the materials and installation is in accordance with the drawings and specifications.

.2 Certification, by the Contractor, that the complete installation has been properly installed and tested.

2 Products

2.01 Grounding and Bonding Conductors

.1 Equipment grounding and bonding conductors shall be UL 83 insulated stranded copper, except that sizes 6 mm² (10 AWG) and smaller shall be solid copper. Insulation colour shall be continuous green for all equipment grounding conductors. Cable insulation shall be plenum rated (CMP).

.1 Example: American Insulated Wire Corp, Telcoflex III series.

.2 Bonding conductors shall be ASTM B8 bare stranded copper, except that sizes 6 mm² (10 AWG) and smaller shall be ASTM B1 solid bare copper wire.

.3 Telecom System Grounding Riser

.1 Telecom System Grounding Riser Conductor: Telecommunications Grounding Riser shall be in accordance with J STO-607A. Use a minimum 50mm² (1/0 AWG) insulated stranded copper grounding conductor unless indicated otherwise.

2.02 Telecommunication and Equipment Ground Busbars

.1 Provide solid copper busbar, pre-drilled from two-hole lug connections with a minimum thickness of 6 mm (1/4 inch) for wall and backboard mounting using standard insulators sized as per details on the electrical drawings.

.2 Manufacturers:

.1 Newton Instrument Company

.2 Panduit

.3 Burndy

.4 Thomas and Betts.

2.03 Splices and Termination Components

.1 Components shall meet or exceed UL 467 and be clearly marked with the manufacturer, catalog number, and permitted conductor size(s).

2.04 Ground Connections

.1 Above Grade:

.1 Bonding Jumpers: compression type connectors, using zinc-plated fasteners and external tooth lockwashers.

.2 Ground Busbars: Two-hole compression type lugs using tin-plated copper or copper alloy bolts and nuts.

.3 Rack and Cabinet Ground Bars: two-hole compression-type lugs using zinc-plated or copper alloy fasteners.

3 Execution

3.01 General

.1 Ground in accordance with the Electrical Code, as shown on drawings, and as hereinafter specified.

.2 Equipment Grounding: IT cabinets, and other conductive items in close proximity with electrical circuits shall be bonded and grounded.

3.02 Secondary Equipment and Circuits

.1 Conduit Systems:

.1 Ground all metallic conduit systems. All metallic conduit systems shall contain an equipment grounding conductor.

.2 Non-metallic conduit systems shall contain an equipment grounding conductor, except that non-metallic feeder conduits which carry a grounded conductor from exterior transformers to interior or building-mounted service entrance equipment need not contain an equipment grounding conductor.

.3 Conduit containing only a grounding conductor, and which is provided for mechanical protection of the conductor, shall be bonded to that conductor at the entrance and exit from the conduit.

.2 Feeders and Branch Circuits: Install equipment grounding conductors with all feeders and power and lighting branch circuits.

.3 Boxes, Cabinets, Enclosures, and Panelboards:

.1 Bond the equipment grounding conductor to each pullbox, junction box, outlet box, device box, cabinets, and other enclosures through which the conductor passes (except for special grounding systems for intensive care units and other critical units shown).

.2 Provide lugs in each box and enclosure for equipment grounding conductor termination.

.3 Provide ground bars in panelboards, bolted to the housing, with sufficient lugs to terminate the equipment grounding conductors.

.4 Receptacles shall not be grounded through their mounting screws. Ground with a jumper from the receptacle green ground terminal to the device box ground screw and the branch circuit equipment grounding conductor.

3.03 Corrosion Inhibitors

.1 When making ground and ground bonding connections, apply a corrosion inhibitor to all contact surfaces. Use corrosion inhibitor appropriate for protecting a connection between the metals used.

3.04 Telecommunications System

.1 Bond telecommunications system grounding equipment to the electrical grounding electrode system.

.2 Furnish and install all new wire and hardware required to properly ground, bond and connect communications raceway, cable tray, metallic cable shields, and equipment to a ground source.

.3 Ground bonding jumpers shall be continuous with no splices. Use the shortest length of bonding jumper possible.

.4 Provide ground paths that are permanent and continuous with a resistance of 1 ohm or less from raceway, cable tray, and equipment connections to the building grounding electrode. The resistance across individual bonding connections shall be 10 milliohms or less.

.5 Above-Grade Grounding Connections: When making bolted or screwed connections to attach bonding jumpers, remove paint to expose the entire contact surface by grinding where necessary; thoroughly clean all connector, plate and other contact surfaces; and apply an appropriate corrosion inhibitor to all surfaces before joining.

.6 Bonding Jumpers:

.1 Use insulated ground wire of the size and type shown on the Drawings or use a minimum of #6 AWG insulated copper wire.

.2 Assemble bonding jumpers using insulated ground wire terminated with compression connectors.

.3 Use compression connectors of proper size for conductors specified. Use connector manufacturer's compression tool.

.7 Bonding Jumper Fasteners:

.1 Conduit: Fasten bonding jumpers using screw lugs on grounding bushings or conduit strut clamps, or the clamp pads on push-type conduit fasteners. When screw lug connection to a conduit strut clamp is not possible, fasten the plain end of a bonding jumper wire by slipping the plain end under the conduit strut clamp pad; tighten the clamp screw firmly. Where appropriate, use zinc-plated external tooth lockwashers.

.2 Wireway and Cable Tray: Fasten bonding jumpers using zinc-plated bolts, external tooth lockwashers, and nuts. Install protective cover, e.g., zinc-plated acorn nuts on any bolts extending into wireway or cable tray to prevent cable damage.

.3 Ground Plates and Busbars: Fasten bonding jumpers using two-hole compression lugs. Use tin-plated copper or copper alloy bolts, external tooth lockwashers, and nuts.

.4 Unistrut and Raised Floor Stringers: Fasten bonding jumpers using zinc-plated, self-drill screws and external tooth lockwashers.

3.05 Communications Raceway Grounding

.1 Conduit: Use insulated #6 AWG bonding jumpers to ground metallic conduit at each end and to bond at all intermediate metallic enclosures.

.2 Wireway: use insulated #6 AWG bonding jumpers to ground or bond metallic wireway at each end at all intermediate metallic enclosures and across all section junctions.

End of Section

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1 General

1.01 Summary

.1 Provide a complete system of empty conduit, pull boxes, outlets, and sleeves for enclosure of wiring by communications cabling.

1.02 Related Requirements

.1 Section 26 05 33.13 – Conduit for Electrical Systems.

.2 Section 26 05 33.16 – Boxes for Electrical Systems.

1.03 References

.1 BISCI Telecommunications Distribution Methods Manual, 13th Edition (2014).

2 Products

2.01 Outlets

.1 Wall outlets shall be 115 mm square boxes with plaster rings to suit single gang devices unless otherwise noted.

.2 Provide 53 mm conduit through walls as noted.

2.02 Conduits

.1 Conduit size shall be in accordance with recommended standard for conduits in Building as published by BICSI.

.2 Minimum conduit size shall be 21 mm diameter.

.3 Minimum space requirements in pull boxes for 90 degree pulls, shall be as follows:

Maximum conduit size	Size of pull boxes in millimetres			For each additional conduit size increase width by:
	Width	Length	Depth	
21 mm	150 mm	300 mm	100 mm	50 mm
27 mm	200 mm	400 mm	150 mm	75 mm
35 mm	250 mm	450 mm	200 mm	75 mm
41 mm	300 mm	600 mm	250 mm	100 mm
53 mm	350 mm	750 mm	300 mm	125 mm

.4 Plenum cables are permitted in accessible ceilings. Provide 'J' hooks in these locations for later cable installation under other sections of this Division.

.5 Plywood backboards shall be minimum 1200 mm by 2400 mm, 19 mm thick, painted with 2 coats of fire retardant light grey enamel.

.6 Provide a minimum of two 5-15R duplex receptacles on separate circuits at each backboard.

3 Execution

3.01 Installation

.1 Vertically mount outlet boxes, unless noted otherwise, 300 mm to centre above floor, or 150 mm above counter top where shown at counters or benches.

.2 Fish conduit, clear blockages and outlet and clean out pull boxes at completion of installation. Leave conduit free of water or excess moisture. Install No. 12 gauge galvanized soft iron pull wire, or 1/8 inch nylon pull cord continuously from outlet to outlet, through conduit and fasten at each box.

.3 Conduit shall have a bending radius of not less than nine times conduit diameter. Ream out conduit and identify ends with green paint.

.4 Install additional steel pull boxes in such a manner that, throughout entire system, there shall be not more than two 90 degree or equivalent bends or more than 30 000 mm in each run, so that wire or cables may be pulled in or withdrawn with reasonable ease. Minimum space requirements in pull boxes having one conduit each in opposite ends of the box, shall be as follows:

Maximum conduit size	Size of pull boxes in millimetres			For each additional conduit size increase width by:-
	Width	Length	Depth	
21 mm	150 mm	300 mm	100 mm	50 mm
27 mm	200 mm	400 mm	150 mm	75 mm
35 mm	250 mm	450 mm	200 mm	75 mm
41 mm	300 mm	600 mm	250 mm	100 mm
53 mm	350 mm	750 mm	300 mm	125 mm

.5 Show as-installed conduit routing and location of all pull boxes on the record drawings, prior to project completion, for use by future installer to facilitate wiring and equipment installation. Include above noted information on final record drawings at project completion.

End of Section

1 General

1.01 Section Includes

.1 Provide a complete system of empty conduits, pull boxes, outlets, and sleeves for enclosure of wiring for this system. Refer to General Requirements.

1.02 Related Requirements

.1 Section 26 05 33.13 – Conduit for Electrical Systems.

.2 Section 26 05 33.16 – Boxes for Electrical Systems.

.3 Section 28 46 13 – Fire-Alarm Systems.

1.03 References

.1 BISCI Telecommunications Distribution Methods Manual, 13th Edition (2014).

2 Products

2.01 Outlets

.1 Wall outlets shall be 115 mm square boxes with plaster rings to suit single gang devices unless otherwise noted.

2.02 Conduits

.1 Conduit size shall be in accordance with recommended standard for conduits in Building as published by BICSI.

.2 Minimum conduit size shall be 21 mm diameter.

.3 Minimum space requirements in pull boxes for 90 degree pulls, shall be as follows:

Maximum conduit size	Size of pull boxes in millimetres			For each additional conduit size increase width by:-
	Width	Length	Depth	
21 mm	150 mm	300 mm	100 mm	50 mm
27 mm	200 mm	400 mm	150 mm	75 mm
35 mm	250 mm	450 mm	200 mm	75 mm
41 mm	300 mm	600 mm	250 mm	100 mm
53 mm	350 mm	750 mm	300 mm	125 mm

.4 Plenum cables are permitted in accessible ceilings. Provide 'J' hooks in these locations for later cable installation by others.

.5 Plywood backboards shall be minimum 1200 mm by 2400 mm, 19 mm thick, painted with two coats of fire retardant light grey enamel.

.6 Provide a minimum of two duplex receptacles on separate circuits at each backboard.

.7 Provide fire alarm over-ride feature at fire alarm control panel (FACP) to deactivate public address system when Fire Alarm System is in alarm.

3 Execution

3.01 Installation

.1 Vertically mount outlet boxes, unless noted otherwise, 300 mm to centre above floor, or 150 mm above counter top where shown at counters or benches.

.2 Fish conduit, clear blockages and outlet and clean out pull boxes at completion of installation. Leave conduit free of water or excess moisture. Install No. 12 gauge galvanized soft iron pull wire, or 1/8" nylon pull cord continuously from outlet to outlet, through conduit and fasten at each box.

.3 Conduit bonds shall have a bending radius of not less than nine times conduit diameter. Ream out conduit and identify ends with green paint.

.4 Install additional steel pull boxes in such a manner that, throughout entire system, there shall be not more than two 90 degree or equivalent bends or more than 30,000 mm in each run, so that wire or cables may be pulled in or withdrawn with reasonable ease. Minimum space requirements in pull boxes having one conduit each in opposite ends of the box, shall be as follows:

Maximum conduit size	Size of pull boxes in millimetres			For each additional conduit size increase width by:-
	Width	Length	Depth	
21 mm	150 mm	300 mm	100 mm	50 mm
27 mm	200 mm	400 mm	150 mm	75 mm
35 mm	250 mm	450 mm	200 mm	75 mm
41 mm	300 mm	600 mm	250 mm	100 mm
53 mm	350 mm	750 mm	300 mm	125 mm

.5 Show as-installed conduit routing and location of all pull boxes on the record drawings, prior to project completion, for use by Cash Allowance installer to facilitate wiring and equipment installation. Include above noted information on final record drawings at project completion.

End of Section

1 General

1.01 Summary

.1 Provide a complete system of empty conduits, terminal cabinets, plywood backboards, pull boxes and outlets for enclosure of access control and intrusion detection system.

1.02 Related Requirements

.1 Section 26 05 33.13 – Conduit for Electrical Systems.

.2 Section 26 05 33.16 – Boxes for Electrical Systems.

2 Products

2.01 Outlets

.1 Wall and door outlets shall be single boxes, or 115 mm square boxes with plaster rings to suit single gang devices unless otherwise noted. Coordinate with Security Contractor.

2.02 Conduits

.1 Provide conduit in all walls, exposed areas and inaccessible ceilings. All conduit work shall be concealed.

.2 Minimum conduit size shall be 21 mm diameter.

.3 Provide J hooks in accessible ceilings for plenum rated wiring.

.4 Minimum space requirements in pull boxes for 90 degree pulls, shall be as follows:

Maximum conduit size	Size of pull boxes in millimetres			For each additional conduit size increase width by:
	Width	Length	Depth	
21 mm	150 mm	300 mm	100 mm	50 mm
27 mm	200 mm	400 mm	150 mm	75 mm
35 mm	250 mm	450 mm	200 mm	75 mm
41 mm	300 mm	600 mm	250 mm	100 mm
53 mm	350 mm	750 mm	300 mm	125 mm

.5 Plywood backboards shall be minimum 1200 x 2400 mm, 19 mm thick, painted with 2 coats of fire retardant light grey enamel.

.6 Provide a minimum of 2 duplex receptacles on separate circuits at each backboard.

3 Execution

3.01 Installation

.1 Vertically mount outlet boxes, unless noted otherwise, 300 mm to centre above floor, or 150 mm above counter top where shown at counters or benches.

.2 Fish conduit, clear blockages and outlet and clean out pull boxes at completion of installation. Leave conduit free of water or excess moisture. Install No. 12 gauge galvanized soft iron pull wire, or 1/8" nylon pull cord continuously from outlet to outlet, through conduit and fasten at each box.

.3 Conduit bonds shall have a bending radius of not less than nine times conduit diameter. Ream out conduit and identify ends with green paint.

.4 Install additional steel pull boxes in such a manner that, throughout entire system, there shall be not more than two 90 degree or equivalent bends or more than 30,000 mm in each run, so that wire or cables may be pulled in or withdrawn with reasonable ease. Minimum space requirements in pull boxes having one conduit each in opposite ends of the box, shall be as follows:

Maximum conduit size	Size of pull boxes in millimetres			For each additional conduit size increase width by:
	Width	Length	Depth	
21 mm	150 mm	300 mm	100 mm	50 mm
27 mm	200 mm	400 mm	150 mm	75 mm
35 mm	250 mm	450 mm	200 mm	75 mm
41 mm	300 mm	600 mm	250 mm	100 mm
53 mm	350 mm	750 mm	300 mm	125 mm

.5 Show as-installed conduit routing and location of all pull boxes on the record drawings, prior to project completion, for use by Security installer to facilitate wiring and equipment installation. Include above noted information on final record drawings at project completion.

End of Section

1 General

1.01 Summary

.1 Provide a complete system of empty conduits, terminal cabinets, plywood backboards, pull boxes and outlet boxes for enclosure of cabling for CCTV.

1.02 Related Requirements

.1 Section 26 05 33.13 – Conduit for Electrical Systems.

.2 Section 26 05 33.16 – Boxes for Electrical Systems.

2 Products

2.01 Video Surveillance Equipment

.1 Video Surveillance equipment shall be based on IP cameras. Size conduits based on industry practices based on Category 6 communications cabling.

2.02 Outlets

.1 Wall and door outlets shall be single boxes, or 115 mm square boxes with plaster rings to suit single gang devices unless otherwise noted. Coordinate with video surveillance contractor.

2.03 Conduits

.1 Provide conduit in all walls, exposed areas and inaccessible ceilings. All conduit work shall be concealed.

.2 Minimum conduit size shall be 21 mm diameter.

.3 Provide J hooks in accessible ceilings for plenum rated wiring.

.4 Minimum space requirements in pull boxes for 90 degree pulls, shall be as follows:

Maximum conduit size	Size of pull boxes in millimetres			For each additional conduit size increase width by:
	Width	Length	Depth	
21 mm	150 mm	300 mm	100 mm	50 mm
27 mm	200 mm	400 mm	150 mm	75 mm
35 mm	250 mm	450 mm	200 mm	75 mm
41 mm	300 mm	600 mm	250 mm	100 mm
53 mm	350 mm	750 mm	300 mm	125 mm

.5 Plywood backboards shall be minimum 1200 mm by 2400 mm, 19 mm thick, painted with 2 coats of fire retardant light grey enamel.

.6 Provide a minimum of two duplex receptacles on separate circuits at each backboard.

3 Execution

3.01 Installation

.1 Vertically mount outlet boxes, unless noted otherwise, 300 mm to centre above floor, or 150 mm above counter top where shown at counters or benches.

.2 Fish conduit, clear blockages and outlet and clean out pull boxes at completion of installation. Leave conduit free of water or excess moisture. Install No. 12 gauge galvanized soft iron pull wire, or 1/8 inch nylon pull cord continuously from outlet to outlet, through conduit and fasten at each box.

.3 Conduit bonds shall have a bending radius of not less than nine times conduit diameter. Ream out conduit and identify ends with green paint.

.4 Install additional steel pull boxes in such a manner that, throughout entire system, there shall be not more than two 90 degree or equivalent bends or more than 30 000 mm in each run, so that wire or cables may be pulled in or withdrawn with reasonable ease. Minimum space requirements in pull boxes having one conduit each in opposite ends of the box, shall be as follows:

Maximum conduit size	Size of pull boxes in millimetres			For each additional conduit size increase width by:
	Width	Length	Depth	
21 mm	150 mm	300 mm	100 mm	50 mm
27 mm	200 mm	400 mm	150 mm	75 mm
35 mm	250 mm	450 mm	200 mm	75 mm
41 mm	300 mm	600 mm	250 mm	100 mm
53 mm	350 mm	750 mm	300 mm	125 mm

.5 Show as-installed conduit routing and location of all pull boxes on the record drawings, prior to project completion, for use by Security installer to facilitate wiring and equipment installation. Include above noted information on final record drawings at project completion.

End of Section

1 General

1.01 Summary

.1 The work covered under this section consists of the furnishing of all necessary labor, supervision, materials, equipment, and services to completely execute the system of non-continuous cable supports ("J-Hooks") as described in this specification.

1.02 Scope

.1 Non-continuous cable supports.

.2 Adjustable non-continuous cable support sling.

.3 Multi-tiered non-continuous cable support assemblies.

.4 Non-continuous cable support assemblies from tee bar.

.5 Non-continuous cable support assemblies from drop wire/ceiling.

.6 Non-continuous cable support assemblies from beam, flange.

.7 Non-continuous cable support assemblies from C & Z Purlin.

.8 Non-continuous cable support assemblies from wall, concrete, or joist.

.9 Non-continuous cable support assemblies from threaded rod.

.10 Raised floor non-continuous cable support assemblies.

.11 Cantilever-Mounted Option for non-continuous cable supports.

.12 Installation accessories for non-continuous cable supports.

1.03 Definitions

.1 UTP: Unshielded twisted pair.

.2 ANSI: American National Standards Institute

.3 ASTM: American Society for Testing and Materials

.4 EIA: Electronic Industries Alliance

.5 TIA: Telecommunications Industry Association

.6 cULus: Listed by Underwriters Laboratories based on both Canadian and US (United States) standards requirements.

1.04 Submittals

.1 Submit product data on non-continuous cable support devices, including attachment methods. Product data to include, but not limited to materials, finishes, approvals, load ratings, and dimensional information.

1.05 Quality Assurance

.1 Non-continuous cable supports and cable support assemblies shall be listed by Underwriters Laboratories for both Canadian and US standards (cULus).

.2 Non-continuous cable supports shall have the manufacturers name and part number stamped on the part for identification.

.3 Manufacturer: Company specializing in manufacturing products specified in this section with a minimum of five years documented experience in the industry, and certified ISO 9000.

2 Products

2.01 Acceptable Manufacturers

.1 Subject to compliance with these specifications, non-continuous cable supports shall be as manufactured by ERICO, Inc or approved equal.

2.02 References

.1 ASTM B633 Standard Specification for Electro-deposited Coatings of Zinc on Iron and Steel

.2 ASTM B 695-90 Standard Specification for coatings of Zinc Mechanically Deposited on Iron and Steel

.3 ASTM A123 Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

.4 ASTM A924/A924M Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process

.5 ASTM A109 Standard Specification for Steel, Strip, Carbon, Cold-Rolled

.6 ASTM A167 Standard Specification for Stainless and heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip

.7 ASTM A480/A480M Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip.

.8 ASTM A568 Standard Specification for Steel, Sheet, Carbon, and High-Strength, Low-Alloy Hot-Rolled and Cold-Rolled

.9 A653 G60-Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-coated (Galvannealed) by the Hot-Dip process

.10 ASTM A666 Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar

.11 ASTM A682 Standard Specification for Steel, Strip, High-Carbon, Cold-Rolled, Spring Quality

.12 ASTM A879 Standard Specification for Steel Sheet, Zinc Coated by the Electrolytic Process for Applications Requiring Designation of the Coating Mass on Each Surface

.13 ASTM B117 Standard Method of Salt Spray (Fog) Testing

.14 ASTM D610 Standard test Method for Evaluating Degree of Rusting on Painted Steel Surfaces UL 2043 - Standard for Fire Test for Heat and Visible Smoke Release for Discrete Products and Their Accessories Installed in Air-Handling Spaces.

.15 ANSI/ TIA/ EIA 568 Commercial Building Telecommunications Cabling Standard, current revision level.

.16 ANSI/ TIA/ EIA 569 Commercial Building Standard for Telecommunications Pathways and Spaces, current revision level.

.17 NFPA 70 National Electrical Code®

2.03 Non-Continuous Cable Support Systems

.1 Non-continuous cable supports

.1 Non-continuous cable supports shall provide a bearing surface of sufficient width to comply with required bend radii of high-performance cables; cULus Listed.

.2 Non-continuous cable supports shall have flared edges to prevent damage while installing cables.

.3 Non-continuous cable supports sized 1 5/16" and larger shall have a cable retainer strap to provide containment of cables within the hanger. The cable retainer strap shall be removable and reusable and be suitable for use in air handling spaces.

.4 Non-continuous cable supports shall have an electro-galvanized or G60 finish and shall be rated for indoor use in non-corrosive environments.

.5 Stainless Steel non-continuous cable supports are intended for indoor and outdoor use in non-corrosive environments or where only mildly corrosive conditions apply.

.6 Non-continuous cable supports shall be ERICO CableCatTM J-hook series CAT12, CAT21, CAT32, CAT64, CAT21SS, CAT32SS, CAT64SS; CAT-CMTM Double J-Hook CAT100CM; CAT-CMTM U-hook series CAT200CMLN, CAT300CMLN; and CAT-CMTM retainer CATRT200CM, CATRT300CM or approved equal.

.2 Adjustable non-continuous cable support sling

.1 Constructed from steel and woven laminate; sling length can be adjusted to hold up to 425 4-pair UTP; rated for indoor use in non-corrosive environments. Rated to support Category 5 and higher cable, or optical fiber cable; cULus Listed.

.2 Adjustable non-continuous cable support sling shall have a static load limit of 100 lbs.

.3 Adjustable non-continuous cable support sling shall be suitable for use in air handling spaces.

.4 If required, assemble to manufacturer recommended specialty fasteners including beam clips, flange clips, C and Z purlin clips.

.5 Acceptable products: ERICO CADDY CableCatTM CAT425; or approved equal.

.3 Multi-tiered non-continuous cable support assemblies

.1 Multi-tiered non-continuous cable support assemblies shall be used where separate cabling compartments are required. Assemblies may be factory assembled or assembled from pre-packaged kits. Assemblies shall consist of a steel angled hanger bracket holding up to six non-continuous cable supports, rated for indoor use in non-corrosive environments; cULus Listed.

.2 If required, the multi-tier support bracket may be assembled to manufacturer recommended specialty fasteners including beam clamps, flange clips, C and Z purlin clips.

.3 The multi-tiered support bracket shall consist of ERICO CADDY CATHBA and CableCatTM J-Hooks with screws; or approved equal.

.4 Non-continuous cable support assemblies from tee bar

.1 Tee bar support bracket with one non-continuous cable support, factory or jobsite assembled; rated for indoor use in non-corrosive environments; cULus Listed.

.2 Acceptable products: ERICO CADDY CAT12TS, CAT21528, CAT32528; or approved equal.

.5 Non-continuous cable support assemblies from drop wire/ceiling

.1 Fastener to wire/rod with one non-continuous cable support, factory or jobsite assembled; rated for indoor use in non-corrosive environments; cULus Listed.

.2 Acceptable products: ERICO CADDY CAT124Z34, CAT126Z34, CAT214Z34, CAT216Z34, CAT324Z34 or CAT326Z34; or approved equal.

.6 Non-continuous cable support assemblies from beam, flange

.1 Fastener to beam or flange with one non-continuous cable support, factory or jobsite assembled; rated for indoor use in non-corrosive environments; cULus Listed.

.2 Acceptable products: ERICO CableCatTM J-hook series CAT12, CAT21, CAT32, CAT64 with CADDY beam clamps and CADDY flange clips; or approved equal.

.7 Non-continuous cable support assemblies from C & Z Purlin

.1 Fastener to C or Z purlin with one non-continuous cable support, factory or jobsite assembled; rated for indoor use in non-corrosive environments, cULus Listed.

.2 Acceptable products: ERICO CableCatTM J-hook series CAT12, CAT21, CAT32, CAT64 with CADDY Purlin hangers; or approved equal.

.8 Non-continuous cable support assemblies from wall, concrete, or joist

.1 Fastener to wall, concrete, or joist with one non-continuous cable support, factory or jobsite assembled; rated for indoor use in non-corrosive environments, cULus Listed.

.2 Acceptable products: ERICO CableCatTM J-hook series CAT12, CAT21, CAT32, CAT64, with CADDY angle bracket; or approved equal.

.9 Non-continuous cable support assemblies from threaded rod

.1 Fastener to threaded rod with one non-continuous cable support, factory or jobsite assembled, rated for indoor use in non-corrosive environments, cULus Listed.

.2 The multi-tiered support bracket shall have a static load limit of 300 lbs.

.3 U-hooks and Double J-hook shall attach directly to threaded rod using standard nuts.

.4 Acceptable products: ERICO CableCatTM J-hook, CAT12, CAT21, CAT32, CAT64 with CADDY CATHBA series; CAT-CMTM Double J-hook CAT100CM, CAT-CMTM Direct mount U-hook CAT200CMLN, CAT300CMLN; or AFAB series; or approved equal.

.10 Raised floor non-continuous cable support assemblies

.1 Fastener to raised (access) floor pedestal with one non-continuous cable support, factory or jobsite assembled, rated for indoor use in non-corrosive environments; cULus Listed.

.2 Acceptable products: ERICO CADDY CAT12CD1B, CAT21CD1B or CAT32CD1B; CAT64CD1B; or approved equal.

.11 Cantilever-Mounted cable supports

.1 U-hook shall be able to be assembled to a wide variety of wall mount brackets.

.2 Spacing of individual U-hooks as needed, max of 4' to 5' apart.

.3 U-hooks may have the optional attachment of a cable roller for ease in pulling cables.

.4 Acceptable products: ERICO CAT-CMTM U-hooks CAT200CMLN, CAT300CMLN: CAT-CM roller assemblies CATRL200CM, CATRL300CM; CATWMCM bracket; or approved equal.

.12 Installation accessories for non-continuous cable supports

.1 Cable Pulley

.1 Non-continuous cable supports may be used as an installation tool when a removable pulley assembly is included. The pulley shall be made of plastic and be without sharp edges. The pin and bail assembly must be able to be secured to the J-Hook during cable installation. The pulley must remain secured while cables are being pulled.

.2 The pin and roller assembly must be removed after cables are installed.

.3 Acceptable products: ERICO CADDY CAT32PLR, CAT64PLR, or approved equal.

.2 Cable Protector

.1 The protective steel tube shall fit over threaded rod and be at least 4" in length.

.2 The tube shall prevent damage to cables placed in or pulled through CAT-CMTM U-hooks. The tube shall not inhibit the pulling of cables.

.3 Acceptable products: ERICO CAT-CMTM CATTBCM, or approved equal.

2.04 Finishes

.1 ASTM B633 Standard Specification for Electro-deposited Coatings of Zinc on Iron and Steel

.2 ASTM B 695 Standard Specification for coatings of Zinc Mechanically Deposited on Iron and Steel

.3 ASTM A123 Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

.4 ASTM A924/A924M Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process

.5 Non-continuous cable supports used where only mildly corrosive conditions apply shall be stainless steel, AISI type 304.

3 Execution

3.01 Installation

.1 Installation and configuration shall conform to the requirements of the current revision levels of ANSI/ EIA/TIA Standards 568 & 569, NFPA 70 (National Electrical Code), applicable local codes, and to the manufacturer's installation instructions.

.2 Install cables using techniques, practices, and methods that are consistent with Category 5 or higher requirements and that supports Category 5 or higher performance of completed and linked signal paths, end to end.

.3 Install cables without damaging conductors, shield, or jacket.

.4 Do not bend cables, in handling or in installing, to smaller radii than minimums recommended by manufacturer.

.5 Pull cables without exceeding cable manufacturer's recommended pulling tensions. Use pulling means that will not damage media.

.6 Do not exceed load ratings specified by manufacturer.

.7 Adjustable non-continuous support sling shall have a static load limit of 100 lbs.

.8 Follow manufacturer's recommendations for allowable fill capacity for each size non-continuous cable support.

End of Section

1 General

1.01 Section Includes

.1 Cable trays, including ladder rack, wire mesh, optical fibre trough, and accessories.

1.02 Related Requirements

.1 Section 26 05 26 – Grounding and Bonding for Electrical Systems.

.2 Section 26 05 29 – Hangers and Supports for Electrical Systems.

1.03 References

.1 CSA C22.1-12 - Canadian Electrical Code, Part I (22nd Edition), Safety Standard for Electrical Installations

.2 Ontario Electrical Safety Code (25th Edition / 2012).

.3 CSA C22.2 No. 126.1 (CSA/NEMA) - Metal Cable Tray Systems.

1.04 Submittals for Review

.1 Product Data: Provide data for fittings and accessories.

.2 Shop Drawings: Indicate tray type, dimensions, support points, and finishes.

1.05 Submittals for Information

.1 Manufacturer's Instructions:

.1 Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements.

.2 Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.06 Submittals for Closeout

.1 Project Record Documents: Record actual routing of cable tray and locations of supports.

1.07 Regulatory Requirements

.1 Products: Listed and classified by CSA (Canadian Standards Association as suitable for the purpose specified and indicated.

2 Products

2.01 Ladder Rack-Type Cable Tray

.1 Description: CSA 22.2 No. 126.1, Class ladder type tray.

.2 Material: Aluminum.

.3 Inside width: As indicated.

.4 Inside depth: As indicated.

.5 Straight section rung spacing: 152 mm on centre.

.6 Inside Radius of Fittings: As indicated.

.7 Unless otherwise noted, provide manufacturer's standard clamps, hangers, brackets, splice plates, reducer plates, blind ends, barrier strips, connectors, and grounding straps.

.8 Refer to drawings for details.

.9 Manufacturers:

.1 Hubbell Nextframe Ladder Rack

.2 Canadian Electrical Raceways "Telecom Cable Rack"

.3 Approved Equal.

2.02 Wire Basket Cable Tray

.1 Description: CSA 22.2 No. 126.1, Class Basket type tray.

.2 Material: Carbon Steel, Hot Dipped Galvanized to ASTM A 123.

.3 Inside Width: As indicated.

.4 Inside Depth: As indicated.

.5 Straight Section Rung Spacing: refer to drawings.

.6 Inside Radius of Fittings: As indicated.

.7 Unless otherwise noted, provide manufacturer's standard clamps, hangers, brackets, splice plates, reducer plates, blind ends, barrier strips, connectors, and grounding straps.

.8 Refer to drawings for details.

.9 Rung spacing 6 inch.

.10 Radius for tees 12 inch minimum. Exact size to be verified on site.

.11 Do not employ tray elbows. Use Tees to permit future extension of tray.

.12 Radius for the dropouts 5 inch minimum. Exact size to be verified on site.

.13 Manufacturers:

.1 Cablofil.

.2 Canadian Electrical Raceways Inc.

.3 Hubbell.

.4 Thomas & Betts

2.03 Optical Fibre Routing System (Fibre Tray):

.1 The optical fiber routing system shall be used to route, segregate and protect fiber optic communication cabling.

.2 ULC Listed (UL2024A)

.3 Size:

.1 4" x 4"

.2 As otherwise indicated on drawings.

.4 2" minimum bend radius through-out pathway.

.5 Impact Resistant and flame retardant material. (UL94-V0 Flammability).

.6 Color: Black

.7 Will include all mounting hardware, waterfalls, directional fittings and other accessories required for installation

.8 Manufacturers:

.1 Panduit Fiberrunner series.

.2 ADC FiberGuide series.

.3 Commscope SpeedPRO series.

3 Execution

3.01 Installation

.1 Trays to be sized to 40 per cent maximum capacity.

.2 Install metallic cable tray to CSA C22.1 SB-02 and C22.2 No. 126.1.

.3 Install fibreglass cable tray to CSA C22.1 SB-02 and C22.2 No. 126.2.

.4 Support trays to Section 26 05 29. Provide supports at each connection point, at the end of each run, and at other points to maintain spacing between supports.

.5 Use expansion connectors where required.

End of Section

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1 General

1.01 Section Includes

.1 Firestopping through penetrations in fire rated assemblies.

1.02 Related Requirements

.1 Section 07 85 00 – Firestopping and Smoke Seals.

1.03 References

.1 ASTM E 84, "Surface Burning Characteristics of Building Materials".

.2 ASTM E 119, "Fire Tests of Building Construction and Materials".

.3 ASTM E 814, "Fire Tests of Penetration Firestop Systems".

.4 ANSI/UL263, "Fire Tests of Building Construction and Materials".

.5 ANSI/UL723, "Surface Burning Characteristics of Building Materials".

.6 ANSI/UL1479, "Fire Tests of Through Penetration Firestops".

.7 Underwriters Laboratories Inc. (UL) – Fire Resistance Directory

1.04 Performance Requirements

.1 Fire rated pathway devices shall be the preferred product and shall be installed in all locations where frequent cable moves, add-ons and changes will occur, such devices shall:

.1 Meet the hourly rating of the floor or wall penetrated.

.2 Permit the allowable cable load to range from 0% to 100% visual fill thereby eliminating the need to calculate allowable fill ratios.

.3 Not require any additional action on the part of the installer to open or close the pathway device or activate the internal smoke and fire seal, such as, but not limited to:

.1 Opening or closing of doors.

.2 Twisting an inner liner.

.3 Removal or replacement of any material such as, but not limited to, sealant, caulk, putty, pillows, bags, foam plugs, foam blocks, or any other material.

.4 Permit multiple devices to be ganged together to increase overall cable capacity.

.5 Allow for retrofit to install around existing cables.

.6 Include an optional means to lengthen the device to facilitate installation in thicker barriers without degrading fire or smoke sealing properties or inhibiting ability of device to permit cable moves, add-ons, or changes.

.2 Where single cables (up to 0.27 in. (7 mm) diameter) penetrate gypsum board/stud wall assemblies, a fire-rated cable grommet may be substituted. Acceptable products shall be molded from plenum-grade polymer and conform to the outer diameter of the cable forming a tight seal for fire and smoke. Additionally, acceptable products shall lock into the barrier to secure cable penetration.

.3 Where non- mechanical products are utilized, provide products that upon curing do no re-emulsify, dissolve, leach, breakdown or otherwise deteriorate over time from exposure to atmospheric moisture, sweating pipes, ponding water or other forms of moisture characteristic during or after construction.

.4 Where it is not practical to use a mechanical device, openings within floors and walls designed to accommodate telecommunications and data cabling shall be provided with re-enterable products that do not cure or dry.

.5 Cable trays shall terminate at each barrier and resume on the opposite side such that cables pass independently through fire-rated pathway devices. Cable tray shall be rigidly supported independent from fire-rated pathway devices on each side of barrier.

1.05 Submittals

.1 Submit under provisions of Section 01 33 00.

.2 Product Data: Provide manufacturer's standard catalog data for specified products demonstrating compliance with referenced standards and listing numbers of systems in which each product is to be used.

.3 Shop Drawings: Submit schedule of opening locations and sizes, penetrating items, and required listed design numbers to seal openings to maintain fire resistance ratings.

.4 Certificates: Product certificates signed by firestop system manufacturer certifying material compliance with applicable code and specified performance characteristics.

.5 Installation Instructions: Submit manufacturer's printed installation instructions.

1.06 Quality Assurance

.1 Products/Systems: Provide firestopping systems that comply with the following requirements:

.1 Firestopping tests are performed by a qualified, testing and inspection agency. A qualified testing and inspection agency is UL, or another agency performing testing and follow-up inspection services for firestop system acceptable to authorities having jurisdiction.

.2 Firestopping products bear the classification marking of qualified testing and inspection agency.

.2 Installer Qualifications: Experience in performing work of this section who is qualified by the firestopping manufacturer as having been provided the necessary training to install firestop products in accordance with specified requirements.

1.07 Delivery, Storage, and Handling

.1 Delivery:

.1 Manufacturer's original, unopened, undamaged containers, identification labels intact identifying product and manufacturer, date of manufacture; lot number; shelf life, if applicable; qualified testing and inspection agency's classification marking; and mixing instruction for multicomponent products.

.2 Handle and store products according to manufacturer's recommendations published in technical materials. Leave products wrapped or otherwise protected and under clean and dry storage conditions until required for installation.

.2 Storage and Protection:

.1 Store materials protected from exposure to harmful weather conditions and at temperature and humidity conditions recommended by manufacturer.

1.08 Project Conditions

.1 Do not install firestopping products when ambient or substrate temperatures are outside limitations recommended by manufacturer.

.2 Do not install firestopping products when substrates are wet due to rain, frost, condensation, or other causes.

.3 Maintain minimum temperature before, during, and for a minimum 3 days after installation of materials.

.4 Do not use materials that contain flammable solvents.

.5 Coordinate construction of openings and penetrating items to ensure that through-penetration firestop systems are installed according to specified requirements.

.6 Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate through-penetration firestop systems.

.7 Schedule installation of firestopping after completion of penetrating item installation but prior to covering or concealing of openings.

2 Products

2.01 Manufacturers

.1 Specified Technologies Inc., 200 Evans Way, Somerville, NJ 08876. Tel: (800) 992-1180, Fax: (908) 526-9623, Email: specseal@stifirestop.com, Website: www.stifirestop.com.

.2 Substitutions: as approved by the Engineer prior to tender closing.

.3 Single Source: Obtain firestop systems for each type of penetration and construction condition indicated only from a single manufacturer.

2.02 Materials

.1 General: Use only firestopping products that have been tested for specific fire resistance rated construction conditions conforming to construction assembly type, penetrating item type, annular space requirements, and fire rating involved for each separate instance.

2.03 Fire Rated Cable Pathways

.1 Steel raceway with intumescent foam pads allowing 0 to 100 percent cable fill, the following products are acceptable:

.1 Specified Technologies Inc. (STI) EZ-PATH™ Fire Rated Pathway.

3 Execution

3.01 Examination

.1 Before beginning installation, verify that substrate conditions previously installed under other sections are acceptable for installation of firestopping in accordance with manufacturer's installation instructions and technical information.

.2 Surfaces shall be free of dirt, grease, oil, scale, laitance, rust, release agents, water repellants, and any other substances that may inhibit optimum adhesion.

.3 Provide masking and temporary covering to protect adjacent surfaces.

.4 Do not proceed until unsatisfactory conditions have been corrected.

3.02 Installation

.1 General: Install through-penetration firestop systems in accordance with Performance Criteria and in accordance with the conditions of testing and classification as specified in the published design.

.2 Manufacturer's Instructions: Comply with manufacturer's instructions for installation of firestopping products.

3.03 Field Quality Control

.1 Inspections: Engage qualified independent inspection agency to inspect through-penetration firestop systems.

.2 Keep areas of work accessible until inspection by authorities having jurisdiction.

.3 Where deficiencies are found, repair firestopping products so they comply with requirements.

3.04 Adjusting and Cleaning

.1 Remove equipment, materials, and debris, leaving area in undamaged, clean condition.

.2 Clean all surfaces adjacent to sealed openings to be free of excess firestopping materials and soiling as work progresses.

End of Section

1 General

1.01 Section Includes

.1 Labelling and identification requirements for communications systems.

1.02 References

.1 ANSI/TIA/EIA-606-A – Administration Standard for Commercial Telecommunications Infrastructure.

.2 UL 969 – Marking and Labeling Systems.

2 Products

2.01 Summary

.1 Adhesive cable labels to meet the legibility, defacement, and adhesion requirements specified in UL 969 (Ref. D-16). In addition, the labels shall meet the general exposure requirements in UL 969 for indoor use.

.2 Self-laminating vinyl construction cable labels with a white printing area and a clear tail that self laminates the printed area when wrapped around a cable. The clear area should be of sufficient length to wrap around the cable at least one and one-half times.

.3 ANSI/EIA/TIA-606 for colour codes shall be followed. Labels are to be mechanically printed using a laser printer. Hand written labels will not acceptable.

2.02 Label Printer

.1 Thermal Transfer Printer shall print high quality, industrial labels on a wide variety of materials for electrical and network applications such as wire/cable, components, safety and facility identification.

.2 Laminated Adhesive Label Cassettes:

.1 For flat label applications.

.2 Polyester material.

.3 Non-Laminated Adhesive Label Cassettes:

.1 For marking wire and cable and flat label applications.

.2 Polyester material

.4 Example Products:

.1 Panduit LS7 series hand-held printer.

.2 Panduit LS8 series hand-held printer.

2.03 Nameplates

.1 Engraved three-layer laminated plastic, letters on contrasting background:

.2 Rack and Cabinet ID labels: 25 mm (1") high White Text on Black Background

3 Execution

3.01 Installation

.1 Cable identification labels should appear at the following locations with the numbers indicated on the cable schedule and drawings:

.1 300 mm (12 inches) from each end of the cable – after termination.

.2 Front of patch panels.

.3 Front of IDC termination blocks.

.4 Front of workstation/communications outlet faceplates.

.5 Each end of each Telecommunications Conduit.

.2 Fibre Optic safety labels shall appear at the following locations:

.1 Along the length of the conduit or innerduct at 3 m (10 foot) intervals.

.2 At all junction boxes

.3 At all pull boxes.

.4 On all fibre optic patch panels.

.3 Provide 25 per cent additional labels to be left in each telecommunications room on site for future growth.

.4 Provide two Rack/Cabinet nameplates. Mount one on the front, and one on the rear of the rack.

3.02 Identification Conventions

.1 All cabling will be labelled with the closet letter, followed by a dash and the wire number (i.e. A-001 would be the first wire in closet A).

.2 Labelling for backbone wiring will be preceded with BB followed by the wire number (i.e. BB-001 would be the first backbone.

End of Section

1 General

1.01 Section Includes

.1 Commissioning Requirements.

1.02 References

.1 Refer to Section 27 05 00 for references.

1.03 Submittals for Review

.1 Provide testing reports.

2 Products – Not Used

3 Execution

3.01 Installation

.1 Testing of all horizontal copper cables are to be completed in accordance with the follow test criteria:

.1 Basic Link

.2 Grounds

.3 NEXT

.4 ELFEXT

.5 Continuity

.6 correct polarity

.7 PSNEXT

.8 PSELFEXT

.9 Shorts

.10 Length

.11 ACR

.12 Return Loss

.13 Opens

.14 Attenuation

.15 PSACR

.16 Resistance

.2 Fibre strands in excess of 122m (400 ft) shall be tested with an Optical Time Domain Reflectometer for length and attenuation.

.3 Test each stand of fibre, bi-directionally, with a Power Meter / Light Source combination operating at wavelengths of 850 nm and 1300 nm for multimode fibres.

.4 Maximum multi-mode passive link loss (including patch cords) is not to exceed -2.35dB.

.5 Maximum single-mode passive link loss (including patch cords) is not to exceed -1.0dB.

3.02 Documentation

.1 The Telecommunications Cabling Contractor is required to submit test results in native tester format or a format which can be read with a text reader (i.e. ".txt" extension). Paper results shall not be submitted for projects with 100 or more horizontal cable drops and/or fibre cables.

.2 The Telecommunications Cabling Contractor is required to provide the software required to view the results.

.3 The report should be divided into sections by Telecommunications Room.

.4 The report should indicate for each cable when it was tested successfully, the result, and the length.

.5 The Telecommunications Cabling Contractor shall sign off on the entire test report prior to submitting to the General Contractor/Construction Manager or The Consultant.

.6 The test result documentation is to be submitted to the General Contractor/Construction Manager or The Consultant for review no later than 10 working days following the completion of the installation.

.7 All deficiencies must be corrected before the General Contractor/Construction Manager or The Consultant will provide a certificate to release the Holdback on the project.

3.03 Record Drawings

.1 The Telecommunications Cabling Contractor is required to maintain one set of correct and accurate record drawings on-site at all times. These drawings are to be made available to the General Contractor/Construction Manager or the Consultant for review during the project.

.2 The Telecommunications Cabling Contractor is required to provide record drawings of the telecommunication cabling installation in relation to the drawings provided in this specification.

.3 The record drawings shall be updated electronically and include, but are not limited to;

.1 Horizontal cable numbers on the floor plans

.2 Horizontal Cable Routing on the floor plans

.3 Changes on the floor plans

.4 Backbone cable Routing between Telecommunications Rooms

.5 Paging Speaker Locations including daisy chain cable run

.6 Wireless Access Points and Cell coverage

.7 Cabinet/Rack Elevation drawings

.8 Backboard Elevation Drawing

.4 The Telecommunications Cabling Contractor shall provide one soft copy in AutoCAD 2007 and one plotted copy for the Consultant to review prior to complete substantial performance and close-out documentation submission.

.5 After approval, the Telecommunications Cabling Contractor shall submit one plotted copy of the drawings for;

.1 The Main Computer Room

.2 Each Telecommunications Room

.3 The Consultant

.6 All close-out documentation must be submitted to the General Contractor/Construction Manager or The Consultant within 10 working days of the completion of the project before the documentation holdback will be released.

End of Section

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1 General

1.01 Summary

.1 Supply, install and test complete data cabling system and accessories, based on physical star wiring topology, and as specified herein and indicated on drawings.

.2 Include data cabling system the following sub-systems:

.1 Backbone Terminal Systems, located in Communications Closets, to serve as connection points between backbone cables and horizontal distribution cables.

.2 Horizontal distribution system links backbone terminal system to telecommunications outlets.

.3 Contractor is to submit details on equipment types and locations for review and approval prior to installation.

1.02 Related Requirements

.1 Reference Appendix A – TCDSB IT Guidelines

1.03 Abbreviations and Acronyms

.1 MTER Main Telecommunication Equipment Room

.2 TC Telecommunications Closet

.3 TCs Telecommunications Closets

.4 RCDD Registered Communications Distribution Designer

.5 BICSI Building Industry Consulting Service International

.6 MDTS Main Distribution Terminal System

.7 IDC Insulation Displacement Connection

.8 OTDR Optical Time-Domain Reflectometer

.9 BCS Backbone Cabling System

.10 IDT Intermediate Distribution Terminal

.11 BTS Backbone Terminal System

1.04 Reference Standards

.1 Conform to CAN/CSA-T530 for new buildings and areas of substantial renovations of telecommunications, spaces and pathways.

.2 Ensure that cabling system shall conform to current issue of industry standard CAN/CSA-T529. This standard is currently being revised and is available as document EIA/TIA SP-2840A (future CAN/CSA-T529). All requirements of this new document must be followed including: Structural Return Loss (section 10.2.4.5), Power Sum Testing (section 10.3.4.7) and End to End Link Performance and continuity, attenuation, cable open and shorts, NEXT; mutual capacitance, pair polarity and cable impedance, S/N ratio, and Pass/Fail status. Tests are to be conducted and recorded using a Penta Scanner. Fibre optic cables shall be tested in conformance to ISO/IEC IS 11801 standards using an EXFO Optical Time Domain Reflectometer. Test results such as; dB loss, cable length and fibre deficiencies (if any) shall be conducted. Verification, documentation, and warranty shall be provided.

.3 Where applicable, have performance of Category 6 cabling components used, verified by nationally recognized testing laboratory. Submit test results upon request.

.4 Conform to applicable Building and Electrical Safety Codes.

1.05 Submittals

.1 Shop Drawings

.1 Provide submittals in accordance with Section 01 33 00 prior to commencing installation.

.2 Submit complete cabling system layout for Consultant review for data, cable routing summary and cable outlet designation. Have cabling system layout performed by accredited RCDD (Registered Communications Distribution Designer) as defined by BICSI (Building Industry Consulting Service International). The Data Cabling system will not be accepted without this submission.

.3 Documentation proving compliance to End-to-End Link Performance test, as specified in Annex E of EIA/TIA SP-2840A shall be provided prior to structured cabling being installed.

.4 Submit detailed layout drawings, including termination racks prior to commencing this installation.

.5 Manufacturer's product information documents on all components of the cabling system, including horizontal and vertical cable management systems and all auxiliary components/devices and equipment prior to commencing this installation.

.6 The following documentation shall be submitted with a following cover letter listing attachments prior to commencement of work.

.1 A list of personnel for the project that will include the name of the Project Manager, Site Manager(s), Lead Hands, and Installers.

.2 Permits and notifications as may be required for the project.

1.06 Closeout Submittals

.1 Provide manufacturer's certificate at completion of installation certifying the installation.

.2 Prepare and submit "As-built" drawings reviewed by an RCDD.

.3 "As-built" drawings are to detail the exact location of equipment indicating wiring runs and raceways, pull, junction and terminal boxes. Also to include outlet locations, cable numbers and equipment rack profiles.

.4 Upon completion of work and prior to final acceptance, the contractor will submit to the Owner the required copies of Network Certification and Documentation in the form of manuals that will include the following:

.1 Detailed information on types of materials and equipment used and their locations including: distribution frame equipment (rack), equipment types and locations; a detailed listing of cable and outlet types and locations.

.2 Accurately and neatly recorded test results.

.3 Accurately and neatly record locations including room numbers, of all network components in list form for easy reference.

.4 Identify drawings as 'Project Record Copy' and maintain in new condition making available for inspection by Owner.

.5 Bind all items listed above in a 3-ring hard covered binder suitably labelled with the names of each site/project.

1.07 Quality Assurance

.1 Qualifications of Manufacturer

.1 Supply equipment manufactured by experienced reputable manufacturer, whose installations have rendered satisfactory service for at least 2 years and who would provide factory trained technicians fully experienced in telecommunications wiring. Submit information regarding number of employees, and proof of VAR/CSV certification, including length of time Contractor or employee(s) have been certified to install Cable systems.

.2 Provide certification that cabling solution offered will perform as a system as is defined in standards documents such as EIA-TIA SP-2840A and T568A configuration for Category 6 system standards. Provide certification supported by manufacturer of cabling components used.

.3 In addition to certificate of assurance, evidence of support by manufacturer for above items shall be provided upon request in writing with bidding response.

.4 Use components sourced completely from single manufacturer.

.2 Qualifications of Installer

.1 Provide installation and supervision work supervised by telecommunications technicians qualified to install voice and data cabling system and to perform related tests as required by manufacturer. Installers/company must have valid certification.

.2 Provide fully qualified telecommunications technicians, trained and certified by manufacturer in installation and testing of equipment specified. Provide evidence upon request in writing prior to work commencement of manufacturer's certification of supplier's ability to properly install structured cabling for building.

.3 Submit proven track record in cabling projects of similar size. Include details of minimum 3 projects of similar size involving Category 6 cabling, Multimode and Single-mode fibre optic cabling which have been completed in last 2 years. Include names, addresses, and phone numbers of references for 3 projects.

.3 Certifications

.1 UTP network wiring shall conform to T568A configuration, Category 6 system standards. All UTP cables shall provide minimum signal impairment by preserving wire pair twists as closely as possible to the point of mechanical termination at each end. The following tests will be conducted and recorded using a Penta Scanner:

.2 End to end continuity, attenuation, cable open and shorts; NEXT; mutual capacitance; pair polarity and cable impedance; S/N ratio and pass/fail status.

1.08 Warranty

.1 The structured cabling systems shall be warranted for 25 years, covering all system products manufactured and provided by the single source supplier. The warrantor shall guarantee the following:

.1 All passive system components, e.g. patch panels, UTP cable and outlet jacks are free from manufacturing defects in material or workmanship

.2 Approved cabling systems exceed the specifications of the T1A-568A standards and ISO/IEC IS 11801, if applicable.

.3 The installation exceeds attenuation and near end cross talk, loss and bandwidth requirements TIA Bulletin TIA TSB-67 and ISO/EIC IS 11801.

.2 General workmanship and apparatus installed under this contract shall be warranted against defects of workmanship and material for a period of one year after final acceptance of work by the Owner, unless otherwise specified. The contractor will make good any defects developed as a result of their work during such time without expense to the Owner.

2 Products

not used

3 Execution

3.01 Installation

.1 Each equipment rack shall be anchored securely to the floor and grounded to the building ground with a #6 AWG Insulated Ground Wire in accordance with applicable code requirements (refer to CAN/CSA T5238).

.2 Ground all data cables shields and associated equipment in Telecommunications rooms to meet applicable code requirements.

.3 Supply vertical cables and backbone cabling using cable clamps or wiring harnesses.

.4 Conform to Telecommunications Industry Standards (refer to EIA/TIA 568A) for all cable termination and pinning assignments.

.5 Utilize cable trays in MTER and TCs to manage cable in orderly fashion.

.6 All sleeves containing cable or unused shall be fire sealed. Coordinate with Section 07 85 00 for provision and installation of fire barriers.

.7 Cabling is to be run at 90 degrees to the building grid except where the distance would exceed 90m in length if installed in this manner.

.8 The maximum horizontal run length is not to exceed 90 metres. If the 90 metre constraint cannot be met, the Cabling Contractor is to notify the Owners Designee of any cables that exceed 90 metres, prior to the installation.

.9 Ensure all grounding conductors are rated FT-6. Tie into bundles and support using j-hooks outside of tray or conduit and fasten to under-slab at intervals not to exceed 1500 mm.

.10 Route all cable in such a way as to ensure minimum separations are maintained from sources of EMI as defined in EIA/TIA SP-2840A.

.11 Place all exposed cabling in TC in neat and professional manner and route as per specifications and drawings. Cables are to be combed, bundled, and routed in a neat and organized manner. Tie-wrap all exposed cable bundles at maximum of every 200 mm using black 'hook-and-loop- fastening ties.

.12 Securely mount voice outlets at all work area locations and locate so that cable required to reach work area equipment will be no more than 3 m long.

.13 Ensure that optical fibre splices, fusion or mechanical, do not exceed maximum optical attenuation of 0.3 dB when measured in accordance with EIA/TIA 455-34 and CSA Standard C22.2 No. 232.

.14 All cables must be properly handled and installed in accordance with the manufacturer's specification. Undue pulling tension, abrasion or rough handling must be avoided to ensure that the cables will permit transmission of the intended information with no impairment or degradation of signal quality. Cable runs between the wiring closets and wall plates must be performed with no splices or cuts to ensure the elimination of reflections, discontinuities, impedance, mismatches, and egress/ingress of undesired signals. Cables must be installed at a specified distance (shown below) from any electrical equipment such as radios, televisions, fluorescent lights or fixtures, motors, transformers, or other significant sources of RFI/EMI interference

.15 Label all cables in accordance with Industry Standards and CAN/CSA T528 specifications. Number cables as per drawings.

.16 In cases where the routing may bring the cable in close proximity to the above mentioned sources of disruption, the following minimum distances must be maintained:

.1 125 mm (5 inches) from power lines of 2 kVA or less.

.2 305 mm (12 inches) from lighting (including fluorescent).

.3 914 mm (36 inches) from power lines of 5 kVA or greater

.4 40 inches from transformers and motors

.17 As well, cables must be routed to avoid direct contact with steam pipes or other heat sources so as to avoid thermal degradation of the cable insulation or other undesired effects.

.18 Cables shall be located in ceiling spaces neatly, tied in bundles and installed in cable management "trays", J-hooks, and conduit as indicated on the drawings.

.19 All cables entering the wiring closets must be neatly dressed in bundles and run to the appropriate terminating location.

.20 Each cable sheath must be clearly and permanently identified with a labelling scheme acceptable to the owner. Each patch panel port a must be clearly and indelibly marked with a structured, user friendly numbering scheme. This numbering scheme must be capable of accepting cable additions so as not to disrupt the logical flow of the scheme. All testing documentation is to reference this numbering scheme.

.21 NOTE: The faceplate identification numbers/tags MUST be added to the electronic versions of the floor plans. This will be considered part of the As Built contract closeout submittals. The electronic version of the floor plan will be provided in ACAD 14 format by the consultant.

.22 The wiring closets shall be labelled C1 etc.

.23 Fibre optic cable installation procedures shall be as follows:

.1 All cables must be properly handled and installed in accordance with the manufacturer's specification. Undue pulling tension, abrasion or rough handling must be avoided to ensure that the cables will permit transmission of the intended information with no impairment or degradation of signal quality. Cable runs between the wiring closets and must be performed with no splices or cuts to ensure the elimination of reflections, discontinuities, excess signal loss, or other undesirable problems.

.2 All fibre cables shall be installed in conduits from end-to-end.

.3 If, during the course of cable installation, it is necessary to bore holes through a firewall, the holes must be sealed with an acceptable sealing material of compound once the cables are in place.

.4 All cables entering the computer room must be neatly dressed in bundles and run to the appropriate terminating location.

.5 Cable runs shall be free of tension at both ends as well as over the length of the run.

.6 Each cable sheath must be clearly and permanently identified at each end using an appropriate labelling scheme accepted by the Owner.

3.02 Cable Identification and Labels

.1 To Section 27 05 53.

.2 All adhesive cable labels shall meet the legibility, defacement, and adhesion requirements specified in UL 969 (Ref. D-16). In addition the labels shall meet the general exposure requirements in UL 969 for indoor use.

.3 Cable labels shall be of self-laminating vinyl construction with a white printing area and a clear tail that self laminates the printed area when wrapped around a cable. The clear area should be of sufficient length to wrap around the cable at least one and one-half times.

.4 All labels must be mechanically printed using a laser printer. Hand written labels are not permitted.

.5 Labels are to be attached to:

.1 front of the IDC connector or communication outlet faceplate

.2 each patch panel jack

.3 each end of the horizontal cable at maximum distance of 50mm from the end of the sheath

.6 Affix faceplate label printed with Workstation Identification number to faceplate cover of in-tile service box.

3.03 Testing

.1 All UTP distribution cabling must be tested with a specialized UTP cable tester to measure the following characteristics:

.1 DC Resistance

.2 Characteristic Impedance

.3 Cable Length

.4 Pair Sequence Testing

.5 Hardcopy checklists indicating room number and faceplate ID, should be prepared, These results should be documented and form part of the Certification Report, Any documentation supplied in hardcopy form should also be supplied in electronic format (suitable word processing file, spread sheet, graphics file (e.g. AutoCAD, etc.).

.6 In addition to the above UTP testing, each cable and termination must be tested to 100 MBS standards.

.7 The specific tests to be performed, after all jack plates are mounted on boxes and labelled, are as follows,

.1 Mutual Capacitance

.2 Attenuation

.3 Near End Cross Talk

.2 Fibre Optic Cable Testing Procedure

.1 System acceptance tests must be performed to verify that the cable plant can be certified fully operational. All optical fibre strands must be properly measured with approved optical fibre test equipment for the following characteristics:

.1 End to end attenuation loss in dB as measured by a calibrated optical power meter.

.2 Splice loss (if any)

.3 Cable length

.2 The above results are to be obtained by the following test procedures:

.1 Power meter and light source.

.2 OTDR - provide hard copy of signature trace in report.

.3 Detailed results of these tests must be included as part of a Certification Report.

.4 No connector should exceed 0.5 dB loss. Splices shall not exceed 0-3 dB loss. Total attenuation of link including fibre cable, connectors and splices shall not exceed 5 dB.

.3 These test results must be documented and form part of the Certification Report.

End of Section

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1 General

1.01 Section Includes

.1 Server Cabinets.

.2 Networking Cabinets.

.3 Blanking Panels.

.4 Rack Shelves.

.5 Combination Door Locks for Server Cabinets.

1.02 Related Work by Other Trades

.1 Division 26 (Electrical)

.1 Permanent Power at Racks.

.2 Cable Tray.

.3 Fibre Optic Tray.

1.03 Related Work in Other Sections

.1 Section 27 05 26 – Grounding and Bonding for Communications Systems: bonding of racks and cabinets.

1.04 References

.1 Refer to Section 27 05 00 for references.

1.05 Action Submittals

.1 Conform with the requirements of Section 01 33 00.

.2 Product Data: Provide manufacturers catalogue information.

1.06 Delivery, Storage, and Handling

.1 Refer to Division 01.

2 Products

2.01 Manufacturers

.1 APC.

.2 Panduit.

.3 Belden.

.4 Commscope.

2.02 Keying

.1 Unless otherwise noted, key all racks and cabinets identically.

.2 Install combination locks on server cabinets as directed by the Owner.

2.03 Cable Management

.1 The Cable Management System shall be used to provide a neat and efficient means for routing and protecting fibre and copper cables and patch cords on telecommunication racks and enclosures. The system shall be a complete cable management system comprised of vertical cable managers, horizontal cable manager, and cable management accessories used throughout the cabling system. The system shall protect network investment by maintaining system performance, controlling cable bend radius and providing cable strain relief.

.2 Vertical Cable Management

.1 Vertical cable managers shall include components that aid in routing, managing and organizing cable to and from patch panels and/or equipment. Managers shall protect network equipment by controlling cable bend radius and providing cable strain relief. Managers shall be a universal design mounting to EIA 482.6 mm (19") or 584.2 (23") racks and constructed of a base with cable management fingers. The fingers shall include retaining tabs to keep cables in place during cover removal. The covers shall be hinged to open in either direction allowing for quick moves, adds, and changes.

.1 Panduit

.1 PRV12 – Front and Rear VCM, 45U, 300 mm (12") max side extension.

.2 PRD12 – Hinged Door for PRV12, 45U, 300 mm (12") max side extension.

.3 PRV8 – Front and Rear VCM, 45U, 200 mm (8") max side extension.

.4 PRD8 – Hinged Door for PRV8, 45U, 200 mm (8") max side extension.

.5 PREP – Vertical Manager End Panel

.2 APC.

.3 Belden.

.4 Commscope.

.3 Horizontal Cable Management

.1 Panduit

.1 NCMHAEF2 – 2U HCM

.2 NCMHAEF4 – 4U HCM

2.04 2-Post Racks

.1 The Rack system shall meet all EIA requirements as defined in EIA-310-D.

.2 Dimensions:

.1 45 Rack U High

.2 482.6 mm (19") Wide

.3 2134 mm (7'-0") Total Height

.3 Construction: Aluminum

.4 Basis of design: APC AR201.

2.05 Rack Shelves

.1 Weight capacity: 250 lbs.

.2 Finish: Black

.3 Basis of design: APC AR8122 series.

2.06 Server Cabinet Combination Lock Handles

.1 3-tumbler combination lock handle with master key override.

.2 Shall utilize same mounting as standard swing-handle, and permit field retrofit.

.3 Basis of design: APC AR8132A series.

3 Execution

3.01 Installation

.1 Install cabinet side panels to cabinets at end of rows, or to cabinets not immediately adjacent (for example where separated by a column).

.2 Provide Rack Bonding Jumpers.

.3 Fill unused rack openings with blank panels, as specified elsewhere herein below.

3.02 Vertical Cable Management

.1 Install vertical cable managers in accordance with manufacturer's instructions.

3.03 Server Cabinets

.1 Install Patch Panels and Horizontal Cable Managers at rear of server cabinets.

End of Section

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1 General

1.01 Section Includes

.1 Termination Blocks, Patch Panels, and Connectors.

1.02 Related Requirements

.1 Section 27 13 13 – Communications Copper Backbone Cabling.

1.03 Submittals for Review

.1 Product Data: Provide manufacturers catalogue information.

2 Products

2.01 Copper Termination Blocks

.1 Refer to Section 27 13 13.

.2 Copper IDC termination block to be wall mounted BIX type, 300 Pair, c/w wire management and cross-connect jumper wires.

2.02 Copper Patch Panels and Termination Blocks

.1 Copper patch panels to be 19" rack mount, 24/48 port, Category 6, 8 pin modular jack (RJ45) with labels and icons, icon color to match field outlet color. Patch panel to have 2 types, angled type for the cabling rack and flat type for equipment cabinets and remote wall mounted telecom cabinets.

2.03 Category 6 1U-48 Port Flat Patch Panels

.1 Suitable for mounting to any standard 19" or 23" EIA rack or cabinet.

.2 Horizontal termination for data circuits shall consist of category 6 flat patch panels, which shall be 1U high and provide either 48 modular jack ports, as indicated on the drawings. Patch panels shall be configured with individually replaceable jacks.

.3 Each modular jack shall be provided with a bend-limiting strain relief. The strain relief shall provide cylindrical support to limit the bend radius at the point of termination.

.4 The front of each 6-port module shall be capable of accepting labels to TIA requirements.

.5 Each port shall be capable of accepting an icon to indicate its function. Patch panels shall meet the Category 6 performance requirements of ANSI/TIA-568-C.2.

.6 Panduit CPP48FMWBLY.

2.04 Fibre Patch Panels

.1 Fiber patch panel to be 19" rack mount enclosure (in all 19" rack/cabinet) or wall mount enclosure, supporting optical fiber connector adapter panels (duplex LC Type), rear cable retention loops, entry cable strain relief supports, cable strength member clamps, D- grommets at cable entry, removable rear panel cover, accommodation and support for splice trays, removable front access cover, front space for patch cable storage, patch cable bend radius controls and identification labeling.

3 Execution

3.01 Installation

.1 Refer to Section 27 13 13 Copper Backbone Cabling.

.2 Refer to Section 27 15 13 Copper Horizontal Cabling.

End of Section

1 General

1.01 Section Includes

.1 Cable Management.

1.02 Submittals for Review

.1 Product Data: Provide manufacturers catalogue information.

2 Products

2.01 Network Cabinet Cable Management Finger Kit

.1 Network cabinet cable management finger kit, nine RU sections. Kit includes five left and five right finger sections to complete 45 RU on one side of post.

.2 Panduit CNBRFK.

2.02 Slack Spool Set

.1 Network Cabinet and 4 post rack end channel slack spools. Package includes one left and one right slack spool and mounting brackets.

.2 Panduit CNSPE.

2.03 3U Horizontal Cable Manager

.1 Horizontal Cable Manager High Capacity Front and Rear 3 Rack Units. 5.2"H x 19.0"W x 13.1"D (133 mm x 482 mm x 332 mm).

.2 Panduit NM3.

3 Execution

3.01 Installation

.1 Refer to Section 27 13 13 Copper Backbone Cabling.

.2 Refer to Section 27 15 13 Copper Horizontal Cabling.

End of Section

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1 General

1.01 Submittals For Review

.1 Product Data: Provide manufacturers catalogue information.

2 Products

2.01 Facility Network Cabling

.1 Minimum plenum rated (CMP) Category 6 UTP.

.2 Panduit TX6000 series.

2.02 Jacks and Modules

.1 Panduit Mini-Com TX6 series

3 Execution

3.01 Installation

.1 Install backbone cables in accordance with manufacturer's specifications ensuring that proper installation techniques are used and that the cable's maximum pull-force and maximum bend radii specifications are adhered to.

.2 Backbone cable/cable bundles shall be secured properly when fastened to backboards or termination cabinets/racks.

.3 For UTP cabling, maintain a minimum of four (4) times cable diameter as a bend radius if no bend radius is specified.

.4 The Contractor shall notify The Consultant immediately if UTP backbone cable run exceeds 90 m (295'-0").

.5 The Manufacturer and the Electrical Contractor shall ensure the maximum length of any zone cabling does not exceed the manufacturer's specifications.

End of Section

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1 General

1.01 Summary

.1 This Section includes:

.1 The supply, delivery, supervision, coordination, and installation of equipment items specified herein and shown on the Drawings.

.2 The testing, documentation, and instructions for completing the Fiber Backbone Cabling System.

.3 Products supplied but not installed under this section, including loose equipment specified herein, which is to be turned over to the Owner at the completion of this project

.2 Examine the contract documents in their entirety (including drawings and specification sections in the other divisions) for requirements or work which may affect work under this section, regardless of whether such requirements or work are specifically indicated in this section.

.3 Contractor Shall Provide and Install

.1 The Contractor shall furnish and install telecommunications passive equipment, including:

.1 Fiber backbone cable

.2 Splicing and terminations

.3 Testing

.4 Administration

.2 Although such work is not specifically mentioned herein or on the Drawings, the Contractor shall furnish and install all miscellaneous items, accessories, appurtenances, and devices incidental to or necessary for a sound, secure, and complete installation, without claim for additional payment.

.3 The Contractor shall provide system testing and demonstration, system documentation, and instruction of Owner personnel, without claim for additional payment.

.4 Errors or Omissions in Drawings or Documentation

.1 If any errors or omissions appear in Drawings, Specifications, or other documents, the bidding Contractor shall notify the Consultant no later than ten (10) days prior to submitting the bid.

.2 Should conflict occur in or between Drawings and Specifications, the bidding Contractor is deemed to have estimated the more expensive way of doing the work, unless the bidding Contractor has asked for and obtained written decision (addendum) before submission of the bid as to which method or materials will be required.

1.02 Related Requirements

.1 Section 27 11 19 – Communications Termination Blocks and Patch Panels.

1.03 Definitions

.1 ANSI – American Northern Standards Institute

.2 AWG – American Wire Gauge

.3 BICSI – Building Industry Consulting Service International

.4 BCT – Bonding Conductor for Telecommunications

.5 BD – Building Distributor – A distributor in which the building backbone cables terminate and at which connections to the campus backbone cables may be made

.6 CP – Consolidation Point – A connection facility within Cabling Subsystem 1 for interconnection of cables extending from building pathways to the equipment outlet

.7 EDA – Equipment Distribution Area – A space allocated for end equipment, including computer systems and telecommunications equipment

.8 EF – Entrance Facility – An entrance to a building for both public and private network service cables, including wireless, that includes the entrance point of the building and continues to the entrance room or space

.9 EIA – Electronics Industry Alliance

.10 ER – Equipment Room – An environmentally-controlled, centralized space for telecommunications equipment that serves the occupants of the building, considered distinct from a Telecommunications Room (TR) because of the nature or complexity of the equipment.

.11 ESD – Electro Static Discharge – The sudden flow of electricity between two electrically-charged objects caused by contact, an electrical short, or dielectric breakdown

.12 ETL – Intertek Certification Services

.13 IEC – International Electrotechnical Commission

.14 IEEE – Institute of Electrical and Electronic Engineers

.15 IDC – Insulation displacement contact

.16 ISO – International Standards Organization

.17 HC – Horizontal Cross-connect – A group of connectors, such as patch panels or punch-down blocks, that allow horizontal, backbone, and equipment cabling to be cross-connected with patch cords or jumpers

.18 HDA – Horizontal Distribution Area – A space in a computer room where a Horizontal Cross-connect (HC) is located, and which may include LAN switches, Storage Area Network (SAN) switches, and Keyboard/Video/Mouse (KVM) switches for the end equipment located in the Equipment Distribution Areas (EDAs)

.19 IC – Intermediate Cross-connect – A facility enabling the termination of different levels of backbone cabling and interconnection between them or equipment

.20 MC – Main Cross-connect – A facility enabling the termination of backbone cables and their connection to incoming services, other backbone cabling or equipment

.21 MDA – Main Distribution Area – The central point of distribution for the structured cabling system, which includes the Main Cross-connect (MC) and, when equipment areas are served directly from the MDA, may also include Horizontal Cross-connect (HC)

.22 MM – Multi-Mode Fiber

.23 NECA – National Electrical Contractors Association

.24 NFPA – National Fire Protection Agency

.25 NRTL – Nationally Recognized Testing Laboratory

.26 TIA – Telecommunications Industry Association

.27 SM – SingleMode Fiber

.28 UL – Underwriters Laboratory

.29 Provide: Furnish, install, terminate, label, test and certify a complete operating cabling system.

.30 Contract Documents (CD): Design drawings, specifications, sketches and schedules provided by the Engineer as they directly relate to this scope of work and this project.

.31 Structured Cabling Systems (SCS) wiring is defined as all required equipment and cabling including hardware, termination blocks, cross connect wire or cordage, patch panels, patch cords, telecommunication outlets, work area cords, UTP and fiber cable installed and configured to provide computer data and voice connectivity.

.32 Point–of–Entry (POE): Unmarked Manholes/Vaults at property line

.33 NET–POP Rooms/MPOE (Main Point of Entry): The area where the outside plant media/carrier services appear in the facility. The NET–POP contains equipment used by owner or carrier to hand–off/transition cable from outside plant into inside plant type.

.34 Network Center/Main Distribution Frame (MDF) Areas: This technology space houses Layer 2/3 network switching gear and other main network distribution equipment and acts as the mid–connection point between the Core/Network and the TR/IDF/access zones for all connections.

.35 Telecommunications Room (TR)/Intermediate Distribution Frame (IDF): is the location for the termination of backbone cables and for termination of horizontal cables, and for the interconnection of each. The space also hosts access–layer switches and user network connections within each floor.

.36 Active Equipment: electronic equipment used to develop various WAN, LAN, and voice services, e.g., digital multiplexers, RS–232 controllers, Ethernet hubs, switches, routers, PBX, etc.

.37 Campus Backbone: cabling system consisting of media and termination hardware interconnecting POE, Net–Pop's and Future onsite buildings.

.38 Building Backbone: cabling system consisting of media and termination hardware interconnecting MDFs to IDFs.

.39 Horizontal: cabling system consisting of media and termination hardware interconnecting the Telecommunication Outlets (TOs) and the TRs.

.40 Bonding: permanent joining of metallic parts to form an electrically conductive path which will assure electrical continuity and the capacity to conduct safely any current likely to be imposed on it.

.41 Basket Cable Tray: A cable support and management system fabricated of continuous, rigid, welded steel wire mesh and available in many sizes with attachment hardware suiting multiple installation methods

.42 Cable Tray: vertical or horizontal open supports, usually made of aluminum or steel, which are fastened to the building structure. Cables are laid in and fastened to the trays.

.43 Cabinet: free standing, floor–mounted or wall–mounted modular enclosure designed to house and protect rack–mounted electronic equipment and passive terminations.

.44 Channel: The end–to–end transmission path between two points at which application specific equipment is connected; encompasses all the elements of the horizontal cabling link, plus the equipment cords in the telecommunications spaces and work area.

.45 Cross–Connect: equipment used to terminate and tie together communications circuits.

.46 Cross–Connect Jumper: a cluster of twisted–pair conductors without connectors used to establish a circuit by linking two cross–connect termination points.

.47 Grounding: a conducting connection to earth, or to some conducting body that serves in place of earth.

.48 Jack: receptacle used in conjunction with a plug to make electrical contact between communications circuits, e.g., eight–position/eight–contact modular jacks.

.49 Ladder Cable Tray: A fabricated structure consisting of two longitudinal side rails connected by individual transverse members (rungs).

.50 LAN: Local area network.

.51 Link: Horizontal cabling link encompassing all components of the horizontal cabling (TO, patch panels, blocks, jumpers and patch cords that join them in the horizontal cross–connect). It is distinguished from a channel because it does not include the equipment cables/cords at the telecom spaces or work area.

.52 Media: twisted–pair, and fiber optic cable or cables used to provide signal transmission paths.

.53 Mounting Frame: rectangular steel framework, which can be equipment rack or wall mounted to support wiring blocks, patch panels, and other communications equipment.

.54 Outside Plant (OSP): generally, any and all portions of the cable system that runs outside of an environmentally enclosed structure and/or building with each end terminated at different buildings. This specifically includes inter–building cables, conduits, manholes, hand–holes, and innerduct.

.55 UTP: Unshielded Twisted Pair.

.56 FO: Fiber Optic

.57 Passive Equipment: non–electronic hardware and apparatus, e.g., equipment racks, cable trays, electrical protection, patch panels, wiring blocks, fiber optic shelves, etc.

.58 Patch Cords: a length of wire or fiber cable with connectors on one or both ends used to join communications circuits at a cross–connect.

.59 Patch Panel: system of terminal blocks or connectors used with patch cords that facilitate administration of cross–connect fields.

.60 Pathway: facility for the placement of communications cable. A pathway facility can be composed of several components including conduit, wireway, cable tray, surface raceway, under floor systems, overhead systems, raised floor, ceiling support wires, etc.

.61 Protectors: electrical protection devices used to limit foreign voltages on metallic communications circuits.

.62 Raceway: an enclosed channel designed expressly for holding wires or cables; may be of metal or insulating material. The term includes conduit, tubing, wire ways, under floor raceways, overhead raceways and surface raceways; does not include cable tray.

.63 Racks: An open, freestanding, floor–mounted structure, typically made of aluminum or steel, used to mount equipment; usually referred to as an equipment rack.

.64 Riser Backbone: The Riser Backbone subsystem links the main cross connect (MDF) in the equipment room to the distribution rooms (TRs).

.65 Structured Cabling System (SCS): A SCS is defined as all required cabling including hardware, termination blocks, cross connect wire or cordage, patch panels, patch cords, telecommunication outlets, work area cords, UTP and fiber optic cable installed and configured to provide computer data and voice

connectivity from each data or voice device to the network file server or voice network/switch designated as the service point of the local area network.

.66 Telecommunication Outlet (TO): Connecting device mounted in a work area used to terminate horizontal cable and interconnect cabling with station equipment.

.67 Trough or Ventilated Cable Tray: A fabricated structure consisting of integral or separate longitudinal rails and a bottom having openings sufficient for the passage of air and using 75 percent or less of the plan area of the surface to support cables.

.68 Work Area Subsystem: The connection between the telecommunications outlet and the station equipment in the work area is provided by the Work Area Subsystem. It consists of cords, adapters, and other transmission electronics.

.69 Wireless Access Point (WAP): Telecom outlet designated for use with wireless network devices. Such outlet shall be mounted above ceiling.

.70 Contractor – The successful bidder engaged to provide the work of this specification

1.04 References

.1 Most recent editions and addenda of the following documents:

.2 ANSI/TIA 568 series, most recent revisions, addenda and systems bulletins. All applicable

.3 ANSI/TIA–569 Telecommunications Pathways and Spaces, most recent revision including all relevant addenda and systems bulletins

.4 ANSI/TIA–606 Administration Standard for Telecommunications Infrastructure, most recent revision including all addenda and systems bulletins

.5 ANSI/TIA–607 Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises, most recent revision including all addenda and systems bulletins

.6 ANSI/TIA–862 Structured Cabling Infrastructure Standard for Intelligent Building Systems, most recent revision including all addenda and systems bulletins

.7 ANSI/TIA–942 Telecommunications Infrastructure Standard for Data Centers, most recent revision including all addenda and systems bulletins

.8 ANSI/TIA–1179 Healthcare Facility Telecommunications Infrastructure Standard, most recent revision including all addenda and systems bulletins

.9 ANSI/TIA–4966 Telecommunications Infrastructure Standard for Educational Facilities, most recent revision including all addenda and systems bulletins

.10 TIA–TSB–162 Telecommunications Cabling Guidelines for Wireless Access Points, most recent revision including all addenda and systems bulletins

.11 TIA-526 Series – Standard Test Procedures for Fiber Optic Systems

.12 TIA-942 – Telecommunications Infrastructure Standard for Data Centers

.13 Telecommunications Distribution Methods Manual, most recent edition

.14 Information Transport Systems Installation Methods Manual (ITSIMM), most recent edition

.15 National Electric Codes (NEC) – all applicable

.16 National Electric Codes (NEC) – all applicable

.17 NECA/FOA 301– Installing and Testing Fiber Optic Cables

.18 OSHA Standards and Regulations – all applicable

.19 Local Codes and Standards – all applicable

.20 UL444 – Standard for Safety of Communications Cable

.21 UL 1666 – Standard for Safety of Flame Propagation Height

.22 Local Authority Having Jurisdiction (AHJ)

.23 Anywhere cabling standards conflict with one another or with electrical or safety codes, Contractor shall defer to the NEC and any applicable local codes or ordinances, or default to the most stringent requirements listed by either.

.24 Manufacturers' Recommendations - Install all cabling and termination devices per the manufacturers' recommended installation practices for the applications warranties.

.25 Any violations of applicable standards or codes committed by the Contractor shall be remedied at the Contractor's expense.

1.05 System Description

.1 The Contractor will provide, install, and test a complete structured cabling system for the project's voice and data communications systems from the Telecommunications Outlet (TO) to the Telecommunications Room (TR), and between telecommunications spaces. The Contractor will provide and install all required components, as identified below.

.2 Fiber Backbone Cabling

.1 Vertical and horizontal backbone cabling will consist of Muilti-mode and Singlemode optical fiber cable installed from each TR to the ER.

.3 Backbone Cabling Termination

.1 Provide fiber distribution enclosures at each end, sized for the number of fibers to be installed.

.2 Terminate with field-installable connectors or with fusion splicing of factory cable assemblies and modular connector panels or splice cassettes.

.4 Typical Equipment Room (ER)

.1 Open racks and/or enclosures with vertical and horizontal wire management.

.2 Fiber Distribution Enclosures (FDEs).

.3 Fire-resistant plywood installed on at least one (1) wall, at a height of 96 inches Above the Finished Floor (AFF) on which to install wall-mounted equipment.

.4 A Grounding and bonding system connected to the building's main grounding electrode system.

.5 A cable runway system, installed above the racks and enclosures, to support and manage the cabling that runs from the racks and enclosures to the equipment in the space, which shall be fitted with all accessories required to adequately support the installed cabling, such as waterfalls, support components, and bonding components.

.5 Typical Telecommunications Room (TR)

.1 Open racks and/or enclosures with vertical and horizontal wire management.

.2 Fiber Distribution Enclosures (FDEs).

.3 Fire-resistant plywood installed on at least one (1) wall, at a height of 96 inches Above the Finished Floor (AFF) on which to install wall-mounted equipment.

.4 A Grounding and bonding system connected to the building's main grounding electrode system.

.5 A cable runway system, installed above the racks and enclosures, to support and manage the cabling that runs from the racks and enclosures to the equipment in the space, which shall be fitted with all accessories required to adequately support the installed cabling, such as waterfalls, support components, and bonding components.

.6 Pathways and Raceways

.1 Pathways and raceways are the support system for the infrastructure. All pathways and raceways shall conform to the standards referenced in this Section.

.2 All horizontal and backbone cable shall be properly supported every 48 to 60 inches. Infrastructure support systems include, but may not be limited to the following:

.1 Properly-supported cable trays and cable runway.

.2 Properly-supported conduits, inside or outside, above ground or underground.

.3 Non-continuous cable supports, which shall be spaced no more than 60 inches apart.

.4 Surface raceway systems that may consist of metallic or non-metallic raceways and boxes.

.7 Using a Combination of Cable Supports

.1 The preferred method for providing pathways is to use a combination of cable tray and non-continuous cable supports.

.2 Cable trays shall be used for main horizontal cable pathways on all levels from the ER and TR locations.

.3 Cable trays shall be installed in the main corridors.

.4 In areas of low cable density, use independently-supported non-continuous cable supports in lieu of the cable tray system.

.5 All backbone cable shall also follow these cable tray pathways.

.6 To allow for future maintenance and access, the primary cable routes shall be located over corridors.

.7 To protect cable from damage and to provide a suitable aesthetic appearance, in areas where the cable may be exposed, such as in open ceiling rooms, conduit or surface raceway must be used instead of non-continuous cable supports.

1.06 Submittals

.1 Consultant's Review

.1 The Consultant's review of shop drawings or samples shall not relieve the Contractor of responsibility for any deviation from the contract documents.

.2 With the shop drawings, the Contractor shall include an index sheet detailing all deviations from the contract documents, and will be held responsible for all deviations, unless the Contractor has received written approval from the Engineer for the specific deviation, separate from general shop drawing approval.

.3 The Consultant's review shall not relieve the Contractor from responsibility for errors or omissions in the shop drawings or samples.

.2 General Component Data

.1 For all products covered under this Section, the Contractor shall submit the following data for each component:

.1 A Specification Section

.2 The Manufacturer's name.

.3 The Manufacturer's model and part number

.3 Fiber Cable

.1 In addition to the general requirements above, the Contractor shall submit the following additional data:

.1 Cable identification numbers.

.2 Cable specifications including quantity of fibers, material, insulation, jacket, wavelength, attenuation, diameter, bend radius, core, cladding, coating, buffering, weight, and color.

.4 Splicing and Terminations

.1 In addition to the general requirements above, the Contractor shall submit splicing and terminating tools, materials, and methods.

.5 Testing and Test Results

.1 The equipment serial number.

.2 A graphic diagram documenting the test procedure, including all connectors, the light source (as applicable), the origin, and the destination of each cable tested.

.3 Refer to Section 27 08 11.

1.07 Quality Assurance

.1 Standards for Materials and Equipment

.1 The Contractor shall provide all materials, equipment, and installation in compliance with the latest applicable standards from ANSI, FCC, ASTM, EIA/TIA, IEEE, NEC, NFPA, NEMA, OSHA, REA, and UL.

.2 Installer Qualifications

.1 Refer to Section 27 05 00.

1.08 Delivery, Storage, and Handling

.1 To prevent damage, theft, soiling, and misalignment, protect equipment during transit, storage, and handling.

.2 The contractor shall coordinate the secure storage of equipment and materials on site, or, if no on-site storage is available, shall provide their own secure storage at the Contractor's expense.

.1 Do not store equipment where conditions fall outside the manufacturer's recommendations for environmental conditions.

.2 Do not install damaged equipment. Remove environmental conditions from the site and replace damaged equipment with new equipment.

.3 If off-site storage of materials is necessary, this shall be at the Contractor's expense.

1.09 Coordination

.1 The Contractor shall coordinate with all other trades. The Contractor will submit a schedule for the installation within 10 days of contract award

.1 The schedule shall include delivery, installation, and testing for conformance to specific job completion dates.

.2 At minimum, the schedule shall provide dates for the start of demolition, the completion of demolition, the installation start date, the completion of copper cabling, the completion of backbone cabling, the completion of testing and labeling, cutover, the completion of the final punch list, final inspection, and acceptance.

.2 Meeting Attendance and Schedule Adherence

.1 The Contractor must attend all project-related meetings and adhere to schedule set by the Project Manager.

.3 Final Inspection

.1 The Contractor is required to notify the Engineer of a proposed appointment for Final Inspection at least 72 hours before the appointment.

.2 Within five working days after the final inspection, the Contractor shall send final project documentation and warranty information to the Owner and Engineer. The final project documentation shall include, but may not be limited to:

.1 As-Built Drawings, in an AutoCAD format, with legible outlet address and cable paths.

.2 Outlet location spreadsheets.

.3 Warranty paperwork.

.4 A copy of the Final Inspection and Acceptance Signoff Sheet.

.5 Photos of each ER and TR.

1.10 Project Conditions

.1 Project Environmental Requirements

.1 Fiber Optic Cable Safety

.1 The following warnings shall be posted on the job site:

.1 WARNING: PERMANENT EYE DAMAGE CAN RESULT FROM LOOKING DIRECTLY INTO A LIGHT BEAM GENERATED BY AN LED OR LASER

SOURCE OR INTO THE END OF A CABLE FIBER CONNECTED TO ONE OR THESE SOURCES.

.2 CAUTION: LIGHT GENERATED BY THESE SOURCES MAY NOT BE VISIBLE YET REMAIN HAZARDOUS TO THE EYE. LOOK FOR WARNING LABELS ON SOURCE DEVICES.

.2 Observe all warning signs on equipment and all written safety precautions in the equipment instruction and technical manuals.

.3 Always handle cable carefully to avoid personal injury. Care should be taken with individual fibers to prevent injury to the eyes or penetration of the fibers into the skin.

.2 Hazardous Materials Prohibition

.1 The Contractor shall ensure that all materials used in the project are asbestos-free, unless specifically authorized in writing by the Owner.

.3 Existing Conditions

.1 Verify that all conditions on the project site are acceptable for the Work specified in this Section. Prior to bid opening, notify the Consulting Engineer, in writing, of any discrepancies, conflicts, or omissions. Otherwise, correct these issues at no additional cost to the Owner.

.2 Continue to monitor the project site. If conditions develop that require a variance from the Specifications or Drawings, then immediately notify the Owner in writing. Otherwise, make recommendations, submit drawings showing how the Work may be installed, and, upon approval, proceed with the necessary changes without additional cost to the Owner.

.2 Record Drawings

.1 Keep a complete set of all telecommunications drawings in the job site office for demonstration of the actual installation work specified in this Section.

.2 Use this set of drawings for no other purpose.

.3 Where any material, equipment, or system components are installed differently than what is shown on the drawings, indicate the differences clearly and neatly using ink or indelible pencil.

.4 Upon completion of the project, submit the record set of drawings.

1.11 Use of the Site

.1 Where the Owner deems it necessary to place restrictions, use the site as directed by the Owner.

.2 When proceeding with the work, do not interfere with the ordinary use of streets, aisles, passages, exits, or operations of the Owner. During the day, set up cones and barriers in hallways and walkways. Do not string cable down the hallways during normal hours.

.3 Request a hazardous materials worksheet that identifies potentially-hazardous locations. Do not proceed with any work in locations where hazardous materials are known to be. Obtain instructions from the Contractor's Project Manager on and when to work in these areas.

.4 Multiple times each day, each contractor shall remove all trash and debris from the site. Before leaving the room each day:

.1 The Contractor shall replace all ceiling tiles that they have removed.

.2 The Contractor shall place all furniture and equipment that they have moved back into its original location.

.3 The Contractor shall return any equipment that they have disconnected to working order.

.4 The Contractor's Job Foreman shall inspect all work locations to ensure that the rooms are clean and that all of the tasks described above have been done.

.5 It is recommended that the Contractor inspect the site and take pictures to document the condition of the ceilings and walls.

1.12 Continuity of Services

.1 Take no action that will interfere with or interrupt existing building services, unless previous arrangements have been made with the Owner's representative. Arrange all work to minimize shutdown time.

.2 The Owner's personnel shall perform shutdown of operating systems. When shutdown of systems is required, the Contractor shall give three (3) days advance notice.

.3 Should building services be inadvertently interrupted:

.1 The Job Foreman shall immediately notify the Project Manager of the accidental disruption of services, the remedy, and how long it will take to restore services.

.2 The Contractor shall immediately furnish the labor, including overtime, the material, and the equipment necessary to promptly restore the interrupted service at no cost to the Owner.

1.13 Warranty

.1 Refer to Section 27 05 00.

2 Products

2.01 Manufacturers

.1 Manufacturer List:

.1 Panduit (basis of design).

.2 Corning.

.3 Belden.

.4 Commscope.

.2 Substitutions: In accordance with Section 27 05 00.

2.02 General

.1 Refer to Section 27 05 00 for General Requirements

.2 All materials and products shall be:

.1 Appropriate for the intended use.

.2 Recognized as such by a Nationally Recognized Testing Laboratory (NRTL) such as Underwriters Laboratories (UL), ETL SEMCO (ETL), the Canadian Standards Association (CSA) or the American National Standards Institute (ANSI).

.3 Permitted by the Authority Having Jurisdiction (AHJ).

.3 All products shall be new, of the latest version at time of bid, and brought to the job site in original manufacturer's packaging. Used equipment and damaged material will be rejected.

.4 Any modifications to equipment to suit the intent of the specifications shall be performed in accordance with these requirements.

.5 Cable lubricants specifically designed for installing communications cable may be used as needed to reduce pulling tension when pulling cable into conduit.

.6 Take care during installation to prevent scratches, dents, chips, etc. Equipment with significant or disfiguring cosmetic flaws will be rejected.

.7 All components will be approved by the Engineer and shall have the most aesthetic value possible while maintaining specified functionality. Hardware shall:

.1 Be in compliance with the Construction Documents.

.2 Have fit and finish compatible with the existing surrounding structure.

.3 Be unobtrusive.

.4 Provide the required functionality.

.8 All work area termination hardware, including mounting boxes, faceplates, and outlets, shall match the existing wall surface color as closely as possible.

.9 All copper and fiber products shall be from a single manufacturer so that a single performance warranty covers all applications on vertical and horizontal links.

.10 Fabricate custom-made equipment with careful consideration given to aesthetic, technical, and functional aspects of the equipment and its installation.

.11 Provide products that are suitable for the intended use, including, but not limited to environmental, regulatory, and electrical factors.

2.03 Optical Fiber Cables

.1 Optical Fiber Strands

.1 All optical fibers shall:

.1 Be usable and shall meet required specifications.

.2 Be sufficiently free of surface imperfections and inclusions to meet the optical, mechanical, and environmental requirements of this specification.

.3 Consist of a doped silica core surrounded by a concentric glass cladding and have a matched clad design.

.4 Be proof tested by the fiber manufacturer at a minimum of 100 kpsi (0.7 GN/m2).

.5 Be coated with a dual layer acrylate protective coating that is in physical contact with the cladding surface.

.6 Have a maximum attenuation value for each cabled fiber at 23˚C ± 5˚C on the original shipping reel.

.2 Graded Index (50/125 µm OM3)

.1 The multimode fiber utilized in the OM3 optical fiber cable shall meet TIA-492AAAC-A, "Detail Specification for 850-nm Laser-Optimized, 50µm Core Diameter/ 125-µm Cladding Diameter Class Ia Graded-Index Multimode Optical Fibers." The fibers shall have:

.1 A core diameter of 50.0 ± 2.5 µm.

.2 Core non-circularity of no more than 5%.

.3 A cladding diameter of 125.0 ± 1.0 µm.

.4 Cladding non-circularity of no more than 1.0%.

.5 A core-to-cladding concentricity of no more than 1.0 µm.

.6 A coating diameter of 250 µm, plus optional 900 µm buffer.

.7 A refractive index core (graded index).

.8 A numerical aperture of 0.200 ± 0.015.

.9 Maximum attenuation of 2.3 dB/km at 850 nm, 0.6 dB/km at 1300 nm, and 1.0 dB/km at 1301-1380 nm.

.10 IEEE 802.3ae performance that supports laser-based 10 Gigabit Ethernet (GbE) operation in the 10GBASE-SR/SW (850 nm) and 10GBASE-LX4 (1310 nm) at 300 m and 10GBASE-LRM (1310 nm) at 220 meters.

.11 A minimum LED bandwidth of 500/500 MHz•km at 850/1300 nm.

.12 Attenuation uniformity with no point discontinuities greater than 0.08 dB at either 850 nm or 1300 nm.

.13 Water peak attenuation with a coefficient at 1380 nm that does not exceed the coefficient at 1300 nm by more than 3.0 dB/km.

.14 Macrobend attenuation due to 100 turns of fiber around a 75 mm ± 2 mm diameter mandrel that does not exceed 0.05 dB at 850 nm or 1300 nm.

.3 Graded Index (50/125 µm OM4)

.1 The multi-mode fiber utilized in the OM4 optical fiber cable shall meet TIA 492AAAD "Detail specification for OM4 850-nm laser-optimized, 50-µm core diameter/125 µm cladding diameter class 1a graded-index multimode optical fibers." The fibers shall have:

.1 A core diameter of 50.0 µm ± 2.5 µm.

.2 Core non-circularity of no more than 5%.

.3 A cladding diameter of 125.0 µm ± 1.0 µm.

.4 Cladding non-circularity of no more than 1.0%.

.5 Core-to-cladding concentricity of no more than 1.0 µm.

.6 A coating diameter of 250 µm, plus optional 900 µm buffer.

.7 A refractive index core (graded index).

.8 A numerical aperture of 0.200 ± 0.015.

.9 Maximum attenuation of 2.3 dB/km at 850 nm and 0.6 dB/km at 1300 nm.

.10 IEEE 802.3ae performance that supports laser-based 10 Gigabit Ethernet (10GbE) operation in the 10GBASE-SR/SW (850 nm) to a maximum distance of 550 meters and 10GBASE-LX/LX4 (1300 nm) to a maximum distance of 300 meters.

.11 A minimum LED bandwidth of 500/500 MHz•km at 850/1300 nm.

.12 Attenuation uniformity with no point discontinuities greater than 0.2 dB at either 850 nm or 1300 nm.

.13 Water peak attenuation with a coefficient at 1380 nm that does not exceed the attenuation coefficient at 1300 nm by more than 3.0 dB/km.

.14 Macrobend attenuation due to 100 turns of fiber around a 75 mm ± 2 mm diameter mandrel that does not exceed 0.5 dB at 850 nm or 1300 nm.

.4 Singlemode (8.5/125 µm)

.1 Single-mode fibers shall meet TIA 492CAAB, "Detail Specification for Class IVa Dispersion-Unshifted Single-Mode Optical Fibers with Low Water Peak," and ITU recommendation TG.652, "Characteristics of Single-Mode Optical Fiber Cable." The fibers shall have:

.1 A core/cladding diameter (characterized) of 8.2 µm/125.0 µm ± 0.7 µm.

.2 Core-to-cladding concentricity of no more than 0.5 µm.

.3 Cladding non-circularity of no more than 1.0%.

.4 A coating diameter of 250 µm, plus optional 900 µm buffer.

.5 Attenuation of 0.34 dB/km at 1310 nm and 0.22 dB/km at 1550 nm.

.6 Attenuation uniformity with no point discontinuity greater than 0.05 dB at either 1310 nm or 1550 nm.

.7 Water peak attenuation at 1383 nm ± 3 nm that is no more than 0.31 dB/km.

.8 A cabled cutoff wavelength: (∂ccf) that is no more than 1260 nm.

.9 IEEE 802.3ae performance that supports laser-based Gigabit Ethernet (GbE) operation in the 10GBASE-LR (1300 nm) operating window at 10,000 m.

.10 A mode field diameter of 9.20 µm ± 0.40 µm at 1310 nm and 10.4 µm ± 0.8 µm at 1550 nm.

.11 Macrobend attenuation due to 100 turns of fiber around a 50 mm ± 2 mm diameter mandrel that does not exceed 0.05 dB at 1310 nm and 1550 nm.

.12 A zero dispersion wavelength (∂o) of 1301.5 nm that is not more than ∂o at 1321.5 nm or less.

.13 A zero dispersion slope (So) of no more than 0.086 ps/(nm•km).

.14 Maximum dispersion of no more than 3.2 ps/(nm•km) from 1285 nm through 1330 nm and less than 18 ps/(nm•km) at 1550 nm.

.15 A fiber curl with a curvature radius of no less than 4.0 m.

.5 Fiber Optic Cable Fire Ratings

.1 Only OFCP listed optical fiber backbone cable is acceptable for use on this project.

.6 Fiber Optic Cable Termination

.1 Where cables are installed, the 900 µm buffer or 250 µm coated fibers contained in these cables may be terminated either by:

.1 Fusion splicing of factory-polished splice-on connectors or factory-terminated cable assemblies ("pigtails").

.2 Cam-style mechanical splice connectors using a tool that provides calculated insertion loss at the point of termination

.3 Individual fibers secured in a protective covering, such as an aramid-reinforced tube with connectors mated to the resulting assembly

.7 Fiber Optic Cable Features

.1 The size and configuration of fiber optic cables shall be as shown on the Drawings.

.2 The buffered fibers shall be grouped in 12 fiber subunits.

.3 The fibers shall be stranded around a dielectric central member in the subunit.

.4 Layered aramid yarns shall serve as the tensile strength member of the subunit.

.5 To facilitate jacket removal, a ripcord may be applied between the aramid yarns and the subunit jacket.

.6 For physical and environmental protection, the subunit jacket shall be extruded over the aramid yarns. The jacket shall:

.1 Be continuous and free from pinholes, splits, blisters, or other imperfections

.2 Have a consistent, uniform thickness

.3 Be smooth, as is consistent with the best commercial practice

.7 The subunits shall be stranded around a dielectric central member, a ripcord shall be inserted beneath the outer jacket to facilitate jacket removal, an outer jacket shall be extruded around the subunits.

.8 An overall helically-wound interlocking metallic armor shall be provided, to surround the outer cable jacket, to which a listed outer jacket shall be applied.

.9 The individual fibers shall be color-coded for identification and shall meet these requirements:

.1 The optical fiber color coding shall be in accordance with EIA/TIA 598, "Optical Fiber Cable Color-Coding."

.2 The coloring material shall be stable over the temperature range of the cable, shall not be susceptible to migration, and shall not affect the transmission characteristics of the optical fibers.

.3 Color-coded buffered fibers shall not adhere to one another.

.10 The overall jacket for graded index cables as specified herein shall be aqua for distribution cables, or black for indoor-outdoor rated cables.

.11 The overall jacket for single-mode cables as specified herein shall be yellow for distribution cables, or black for indoor-outdoor rated cables.

.8 Fiber Optic Cables - The table below lists part numbers. The part numbers and sizes listed are a small subset of the number available. For additional information, contact Panduit customer service or refer to the current parts catalog.

Part Number	Description
Indoor Distribution Cable	
FODPZ12Y	50um OM4 12 Fiber Indoor Distribution Cable, Plenum (OFNP), 900um Buffered Fibers
FODPZ24Y	50um OM4 24 Fiber Indoor Distribution Cable, Plenum (OFNP), 900um Buffered Fibers
FSDP912Y	9um OS2 12 Fiber Indoor Distribution Cable, Plenum (OFNP), 900um Buffered Fibers
FSDP924Y	9um OS2 24 Fiber Indoor Distribution Cable, Plenum (OFNP), 900um Buffered Fibers
Indoor Distribution Cable with Interlocking Armor	
FOPPZ12Y	50um OM4 12 Fiber Indoor Armored Cable, Plenum (OFCP), 900um Buffered Fibers
FOPPZ24Y	50um OM4 24 Fiber Indoor Armored Cable, Plenum (OFCP), 900um Buffered Fibers
FSPP912Y	9um OS2 12 Fiber Indoor Armored Cable, Plenum (OFCP), 900um Buffered Fibers
FSPP924Y	9um OS2 24 Fiber Indoor Armored Cable, Plenum (OFCP), 900um Buffered Fibers
Indoor-Outdoor Loose Tube Cable	
FOCPZ12Y	50um OM4 12 Fiber Indoor-Outdoor Central Tube Cable, Plenum (OFNP), 250um Fibers
FONPZ24Y	50um OM4 24 Fiber Indoor-Outdoor Stranded Tube Cable, Plenum (OFNP), 250um Fibers
FSCP912Y	9um OS2 12 Fiber Indoor-Outdoor Central Tube Cable, Plenum (OFNP), 250um Fibers
FSNP924Y	9um OS2 24 Fiber Indoor-Outdoor Stranded Tube Cable, Plenum (OFNP), 250um Fibers
Armored Outside Plant Cable	
FSWN912	9um OS2 12 Fiber Outside Plant Armored (Single Armor, Single Jacket) Cable, Non-Rated, 250um Fibers
FSWN924	9um OS2 24 Fiber Outside Plant Armored (Single Armor, Single Jacket) Cable, Non-Rated, 250um Fibers
FSWN948	9um OS2 48 Fiber Outside Plant Armored (Single Armor, Single Jacket) Cable, Non-Rated, 250um Fibers

2.04 Optical Fiber Distribution Enclosures and Connector Panels

.1 Refer to Section 27 11 19 – Communications Termination Blocks and Patch Panels.

3 Execution

3.01 General

.1 Upon completion of work, a Registered Communications Distribution Designer (RCDD) shall submit as-built drawings to the Owner and Engineer.

.2 The Contractor shall input the cabling data into the cable management software.

.3 Install all cables in accordance with project Drawings.

.4 Provide any screws, anchors, clamps, tie wraps, distribution rings, miscellaneous grounding and support hardware, etc. needed to facilitate the installation of the cable plant system.

.5 Furnish any special installation equipment or tools required to properly complete the installation.

.6 Do not roll or store cable reels without an appropriate underlay.

.7 Failure to follow the appropriate guidelines may require the installer to provide the additional material and labor required to bring the installation back into alignment with the guidelines. This shall also apply to any and all damages caused to the cables by the installer during the implementation.

.8 Provide fire blocking at all fire-rated ceiling, wall, and floor penetrations.

.9 Plug conduits where cabling has been installed in the main equipment room, backbone and other cable entrance locations with re-enterable duct seal of flame-retardant putty.

.10 Provide bushings on all conduit ends.

.11 All wiring, materials, and equipment must be listed and labeled by an NRTL. To certify that performance characteristics, meet ANSI/TIA 568 Standards, provide all Original Equipment Manufacturer (OEM) documentation to the Owner.

.12 All techniques and fixtures used in the installation must minimize complexity must allow for easy maintenance of, and ready access to, all components for test measurements.

.13 No self-tapping screws shall be used.

.14 All parts shall be made of corrosion-resistant material, such as plastic, anodized aluminum, or brass.

.15 All materials used in the installation shall be resistant to fungus growth and moisture deterioration.

.16 To avoid corrosion caused by electrolysis between dissimilar metals under the environmental operating conditions specified, separate dissimilar metals with an inert dielectric material.

.17 All empty innerduct or conduit shall include a non-corrosive pull-rope.

.18 All of the pathways shown on the drawings are suggested routes for the Contractor to use as guidelines. Prior to construction, the Contractor shall coordinate in the field with other trades to determine the exact feeder, tie, and riser backbone cabling pathways. In any case where the communication pathway must be removed and re-routed, due to conflicts with other trades with which the Contractor did not previously coordinate, the Contractor is responsible for all costs associated with the removal and relocation.

3.02 Optical Fiber Cable

.1 Install the optical fiber backbone in a continuous length from the FDE in the MC to an FDE within each TR.

.2 Throughout its length, run the backbone cable in appropriate, listed raceway.

.3 Leave a 3 m long maintenance loop at each end of the link, neatly contained in the integral management rings and saddles in a "figure 8" loop at the rear of the FDE.

.4 Throughout the length of the cable, maintain the minimum bend radius and pulling force recommended by the manufacturer and required by industry standards, both during installation and after termination and testing.

.5 On each end, remove all outer jacket and strength member materials to expose the individual 900-micron buffering of the individual strands for a length of 0.5 m (18 inches).

.6 On each end, hold the cable ends securely in place with the cable clamping accessories in each FDE.

.7 Route individual strands in the rear of the FDE in a neat and orderly fashion and place them so as not to create undue stress or micro bending of the strands.

3.03 Cable Bundling Materials

.1 Secure all cable bundles with proper bundling or securing materials so as to ensure that the cable runs are securely held in place both vertically and horizontally.

.2 Do not tighten bundling materials or securing devices so tightly that they deform the inherent cable geometry or construction.

.3 Do not use cable ties or hook-and-loop tape to secure cable runs to other building systems such as electrical conduit, Electric Metallic Tube (EMT), sprinkler pipes, ceiling suspension members.

.4 In environmental air-handling spaces, only use appropriately-listed materials.

3.04 System Administration

.1 Uniquely identify all components of the installed system by location, function, unit, and sub-unit.

.2 Identify each location with a unique alphanumeric identifier.

.3 Assign a unique alphanumeric identifier for each equipment enclosure in the building.

.4 Identify each adapter module in each distribution or interconnect enclosure with an alphanumeric identifier.

.5 Identify all conduits, trays, and pathways with a unique alphanumeric identifier.

.6 Identify optical fiber cables by a textual label that indicates its type, strand count, point of origin, and termination.

.7 Supply a Cable Identification Matrix

.8 Supply all records in compliance with ANSI/TIA 606.

3.05 Identification

.1 Refer to Section 27 05 53.

.2 Before installing or terminating cable, confirm all specific labeling requirements with the Owner or the Consultant.

.3 Mark each backbone cable at each endpoint and at all intermediate pull and access points and junction boxes with a label that indicates the origination and destination identifiers, the sheath identifier, and the strand or pair range.

.4 Fiber Distribution Enclosures (FDEs)

.1 Mark each FDE with an adhesive label that indicates the range of circuits installed within it.

.2 Label each port with the origination and destination grid identifier and the individual strand ID.

.3 At each end of each cable, within 75 mm (3 inches) of the end of the sheath, place a self-laminating label that surrounds the outermost jacket and bears the appropriate cable identifier.

.4 On each equipment enclosure, affix self-adhesive labels, bearing the enclosure's identifier in block characters, at the top center of the front and rear doors or faces.

.5 In all enclosures, place a label directly adjacent to the shortest side of each adapter that bears that adapter's identifier. Rotate the characters on the labels to maintain a left to right, top to bottom orientation.

3.06 Field Quality Control

.1 General Testing

.1 Refer to Section 27 08 11 for complete testing specifications.

End of Section

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1 General

1.01 Summary

.1 Provide a CATV network system which includes conduit, wall box, CATV outlet, and coaxial cables.

2 Products –Not Used

3 Execution

3.01 Installation

.1 Provide CATV cabling distribution system. Install CATV coaxial cables back to IT closet/Owner's Server Room. All coaxial cables passing through air plenum space to be plenum (CMP FT6) rated unless they are installed in complete enclosed non-combustible electrical raceway. All cables to be labeled at both ends with room number.

3.02 Coordination with Television Providers

.1 Co-ordinate cable TV carrier to provide cable TV trunk backbone feeder cable from street via telecom Entrance Facility (EF) rooms to Owner's server room and feed into CATV distribution system.

.2 Co-ordinate with Satellite and Cable TV carrier to provide detail design for owner review and confirmation.

3.03 CATV Outlets

.1 Locations

.1 Lobby and Reception area.

.2 Classrooms.

.3 Meeting Rooms.

.4 Training Rooms.

.5 Kitchen/Lunch room.

.6 Fitness Rooms, allow for total of 10.

.7 Security Room.

.8 Other locations as noted on the plans.

.2 Provide power receptacle adjacent to each CATV outlet.

.3 Provide data outlet adjacent to CATV outlet as part of the structured cabling system.

End of Section

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1 General

1.01 Section Includes

.1 Cabling requirements for IP based CCTV cameras.

1.02 Related Requirements

.1 Division 27 – Communications.

2 Products

2.01 Owner-Furnished Products

.1 New IP cameras, and associated equipment shall be supplied and installed per Section 28 20 00.

.2 This contractor shall be responsible for coordinating rough-in requirements.

2.02 Cabling

.1 Plenum rated Category 6 cabling in accordance with Division 27.

3 Execution

3.01 Installation

.1 In accordance with sections of Division 27.

End of Section

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1 General

1.01 Section Includes

.1 Communications conductors and cables for fire detection, suppression, and alarm systems.

.2 Conduit for fire detection, suppression, and alarm systems.

1.02 Related Requirements

.1 Section 28 46 13 – Fire-Alarm Systems.

.2 Section 28 46 31 – Fire-Alarm Initiating Devices.

1.03 Definitions

.1 ULC-S524: CLASS A CIRCUIT (Return Loop Circuit) – A circuit having one continuous path connecting all components on the circuit and terminating through an alternate connection path in the source enclosure.

.2 ULC-S524: CLASS B CIRCUIT (Terminated Circuit) – A circuit having one continuous path connecting all devices on the circuit and terminating at an end-of-line device.

1.04 References

.1 CSA C22.1-18, Canadian Electrical Code, Part 1 (24th Edition), Safety Standard for Electrical Installations.

.2 Ontario Electrical Safety Code (27th edition/2018).

.3 CSA C22.2 No. 208-14 – Fire Alarm and Signal Cable.

.4 CAN/ULC-S139:2017 – Standard for Fire Test for Circuit Integrity of Fire-Resistive Power, Instrumentation, Control, and Data Cables.

.5 CAN/ULC-S524-14 – Standard for the Installation of Fire Alarm Systems.

1.05 Delivery, Storage, and Handling

.1 In accordance with Section 01 60 00.

1.06 Warranty

.1 All work performed and all material and equipment furnished under this contract shall be free from defects and shall remain so for a period of at least one year from the date of acceptance.

2 Products

2.01 Conduit and Wire for Fire Alarm System

.1 Conduit:

.1 In accordance with Section 26 05 33.13.

.2 All wiring shall be installed in conduit or raceway.

.2 Terminal Boxes, Junction Boxes and Cabinets:

.1 All boxes and cabinets shall be listed for their purpose and use.

2.02 Fire Alarm Cable

.1 Wiring shall be in accordance with local, provincial and national codes and as recommended by the manufacturer of the fire alarm system. Number and size of conductors shall be as outlined in the Ontario Electrical Safety Code, and as recommended by the fire alarm system manufacturer.

.2 All wire and cable shall be listed and/or approved by a recognized testing agency for use with a protective signalling system, as outlined in the Ontario Electrical Safety Code.

.3 Certified by CSA as fire alarm and signal cable type FAS 105 to CSA C22.2 No. 208.

.4 Conductors:

.1 300 V rated multiconductor, insulated, colour coded, copper conductor.

.1 Use solid conductors unless noted otherwise.

.2 Use stranded conductors for connections between closest junction box and vibrating equipment i.e. generator set supervisory connection.

.2 Minimum #16 AWG for initiation circuits.

.3 Minimum #12 AWG for strobe signal circuits.

.4 Minimum #14 AWG for horn signal circuits.

.5 Minimum #12 AWG for bell signal circuits.

.5 Non-Fire rated cable:

.1 Insulation: 105 degrees C flame retardant PVC.

.2 Outer Jacket: 105 degrees C flame retardant PVC Red.

.3 Armour: Interlocking aluminum without overall Jacket. For drops to devices in suspended ceilings from conduit system.

.6 Fire rated fire alarm cable:

.1 Pentair Pyrotenax 1850 series mineral insulated (MI) cable with 2 hour fire rating to ULC S139 and to meet Ontario Building Code Rule 3.2.7.10.

.2 Substitution: VITALink CIC Type FAS105, manufactured by Comtran (listed by ULC under ULC category code 'FHIT7' and 'FHJR7', dated 19 May 2015), installed in EMT conduit.

.3 Substitutions such as "Lifeline" installed in conduit may only be considered if listed by ULC under ULC Category Code 'FHIT7'.

3 Execution

3.01 Installation

.1 All conduit, junction boxes, conduit supports and hangers shall be concealed in finished areas and may be exposed in unfinished areas. Smoke detectors shall not be installed prior to the system programming and test period. If construction is ongoing during this period, measures shall be taken to protect smoke detectors from contamination and physical damage.

.2 The entire system shall be installed in accordance with the latest edition of CAN/ULC-S524 and the approved manufacturer's manuals and wiring diagrams.

.3 The contractor shall furnish all labour, conduit, wiring, outlet boxes, junction boxes, cabinets and similar devices necessary for installation of system devices.

.4 Provide all necessary power supply, interconnecting and remote signal wire in dedicated conduit throughout and installed in accordance with the manufacturer's wiring diagrams and the requirements of the Ontario Electrical Safety Code and the Inspection Authority.

.5 All penetration of floor slabs and fire walls shall be fire stopped in accordance with all local fire codes.

.6 Install all wiring in metal raceways.

.7 Provide wiring suitable for fire alarm circuits.

.1 Class A wiring for initiating circuits.

.2 Class B wiring for signalling circuits.

.8 Fire rated conductors:

.1 Install fire rated conductors in accordance with the manufacturer's installation guidelines.

.2 Install 2 hour fire rated cables for fire alarm circuits as required by the building code where transponders (data gathering panels) or annunciators are installed in a separate fire compartment from the main FACP CPU.

.3 Install 2 hour fire rated cables for fire alarm system branch circuits where the transponder or DGP is not within the same storey as the first initiation, signalling, or voice communication device in the loop for that storey.

.4 In lieu of fire rated cables for the above noted cases, Contractor may, when reviewed beforehand by the Consultant, install non rated conductors in be located in a service space that is separated from the remainder of the building by a fire separation that has a fire resistance rating of not less than 2 hours.

3.02 Site Tests and Inspections

.1 The manufacturer's representative shall make an inspection of the fire alarm equipment. The inspection shall comprise an examination and test of such equipment for the following:

.1 That the type of conductors and cables installed are that designated by the specifications.

.2 That the specified equipment has been installed in accordance with the manufacturer's recommendations.

.3 That the supervisory wiring of all devices connected to a supervised circuit is operating and that the wiring has been met to the satisfaction of the inspecting officials.

.2 Testing to be done in the presence of the local building inspector, and the local fire inspector.

End of Section

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1 General

1.01 Section Includes

.1 Category 6 copper unshielded twisted pair (UTP) communications cabling.

1.02 References

.1 Refer to Section 27 05 00 for references.

1.03 Submittals

.1 Product Data: Provide manufacturers catalogue information.

2 Products

2.01 Manufacturers

.1 Panduit TX6000 series.

.2 Commscope.

.3 Belden.

2.02 Termination Equipment

.1 All termination mounts shall be fully loaded with the appropriate connectors.

.2 Blank labelling strips are required for connectors that are not in use.

.3 IDC block quantities shall accommodate the number of terminated cable pairs.

.4 Material and equipment shall be new, and conform to grade, quality and standards specified.

.5 Backboard layout will be as per manufacturer's recommendations unless expressly written otherwise by the General Contractor/Construction Manager or the Consultant.

3 Execution

3.01 Installation

.1 The Telecommunications Cabling Contractor shall ensure ANSI/EIA/TIA-568-B installation practices are followed.

.2 The Telecommunications Cabling Contractor shall terminate all pairs of cable. Terminate all spare cables at the Telecommunication Room end.

.3 The Telecommunications Cabling Contractor shall run all horizontal cables parallel to building grid lines with no splices.

.4 Provide 3 m (10'-0") of slack at the workstation end of the cable to permit future outlet relocation. Neatly coil slack in ceiling space or on the side of the cable tray.

.5 Provide 1 m (3'-0") of slack at the Telecommunications Room end of the cable to permit future relocation. Neatly coil the cable in the cable tray or in the ceiling space.

.6 Inform the Consultant immediately of any horizontal cable runs exceeding 90 m (295 feet).

.7 When terminating copper cables remove cable jacket only enough to perform termination and untwist pairs a maximum of 13 mm (1/2") for Category 6 cables.

.8 The Consultant shall determine the quality of workmanship during installation. Cables that have not been properly installed will be reinstalled by the Telecommunications Cabling Contractor at no additional expense to the client.

.9 Maintain a minimum of four (4) times cable diameter as a bend radius if no bend radius is specified.

.10 All horizontal cables shall be bundled on the Telecommunications Racks using "Hook & Loop" fastener straps. Bundles shall be wrapped at a maximum of 203 mm (8") separation.

.11 All exposed cabling at the workstation between wall/floor-input point locations and systems furniture are to be wrapped with Split Harness Wrap or Polyethylene Spiral Wrap, size and length as required to suit.

.12 Provide blank filler plates for all unused modular jack positions on faceplates.

.13 Supply and install Category 6 CMP cables to the outlets outlet indicated on the drawings. The Telecommunications Cabling Contractor shall refer to the legends on the drawing to determine the number of cables to each outlet location.

.14 Terminate, test and label each Category 6 cables in accordance to the parameters stated in this specification document.

3.02 Patch Cables

.1 Supply copper patch cords as per schedule in Section 27 16 19.

End of Section

1 General

1.01 Section Includes

.1 Twisted Pair Patch Cords.

.1 Schedule of copper patch cords to be supplied.

.2 Fibre Optic Patch Cords.

.3 Related Cross-connect components.

.4 Cross-connection and patching.

1.02 Related Requirements

.1 Section 27 13 23 – Communications Optical Fiber Backbone Cabling.

.2 Section 27 13 13 – Communications Copper Backbone Cabling.

.3 Section 27 11 19 – Communications Termination Blocks and Patch Panels.

1.03 Submittals

.1 Product Data: For each type of product indicated.

.1 For Category-6 patch cords, include the following installation data for each type used:

.1 Nominal OD.

.2 Minimum bending radius.

.3 Maximum pulling tension.

.2 For Fiber Optic patch cords, include the following installation data for each type used:

.1 Nominal OD.

.2 Minimum bending radius.

.3 Maximum pulling tension.

.2 Source quality-control reports.

.3 Field quality-control reports.

1.04 Quality Assurance

.1 Electrical Components, Devices, and Accessories: Listed and labeled by a qualified testing agency, and marked for intended location and application.

.2 Warranty: see Section 27 05 00.

1.05 Delivery, Storage, and Handling

.1 Test cables upon receipt at Project site.

.1 Test optical fiber cables to determine the continuity of the strand end to end. Use optical loss test set.

.2 Test each pair of UTP cable for open and short circuits.

1.06 Project Conditions

.1 Environmental Limitations: Do not deliver or install cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

2 Products

2.01 Manufacturers

.1 Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:

.1 Panduit (selection based on Owner's standard).

.2 No alternative will be accepted.

2.02 Patch Cables

.1 General Requirements: Comply with TIA/EIA-569-C.

.2 Category 6 Copper Patch Cords:

.1 Factory-made, four-pair cables terminated with eight-position modular plug at each end in lengths as indicated in pricing sheet.

.2 Patch cords shall have bend-relief-compliant boots to ensure Category 6 performance.

.3 UTP Patch Cords will be supplied in the following lengths:

Quantity	Length	Colour	Use	Panduit Part Number
450	5'	White	Desks	UTP28SP5
150	7'	White	Cabinet	UTP28SP7
150	10'	White	Cabinet	UTP28SP10
75	7'	Yellow	Internet	UTP28SP7YL
75	10'	Yellow	Internet	UTP28SP10YL

.3 Fibre Optic Patch Cords: Factor-made, dual-fibre cables with LC duplex connectors.

.1 Fibre patch cords will be available in the following lengths.

.4 Estimated Quantities

.1 The estimate of cable counts and lengths is given for bid purposed only; the final count and lengths will be provided in the integration phase of the project.

.2 Pricing should include single cable pricing and quantity discount pricing.

.5 Cable Connecting Hardware:

.1 Comply with Optical Fiber Connector Intermateability Standards (FOCIS) specifications of TIA/EIA-604-2, TIA/EIA-604-3-A, and TIA/EIA-604-12. Comply with TIA/EIA568-C.3.

.2 Quick-connect, simplex and duplex, Type LC connectors. Insertion loss not more than 0.75 dB.

2.03 Identification Products

.1 Comply with TIA/EIA-606-A and UL 969 for labeling materials, including label stocks, and inks used by label printers.

.2 Comply with requirements in Section 26 05 53 "Identification for Electrical Systems."

2.04 Source Quality Control

.1 Factory test UTP cables according to TIA/EIA-568-C.2.

.2 Factory test multimode optical fiber cables according to TIA/EIA-526-14-A and TIA/EIA-568-C.3.

.3 Provide test and inspection reports.

3 Execution

3.01 Field Quality Control

.1 Perform tests and inspections.

.1 Visually inspect UTP and optical fiber cable jacket materials for NRTL certification markings. Inspect cabling connections for compliance with TIA/EIA-568-C.1.

.2 Visually confirm Category 6a, marking of patch cables.

.3 Visually confirm Fiber patch coble marking.

.4 Visually inspect cable placement, and patch cords, and labeling of all components

3.02 Supply of Patch Cords

.1 Patch cords included in contract; all patch cords to be supply only, installation by the Owner.

.1 Supply two (2) copper patch cords per each telecom field outlet.

.1 7'-0" length at telecom room.

.2 10'-0" length at workstation.

.2 Supply one (1) duplex Fiber patch cord for every 12 strand fiber backbone cable.

.3 Supply one (1) duplex Fiber patch cord for every 2 strand fiber horizontal distribution cable.

.2 Patch cord colour to match colour of system cabling.

End of Section

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1 General

1.01 Section Includes

.1 Wireless Access Points (WAPs) for WiFi network communications.

2 Products

2.01 Owner-Supplied Products

.1 WAP (Wireless Access Points).

.1 Free issued by Owner to this Contractor for installation at locations as indicated on the drawings.

.2 Power Over Ethernet (PoE) powered.

3 Execution

3.01 Installation

.1 Refer to drawings for WAP locations and provide CAT 6 cabling for each WAP unit.

.2 Allow for site wireless survey for the final locations of WAPs.

.3 Allow for 5 m cable slack at WAP outlets end for final location adjustment.

End of Section

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1 General

1.01 Section Includes

.1 Sound system to be provided in gymnasiums with stage.

2 Products

2.01 Suppliers

.1 Contact Brad Kosid of Long & McQuade at bkosid@long-mcquade.com.

2.02 Bill of Material

Product No. & Description	Qty
XSW 35 - SENNHEISER XSW WIRELESS HANDHELD DYNAMIC SYS	1
XSW 52 - SENNHEISER XSW WIRELESS HEADSET SYSTEM	1
GAM-2 - MOUNTS 2 SENHSR XS WIRELESS SERIES RECEIVERS	1
SBX-10 - 10 SPACE, 15" DEEP WALL RACK	1
CD-200BT - PROFESSIONAL SINGLE CD PLAYER W/BLUETOOTH	1
Speaker Cage	2
SKS-WALL2 - YSL HEAVY DUTY WALL MOUNTING SPKR BRKT	2
PS4X4 - ART DUAL METERD DIS SYS W/LHT PIPES	1
Dual Female XLR Plate	2
APEX185B - APEX MATCHED PENCIL MICS-BLK/CHRM	1
E835-S - SENNHEISER EVOLUTION HANDHELD DYNAMIC W/SWTCH	1
MS-2068- YSL ECONOMY TRIPOD NON-TELESCOPIC BOOM	1
MC-25N 25' - LO Z NEUTRIK CABLE	4
NL4FX - SPEAKON CABLE CONNECTOR	4
Bulk Cable Package	1
NC3MXX - MALE NEUTRIK XLR(MINIMUM ORDER 6)	4
MC-2N - YORKVILLE 2' LO Z NEUTRIK CABLE	2
A203RR - DUAL RCA TO RCA CABLE 3'	1
A206MPY - STEREO MINI TO 2 X MONO 1/4"M Y -6'	1
Crown XTI1002 Power Amplifier w/DS	1
Crown 28M 8ch mixer	1
NX35-2 - YSL 12"/1" 350W 8R CAB (NEO WFR)	2
EVT1 - MAP 1 U (1 3/4') SLOTTED ECON VENT	3

3 Execution

3.01 Installation

.1 Mount wall mounted equipment rack on stage.

.2 Provide XLR wall plate shall be provided on the apron of the stage.

End of Section

1 General

1.01 Section Includes

.1 Public Address system.

.2 Master Clock system.

1.02 Submittals

.1 In accordance with Section 01 33 00.

.2 Submit shop drawings for products specified in this Section.

1.03 Systems Inspection, Testing, Start-Up and Verification

.1 In additional to requirements specified in this Section, refer to requirements of Section 26 08 00 – Commissioning of Electrical Systems.

1.04 Software Nomenclature Reprogramming

.1 Include additional costs for each system manufacturer to make necessary on-site final changes to applicable system/equipment software.

.2 Changes shall be made after successful testing, verification, and commissioning of the systems, but prior to turn over to Owner.

.3 After successful final commissioning of the work, confirm and obtain approval of final nomenclature in writing from Owner and Consultant.

.4 Software revisions shall incorporate final room names/area names/building names and equipment identification. Include for second "burning" of fire alarm system software to suit authority having jurisdiction requirements.

1.05 System Training and Instructions

.1 In additional to requirements specified in this Section, refer to following for additional requirements:

.1 Section 26 05 00 – Common Work Results for Electrical.

.2 Division 01.

1.06 System Supplier Qualifications

.1 Supplier of respective systems shall be an established communications and electronics contractor that has had and currently maintains a locally run and operated business for at least five years. The System Supplier shall hold all applicable provincial and local licenses.

.2 The System Supplier shall be an Authorized Distributor for the product/system proposed with full manufacturer's warranty privileges.

.3 The System Supplier shall employ technicians who have attended and successfully completed the manufacturer's technical certification classes for the proposed system.

.4 The System Supplier shall show satisfactory evidence, upon request, that they maintain a fully equipped service organization capable of furnishing adequate inspection and service to the system on a 24-hour / 7-day basis. The System Supplier shall maintain at their facility the necessary spare parts in the proper proportion as recommended by the manufacturer to maintain and service the equipment being supplied.

2 Products

2.01 Clocks

.1 Telecor ULC listed and labelled No. 2420/2430 synchronized digital clock displays and accessories as follows:

.1 flush mounting 11"W x 4.75"H x 2.5"D and 14"W x 7.5"H x 2.5"D;

.2 enamel coated steel housing;

.3 2430 with 4" display for the gymnasium and other large assembly areas;

.4 protective guards;

.5 2401 remote clock drivers;

.6 24 VAC operation via the public address system;

.7 system programming and commissioning;

.8 ancillary devices as required for complete system;

.2 Manufacturers:

.1 Telecor.

.2 Dukane.

.3 Rauland Borg.

2.02 Public Address (PA) System

.1 Telecor XL, ULC listed and labelled, CSA approved, microprocessors based and controlled public address and intercom system with the following features:

.1 simultaneous program distribution and direct dialling, two-way and room to room communications;

.2 built-in and remote diagnostics;

.3 selectable single queue operation;

.4 built-in analogue tone generator and chime;

.5 user programmable inputs and outputs;

.6 user programmable, battery backed remote clock driver;

.7 provide user programmable signalling of exterior programme bells;

.8 standard manufacturer's features;

.9 ability to integrate PA handsets into an IP based telephone.

.2 Administrative Control Console:

.1 The administrative control consoles (ACC) shall be microcomputer based, desk top units, manufactured of high impact moulded plastic with a moisture proof mylar faceplate, providing the following colour coded function keys:

.1 room Select Keypad;

.2 push to Talk Key;

.3 page Key;

.4 cancel Key;

.5 all Rooms Key;

.6 priority Key;

.7 zone key;

.8 telephone key;

.9 conference key;

.10 display calls key;

.11 time function key;

.12 program function key.

.2 The above keys shall be organized in a logical graphic format.

.3 The console shall be equipped with a telephone handset with a retractable cord to allow private conversations. A built in microphone and speaker shall provide for push to talk intercom conversations.

.4 Calls from classrooms shall be annunciated on a LCD digital display by room number and priority level. Calls of a higher priority shall be displayed ahead of lower priority calls automatically. All incoming calls shall be held in memory and displayed in sequence.

.5 Distribution of program sources (microphone, tuner, CD, MP3 and aux.) shall be accomplished from the console keypad and distributed to classrooms on an All Call or Selected Room basis.

.6 The following user programmable functions shall be programmed from the console keypad:

.1 architectural room numbers;

.2 room call in priority levels;

.3 12 hr/24 hr clock;

.4 528 event, 8 zone program clock;

.5 speaker paging zone assignment;

.6 call in tone characteristics.

.7 Paging announcements shall be distributed from the control console on an Emergency All Call, All Call or Zone page basis to classroom speakers. Speaker zoning configuration shall be easily revised through software programming.

.8 The program unit to be wired to provide automatic operation of electronic tone program signalling and system's internal clock.

.9 The master program control to be a microprocessor based self-regulation unit. Control unit to allow for scheduling/sequencing as co-ordinated with the School Principal.

.3 Central Control Unit:

.1 The Central Control Unit shall be specifically designed for use with the control console. It shall be complete with circuitry for accomplishing all functions for signalling and communications for stations. The central control unit shall have provisions for expanding the system with the addition of plug in modules as required and shall have battery backup of minimum thirty (30) minutes at maximum system capacity.

.2 The Central Control Unit shall enable the system to provide the following features and functions:

.1 instant direct dialling, two-way conversations between main control consoles as well as to classroom speakers;

.2 room to room dialing;

.3 visual display of all incoming calls in order of priority;

.4 ability to review all calls in the system;

.5 retention of last room number dialled until new room is dialled or previous call cancelled;

.6 single button response to all call ins;

.7 pre-announce tone to alert classroom to incoming calls;

.8 instantaneous selection and distribution of program material on an all call, or selected room basis, without the need for additional Room Selector Panels or Program Control Panels;

.9 ability to program classroom priority at the main control console;

.10 ability to program and control a built in master clock and remote clock driver with events, time zones and schedules;

.11 choice of handset or push to talk speaker/microphone communications;

.12 ability to produce 8 different tone signals for classroom time changes or emergency signals.

.3 The central control unit shall be rack mounted in a 19" floor mounted equipment cabinet.

.4 Music Sources:

.1 These music sources are minimum requirements. In event of the model numbers being obsolete, provide the latest model with at least the similar features as specified.

.2 Provide and integrate into the system an AM/FM receiver Model Technic SAEX 140 or approved equal from Teac and Yamaha. Unit shall be provided with a rack mount kit suitable for installation in a standards 19" equipment rack.

.3 Provide and integrate into the system a 5-disk CD/MP3/WMA changer from Technics, Teac, Yamaha or approved equal. Unit shall be provided with a rack mount kit suitable for installation in a standards 19" equipment rack.

.4 Provide and integrate into the system a paging console unit. Unit shall be provided with a rack mount kit suitable for installation in a standard 19" equipment rack, complete with microphone.

.5 Music sources shall be integral with and rack mountable within central control unit.

.5 Power Amplifiers:

.1 Solid state amplifiers suitable for rack mounting in component enclosure. Each amplifier shall be capable of an audio output of 120 WRMS/channel (8 ohms) at less than 1% distortion. The frequency shall be flat from 20 hz 20 kHz ± 1 db. The amplifiers shall be designed to operate continuously on line voltages of 105 to 130 VAC, 60 Hz. Separate output terminals shall be provided for 4/8 ohms and 25/70 volts. The number of amplifiers required shall accommodate capacity for all connected devices plus an additional 25% future spare capacity.

.6 Speaker Assemblies:

.1 Speakers shall be installed in a steel, acoustically treated back box, flush mounted in a drywall or T-bar ceiling or mounted in the panel of each classroom or wall as required. Be responsible for proper selection and installation, on site and co-ordinate with General Contractor to ensure the timely and correct installation of backboxes, into ceilings, walls and classroom control panels.

.2 Speakers shall be dual cone or co-axial, power handling of 15WRMS, multi power taps, 200 mm (8") diameter, 10 oz. permanent magnet, a voice coil of 25 mm (1"), shall have an impedance of 8 ohms, frequency response from 60 Hz to16 kHz. and sensitivity of 96 dB (1W @ 1m). The speakers shall be supplied complete with a 25/70 volt, line-matching transformer as required to suit application.

.3 Classroom speaker to be tapped off at 2 watts and speakers in the hallways, cafeterias, gymnasiums, stairwells and any other large room areas to be tapped off at 4 watts.

.4 Speaker grilles/baffles to be white in colour. Shape to be either square or round as confirmed with Owner and/or Consultant prior to ordering.

.7 Audible Devices:

.1 Exterior Speakers shall be provided in high abuse areas and exterior locations. Horns shall have 15 watt rating, with individual adjustable taps. Exterior horns shall be weatherproof, corrosion resistant, vermin-proof, and vandal-proof.

.1 Steel exterior speakers, 15 watts power handling capacity, frequency range 150 Hz to15 kHz, minimum 110 dB at 1 m (3') and complete with adjustable mounting bracket and shall be Atlas Sound VTF series with neutral gray finish.

.2 Exterior speakers must sound distinctly different from the fire alarm system audible devices.

.2 Interior Loudspeakers:

.1 Typically provided in Boiler Rooms and Mechanical Rooms.

.2 Equivalent to Telecor A-15T loudspeakers.

.3 15 watt rating.

.4 Individual adjustable taps.

.5 Versatile 25/70 volt variable tap transformer.

.6 Complete with universal mounting brackets.

.3 Door Bell:

.1 At main front door install P.A. doorbell, Edwards #1786-B brass doorbell or approved equal.

.8 PA Handset Call Stations:

.1 Call stations shall be equivalent to Telecor model HS-1301 and shall be surface mounted on the existing walls. The minimum features for the hands are the following:

.1 compact contemporary styling;

.2 modern dual tone dialling;

.3 last number redial;

.4 4 special function buttons;

.5 3 priority dial buttons;

.6 10 number speed dialling;

.7 13 memory locations;

.8 hearing aid compatible;

.9 receiver volume control;

.10 memory index and cover card;

.11 optional speaker;

.12 optional message waiting lamp.

.9 Microphones:

.1 The desk microphones shall be a complete with a push to talk bar and locking switch. The unit shall have a directional pick up pattern, with a flat frequency response from 100-10 kHz. Provide quantity of two (2).

.2 Wall Microphone Receptacles shall be XLR type, female units, installed in single gang, stainless steel plates.

.10 Relays:

.1 Provide required relays in device boxes to connect program horns, speakers and night call bell to main central control unit.

.11 Volume Controls:

.1 AudioTrak No.VCC 7040S, audio transformer type attenuator. The exact voltage and power rating shall be confirmed with PA system supplier and be matched to specific system. Features to include:

.1 providing 30 dB attenuation over 10 steps including OFF;

.2 frequency range from 35 Hz to 20kHz;

.3 25V/3.5W or 70V/40W; (as per recommendations of system supplier);

.4 gold plated screw terminals;

.5 white ABS control knob;

.6 single gang white metal decorative style faceplate.

.12 UPS System:

.1 Rack mounted UPS system, Powerware PW9-700 (700 Va), black complete with extended battery which shall be included in P.A. rack. This UPS shall be designed to operate the system in "Lockdown Operation" for a minimum of one (1) hour.

.13 Equipment Cabinets:

.1 Equipment cabinets shall be used to house the central control unit, system power supply, amplifiers, music sources and shall be complete with surge protected power distribution strip of receptacles.

.2 Equipment cabinets shall be floor mounted 19" EIA type, enclosed racks with steel enclosure constructed from minimum 16 gauge cold roll steel, enamel painted finish to Consultant's approval, stainless steel front trim plate, as sized to accommodate system components and spare 25% capacity. Cabinet to be equal to Middle Atlantic ERK2725 P.A. rack with at least the following:

.1 with back door;

.2 middle Atlantic PD915R power bar;

.3 middle Atlantic space shelf U-2;

.4 vent panel shelf EVT-1;

.5 blank panel EB2;

.6 levelling feet LF.

.3 A flush wall mounting termination cabinet, minimum 600mm x 600mm x 100 mm (2' x 2' x 4") shall be provided for cable termination.

.14 Cabling:

.1 Cabling shall be provided in accordance with requirements of governing authorities and system manufacturer and at least the following minimum requirements:

.1 paging cable for centrally amplified system 2 pair, solid copper, FT 6 rated, twisted, unshielded cable, of a gauge suitable for the overall design of the system;

.2 paging cable for distributed amplified system 2 pair, solid copper, FT6 rated, twisted unshielded cable, or a gauge suitable for the overall design of the system;

.3 paging cable for all corridor speaker cable shall be one (1) pair twisted FT-6 rated, AWG 18 type with an overall PVC jacket, zoned per floor and exterior;

.4 the microphone cable shall be one (1) pair twisted, shielded 22 AWG stranded conductors, PVC jacket;

.5 PA Handsets – 4 pair, solid copper FT-6 rated cat 5E twisted unshielded 24 AWG cable.

.15 Bridging Control:

.1 The general-purpose room will be provided with a stand-alone sound system. Provide bridging control to allow the public address system to override the local amplifier in event of an emergency all call.

.16 System Programming, Testing and Commissioning:

.1 Include costs for complete programming of system to perform sequence of operation as per Owner's requirements. Confirm exact sequence of operation with Owner prior to programming.

.2 Test, adjust, and commission system to satisfaction of Consultant and Owner, to the recommendation of the system manufacturers.

.17 Training:

.1 The supplier shall perform on site training of each user (including the provision of user guides) prior to project completion and to attend at the school the week following project completion to ensure that all staff are properly trained in the operation of the system.

.2 Train up to two (2) selected appointees in the complete administration of the system.

.3 Refer to Instructions to Owner specified in other Sections.

.18 Warranty and Maintenance:

.1 Warranty to include the following:

.1 a one (1) year repair or replacement warranty on all components;

.2 warranty to begin upon system acceptance;

.3 the 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 the 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 the major components to provide written confirmation of full warranty, extended warranty and service back up, in case of the failure to perform or insolvency of the successful supplier.

.19 Manufacturers:

.1 Telecor.

.2 Rauland-Borg.

.3 Carehawk.

.20 Suppliers/Installers:

.1 Acceptable system suppliers and installers must be manufacturer's authorized Canadian regional representative which may include:

.1 Barrie Communications (905-564-7026);

.2 High Tech Communications (416-798-7267);

.3 AC Technical (905-666-8676);

.4 Chubb Edwards/GE;

.5 SimplexGrinnell.

2.03 Integration between PA System and Telephone Switch

.1 System Overview:

.1 It is a requirement that the PA system to be "integrated" with the Nortel Meridian Norstar MICS switch. The objective is to allow the telephone handsets through the telephone switch to access the PA system to perform all paging and two way communication functions, but not allow the PA system to have access to the telephone functions. Paging will entail "all call", zone calls or individual classroom calls via the handsets. Calling other handsets could entail a voice and/or a ringing call to a classroom to communicate with a teacher.

.2 The exact system features and programming to be confirmed with Owner.

.3 Private, confidential telephone communication from each classroom will allow the ability for teachers to quickly summon assistance in an emergency. Direct communication between the classroom and the public network will not be required. Programmability of the system must be on a handset-by-handset basis. Communications through classroom speakers to teachers may be directed "hands free" through the speaker without use of PA hand set or may be privately answered through use of handset. Direct communication between classroom handsets (or any designated set) can be restricted by software programming at central console. The classroom handsets shall be programmed for 1 button direct dialling access to office. Exact operating functionality shall be reviewed with Owner prior to programming and clearly identified on shop drawing submission.

.4 To access paging from telephone handset, user shall enter programmed paging code for selected zone.

.5 The PA system supplier shall coordinate work and requirements with telephone system vendor.

.2 Paging Capabilities:

.1 The paging requirements must include at least the following "paging" capabilities/hardware:

.1 only centrally amplified paging component systems are acceptable;

.2 operation - Depressing the talk switch code on the desk microphone shall activate the call zone, and sound a pre-tone;

.3 muting - automatic muting of the page channel unless signal activated;

.4 output levels - automatic levelling of page channel;

.5 program muting - voice activated, variable-level muting of program input during a page;

.6 administration - capability for user to readily modify zones, paging functions, etc. via the telephone keypad;

.7 clock - provide as an internal modular component, a master program clock for tone signalling operating the P.A. to simulate approved tone over speakers;

.8 emergency call - ability to activate an emergency alert tone and/or voice page that overrides all normal paging features (specify activation required and paging functionality possible);

.9 simultaneous high and low power paging;

.10 zone and zone group paging (plus growth capacity for 25%);

.11 built-in talk back amplification;

.12 capability of distributing and monitoring audio program sources from the control console. Inputs shall be provided for microphones, tuner, CD player and AUX. Program distribution shall be accomplished on a SELECTED ROOMS or SELECTED ZONES basis as programmed from the console;

.13 facilities for the distribution of highest priority emergency announcements or tones from the control console to all locations equipped with telephone sets or loud speakers;

.14 emergency all-facility page override;

.15 twenty-four daily time-triggered signalling event;

.16 daily master clock synchronization;

.17 relay driver per zone;

.18 auxiliary contracts (2 N.O. and 2 N.C.) for external device control;

.19 compatible with desktop microphone, with on-off switch and jacked outlet and connector plug for use with system including any additional interfacing hardware;

.20 night ringer - ability to sound a night ringer tone through the paging speakers;

.21 music program source;

.22 capabilities of overriding a local gym or multi-purpose room sound systems.

.3 Omni directional desktop microphone with choice of push to talk or lift to talk operation. The push to talk bar should include a locking mechanism, indispensable for long announcements.

2.04 General Purpose Room Sound System

.1 The sound system components for the general-purpose room shall consist of CSA approved devices specified herein this Article.

.2 The system head end shall include interface for users to connect their own MP3 players to system.

.3 CD/WMA Player:

.1 Yamaha, 5-disc player as follows:

.1 progressive scan video output;

.2 108MHz/12-bit video DACs;

.3 192KHz/24-bit D/A conversion audio processing;

.4 SA-CD playback compatibility;

.5 multi format playback (DVD /CD/CD-R/CD-RW/MP3/WMA);

.6 wireless remote control;

.7 rack mounting shelf.

.4 Amplifier:

.1 Solid state modular amplifier as follows:

.1 output power 240 WRMS (8 ohms);

.2 frequency response from 20 kHz, ± 1dB;

.3 S/N ratio 100dB or greater;

.4 harmonic distortion less than 0.5%;

.5 indicators LED for power "ON", "PROTECT" and "CLIP";

.6 XLR type input connector and phone jack input;

.7 rack mounting hardware.

.5 Graphic Equalizer:

.1 1/3 octave active graphic equalizer as follows:

.1 28 filters on ISO 1/3 octave centre frequencies, with frequency response from 10 Hz to 30 kHz;

.2 slide type filter controls;

.3 frequency response 31 Hz to 16 kHz (± 1 dB);

.4 LED peak indicator;

.5 rack mounting hardware.

.6 Mixer / Pre-amplifier:

.1 Mixer / Pre-amplifier as follows:

.1 minimum 8 inputs;

.2 frequency response 20-20,000 Hz ± 1 dB;

.3 base and treble controls and peak indicator;

.4 signal processing input and outputs;

.5 rack mounting hardware.

.7 Rack Control Panel:

.1 Custom monitor panel as follows:

.1 complete with head phone jack for monitoring of speakers;

.2 quantity of four (4) microphone type connectors and minimum two (2) dual RCA connectors;

.3 speaker selection switches;

.4 component nameplates and rack mounting hardware suitable for installation in enclosure;

.5 required connectors and jacks to suit system design requirements.

.2 Speaker output protection shall be provided to prevent speakers from being overdriven. Protection device shall be user resettable and supplied integral with amplifier or custom provided in rack inaccessible by unauthorized people.

.3 Provide one (1) set of head phones complete with plug-in cord set.

.8 Microphone and Floor Stand:

.1 Electro Voice dynamic cardioid microphones and floor stands as follows:

.1 directional polar pattern;

.2 frequency response from 40- 4,000 Hz;

.3 low impedance;

.4 SPST "ON/OFF" slide switch;

.5 detachable 15 m (50') flexible, shielded microphone cable with XLR connector;

.6 die cast zinc alloy case;

.7 quick release swivel stand adapter;

.8 removable wind screen;

.9 floor stand grip action clutch, low profile demountable base, satin chrome telescoping 2 piece tubing and self-levelling pads.

.2 Provide quantity of two (2) complete packages.

.9 Speakers:

.1 Speaker mounting requirements shall be confirmed with Consultant to suit and coordinate with wall and/or ceiling structure of the room. Unless otherwise noted on drawings, speakers shall be recessed ceiling mounted (as confirmed with Consultant). Ensure that speaker assembly can be accommodated within the ceiling space and that speaker is mounted within a back box that is acoustical type ULC approved for application.

.2 For recessed in ceiling applications of low to standard height: Electro-Voice "EVID C8.2LP" loudspeaker system as follows:

.1 200 mm (8") 8 ohm coaxial speaker;

.2 frequency response from 50Hz to 20kHz;

.3 power handling of 100 W continuous;

.4 coverage of 110°;

.5 sensitivity of 91 dB (SPL 1w/1m);

.6 70v/100v transformers as required;

.7 ABS enclosure baffle with zinc plated steel acoustic back can and perforated power coated steel grille with safety tether;

.8 approximately 178 mm H x 270 mm diameter (7" x 10.6").

.3 For recessed in ceiling applications of greater than 4.5m (15') height: Electro-Voice "EVID C8.2HC" loudspeaker system as follows:

.1 200 mm (8") 8 ohm coaxial speaker;

.2 frequency response from 50Hz to 20kHz;

.3 power handling of 100W continuous;

.4 coverage of 75°;

.5 sensitivity of 93 dB (SPL 1w/1m);

.6 70v/100v transformers as required;

.7 ABS enclosure baffle with zinc plated steel acoustic back can and perforated power coated steel grille with safety tether;

.8 approximately 300 mm H x 320 mm diameter (11.9" x 12.6").

.4 For surface wall mounting applications subject to approval of Consultant: TOA HX5 Series compact array speaker system as follows:

.1 4-12cm (5") cone-type low frequency speaker component;

.2 12 balanced dome type high frequency speaker component;

.3 frequency response from 70Hz to 20kHz – 10db;

.4 power handling of 200W continuous pink noise and continuous program of 600W;

.5 coverage area of 1008 horizontal x 608 vertical plane;

.6 entire assembly must be constructed of high impact resistant materials to provide maximum protection from contact from sports equipment or supplied with metal wire cage;

.7 white in colour;

.8 ceiling mounting hardware and suspension chains.

.10 Wireless Microphone Systems:

.1 Shure Bros., wireless microphone systems as follows:

.1 diversity type UHF radio receiver with audio level meter, RF level meters for antennae, noise sensing squelch control, output level control, outputs, power supply and antenna;

.2 low profile, durable body pack transmitter with power on/off/mute switch, LED power/battery gauge, adjustable audio gain control, frequency selector switch and 9 volt battery;

.3 rack mount kit;

.4 cardioid condenser lavalier microphone with required clips, cords and connectors;

.5 handheld transmitter consisting of ABS microphone body with on/off/mute switches, battery status LED and level adjustment.

.2 Provide quantity of two (2) complete system packages, fully installed and adjusted to be integrated to the system.

.11 Enclosure:

.1 Floor standing, portable rack cabinet as follows:

.1 constructed from 14 gauge cold rolled steel;

.2 finished in baked enamel;

.3 sufficient size for mounting of system components plus future assistive sound listening control unit and future spare 25% space;

.4 hinged key locking front and rear panel;

.5 ventilation louvers;

.6 wiremold "SPD" series rack mounted surge suppressor power distribution strip with receptacles;

.7 heavy duty casters.

.12 Outlets:

.1 Microphone outlets shall be XLR, 3-pin type jacks suitable for microphones mounted on rack panel or on stainless steel faceplate and suitable for mounting on flush, wall boxes as shown. Stage area microphone outlets shall extend back to back of stage interconnect box mounted flush in wall.

.2 Remote interconnect boxes shall include auxiliary inputs to allow for external connection of the system speakers to the music sources and equipment, and speaker switch controls to turn speakers ON/OFF to suit room configuration; all housed in flush wall mounted type D box with key locking front hinged door.

.13 Wiring:

.1 Wiring shall be shielded type in accordance with the equipment manufacturer's requirements.

.1 Maintain maintenance records for each system supplied, and must submit a monthly report containing a time and date record of all reported or detected problems, detail of corrective action taken and the cause of the problem.

.2 Supply with shop drawings, a copy of the standard maintenance contract form with detailed description of services.

.14 Manufacturers:

.1 Audio source:

.1 Yamaha;

.2 Technics;

.3 Sony;

.4 Panasonic.

.2 Amplifiers and control equipment:

.1 TOA;

.2 QSC;

.3 Crown;

.4 Mackie;

.5 Rauland;

.6 Inter-M;

.7 Electro Voice.

.3 Microphones:

.1 Shure Bros;

.2 TOA Canada;

.3 AKG;

.4 Electro Voice;

.5 Telex.

.4 Speakers:

.1 TOA Canada;

.2 EVI;

.3 Tannoy;

.4 JBL;

.5 Yamaha.

.15 System Testing and Verification:

.1 Manufacturer's authorized technician shall provide system testing, inspection and verification work.

.2 Refer to Part 1 and Part 3 for additional testing and verification requirements.

.16 Suppliers/Installers:

.1 Acceptable system suppliers and installers include:

.1 Barrie Communications (905-564-7026);

.2 High Tech Communications (416-798-7267);

.3 AC Technical (905-666-8676);

.4 AATEL Communications.

2.05 Assistive Listening System

.1 Williams Sound, model PPA 335, FM hearing assistance system consisting of PPA T35 transmitter base station with digitally tuneable 10 wide band and 77 narrow band channels, digital display of output levels and channels, and complete with antenna, transformer and rack mount kit. Receivers shall be No. PPA R35 wide band, 13 channels wireless units complete with rechargeable NiMH batteries, belt clip provisions and No. EAR 022 easy to clean surround earphones. Include in Bid a quantity of four (4) receivers. Include also for one (1) No. CHG 3512 multi unit charger and a system carry case for storing all components.

.2 Mount unit in gymnasium sound system rack in accordance with manufacturer's instructions.

.3 Manufacturers:

.1 William Sound Corp (Thorvin 905-829-3040).

.2 Telex Communications.

2.06 Washroom Emergency Call Systems

.1 Provide an emergency call system consisting of CSA approved and/or ULC listed components to provide system in compliance with local governing codes and standards, with following operations:

.1 activated emergency call station in ADA designated washroom sends signal to un-attended central control unit that indicates that someone in washroom needs assistance; stations to be supervised; trouble signal to be sent to control unit in event of station failure, unless otherwise directed by Owner;

.2 central control station includes head end equipment for system terminations and console for responding to communications device and circuitry to automatically dial and forward assistance calls and trouble signals to designated Owner's monitoring station / response station;

.3 audible devices and visual devices located over washroom door illuminate and sound tone when remote call stations are activated; visual and audible signals to be distinct and of different types of signals from other building systems;

.4 call stations, audible devices and visual devices to only be reset when call has been responded to and activated station locally reset.

.2 Central control head end equipment is microprocessor based equipment with capacity for monitoring up to minimum 6 remote stations. Power supplies include battery back-up for entire system for minimum 60 minutes, or more where required by local governing authority. Console includes:

.1 annunciator with LCD display or individual LED lamps with nameplates identifying calling stations;

.2 non-volatile memory for calls and system events;

.3 lamp test push button, other required controls and power supplies;

.4 wall or desk mounting provisions as coordinated with Consultant to suit specific applications.

.3 Remote stations to be tamper-proof, vandal-proof and with call pushbutton of minimum 32 mm (1-1/2") dia., but of greater size if required by local governing codes. Stations include reset button, call tone and call assurance LED light. Stations to include user able reset feature. Call tone to have adjustable sound level.

.4 Signage: engraved lamacoid emergency sign that contains wording – "IN EVENT OF EMERGENCY PUSH EMERGENCY BUTTON AND AUDIBLE AND VISUAL SIGNAL WILL ACTIVATE" in letters at least 25 mm (1") high with 5 mm (3/16") stroke and that is posted above call station. Exact sizing and

nomenclature to be as per local governing code requirements and reviewed with Consultant prior to ordering.

.5 Visual devices to be flashing LED type with Lexan lens and audible signal tone, mounted onto single gang stainless steel faceplate, and suitable for mounting onto recessed electrical box. Signals to be distinct from other building systems. Confirm LED colour with Consultant prior to ordering.

.6 Subject to approval of local governing inspection authority, interior audible and visual signals may be devices remote from call station but still within room and also must meet performance requirements specified herein. Flush mount in recessed boxes.

.7 Provide power supplies, wiring and mounting hardware as required and as recommended by system manufacturer.

.8 Wiring to be of type in accordance with applicable local governing codes and standards, and as recommended by system vendor.

.9 Provide system to suit application as shown and as required. Ensure that stations meet requirements of each application as recommended by manufacturer. Include required accessories to suit. Provide weatherproof and corrosion resistant devices for devices located in non-climate controlled areas.

.10 Verify system sequence of operation with local governing authority inspector and coordinated with Consultant.

.11 Manufacturer's authorized vendor to supply, install, test, start-up and certify complete systems as required.

.12 Manufacturers:

.1 Edwards;

.2 Aiphone;

.3 TOA;

.4 Telecor;

.5 Rauland;

.6 Mircom;

.7 Jeron.

3 Execution

3.01 Installation of Clocks

.1 Provide specified clocks in locations as shown. Install devices in accordance with the manufacturer's requirements.

.2 Install clocks where shown and connect complete. Install large display clocks in gymnasium and other large assembly areas.

.3 Connect all clocks to the public address systems 24VAC power supply to synchronize with the other digital display units.

.4 Confirm exact locations of devices and finishes with the Consultant prior to roughing-in.

3.02 Installation of Public Address System

.1 Provide a complete, fully operational public address paging system and install all devices in accordance with the manufacturer's instructions.

.2 Provide wiring between PA central control unit (CO Trunk Card) and owner's telephone switch. Be responsible to coordinate and work with and Owner's telephone service provider during construction.

.3 Desk mount the main control consoles where shown and connect complete. Confirm exact location of outlets with Owner, prior to roughing-in. Provide a main console in each of the Administration office, Principal's room, and Vice Principal's room.

.4 Paging speakers shall be located throughout the corridors, classrooms, offices, general purpose rooms and mechanical/electrical rooms. Paging speakers shall be organized in different zones to reduce need for "all -call" paging. Zones can be revised easily at main control console via software programming. Wiring to speakers in classrooms, offices, mechanical/electrical rooms, multipurpose room, staffrooms and caretaker's office shall be each "home run" back to central equipment location. Corridor speakers shall be grouped in zones.

.5 Program the consoles and provide paging in zones in accordance with the Owner's requirements, when installation is complete. Confirm exact requirements with Owner. Paging zones shall be flexibly programmed for each area as follows:

.1 each classroom;

.2 corridors (multi-zones per floor);

.3 washrooms zoned with corridors;

.4 multi-purpose room;

.5 Gymnasium;

.6 mechanical rooms;

.7 administration rooms;

.8 exterior;

.9 Etc.

.6 Provide wall mounting handsets and speakers in classroom control panels where shown on the drawings and connect complete. Where control panels are not provided, handsets and speakers shall be installed flush mounted in building surfaces.

.7 Rack mount central control unit and amplifiers where shown.

.8 Rack mount the music source components where shown.

.9 Provide protective wire guards for all devices in the gymnasium.

.10 Provide ceiling speakers in backboxes with baffles where shown, flush with the finished ceiling and walls. Secure backboxes from the structure. Connect complete.

.11 Install exterior programme horns where shown. Provide suitable weather-proof backboxes and grilles. Connect complete to control unit via required relays. Confirm exact mounting heights and locations prior to roughing-in.

.12 Provide microphone jacks where shown including at least one (1) in the administration area and one in Principal's office. Secure each to a single gang flush wall mounted outlet box and connect complete. Microphone jacks shall be "home run" wiring back to central equipment rack.

.13 Provide emergency call switches in handicap washrooms as shown.

.14 Provide telephone handset with call switch and horns in mechanical rooms.

.15 Supply two (2) desk mounting microphones and turn the microphones over to the Consultant prior to application for a Certificate of Substantial Performance of the Work.

.16 Label each cable run in 2-places, 3' (1 m) apart, at each end after being pulled and trimmed. Identify runs individually.

.17 All cabling to be installed in conduit.

.18 Speaker cable terminations to be punched down into a labelled connection block arrangement (IDC) provided with paging system and be neatly tie wrapped and secured. Speaker runs to be terminated on terminal strips integral with speakers.

.19 Install all systems wiring in conduit in accordance with certified "reviewed" wiring schematic shop drawings. Ensure that all wiring is in accordance with the system supplier's recommendations and is colour coded and properly identified at terminals.

.20 Do not install microphone wiring in the same conduit as speaker wiring.

.21 Do not splice wiring in conduit runs. Where required, make splices in proper junction boxes utilizing terminal strips.

.22 All audio circuits shall be balanced to ground.

.23 When system installation is complete, provide all requirements as specified in article "System Startup, Inspection and Commissioning."

.24 Refer to system riser on the drawings.

.25 Testing and Programming:

.1 The supplier/contractor will be required to test all runs for correct continuity, polarity and grounding and to submit cable records recording such test results, together with an undertaking as to the accuracy of the results.

.2 The supplier shall provide all programming and adjusting of all features and balancing all components to the satisfaction of the Owner's representative.

.26 Training:

.1 The supplier shall perform on-site training of each user (including the provision of user guides) prior to project completion and to attend at the school the week following project completion to ensure that all staff are properly trained in the operation of the system.

.2 Train up to two (2) selected appointees in the complete administration of the system.

.27 Warranty:

.1 Warranty to include the following:

.1 a one (1) year repair or replacement warranty on all components;

.2 warranty to begin upon system acceptance;

.3 the support of an operational remote maintenance capability;

.4 repair response times for problems defined as routine to be addressed and corrected within twenty-four (24) hours, excepting statutory holidays and weekends;

.5 repair response times for problems defined as major to be addressed and corrected within four (4) hours, excepting statutory holidays and weekends;

.6 requirement to have at least one (1) full system of each model provided available in the 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 the major components to provide written confirmation of full warranty, extended warranty and service back-up, in case of the failure to perform or insolvency of the successful supplier;

.28 maintain maintenance records for each system supplied, and must submit a monthly report containing a time and date record of all reported or detected problems, detail of corrective action taken and the cause of the problem.

3.03 Installation of Gymnasium Sound System

.1 Provide a complete and fully functional sound system consisting of the specified components.

.2 Install all devices in accordance with the manufacturer's instructions.

.3 Mount the music and audio sources and control equipment in the equipment rack.

.4 Install microphone outlets, remote interconnect boxes and auxiliary input receptacles where shown. Secure each in wall mounted outlet boxes and connect complete. Confirm exact type of outlets with the Consultant prior to ordering. Refer to drawing notes for microphone wiring requirements.

.5 Supply transmitters, microphones and stands as required and turn the microphones and stands over to the Consultant prior to application for Certificate of Substantial Performance of the Work.

.6 Mount speakers to walls in accordance with manufacturer's recommendations and subject to approval of the Structural Consultant. Confirm exact height and locations prior to roughing-in.

.7 Mount speakers to ceiling structure in accordance with manufacturer's recommendations and subject to approval of the Structural Consultant. Be responsible for verifying that the ceiling structure can adequately support the speakers. Confirm exact height and locations prior to roughing-in.

.8 To maintain maximum flexibility in the use of the areas, each speaker shall be "home run" wired back to central equipment rack and connected to monitor panel/speaker selector switches, as applicable. Confirm exact requirements with the Consultant. Confirm finishes with the Consultant prior to ordering.

.9 The exact speaker locations and aiming shall be co-ordinated on site with the sound system contractor and Consultant to ensure minimum feedback effects and proper coverage of areas, prior to roughing in work. Prepare drawing of proposed speaker locations and submit as part of shop drawings.

.10 Provide required relays/contacts to connect system to the P.A. system bridging control to allow for emergency calling provisions.

.11 Install assistive listening device station into rack, in accordance with manufacturer's instructions. Test and adjust as required. Turn over remote devices to the Consultant for forwarding to Owner.

.12 Install all system wiring in conduit in accordance with certified "reviewed" wiring schematic shop drawings. Ensure that all wiring is in accordance with the system supplier's recommendations and is colour coded and properly identified terminals.

.13 Do not install microphone wiring in the same conduit as speaker wiring.

.14 All connections of 2-pair cable to multi-conductor cable shall be made with approved crimp connectors.

.15 Do not splice wiring.

.16 All audio circuits shall be balanced to ground.

.17 When system installation is complete, provide all requirements as specified in Section regarding testing.

.18 Refer to system riser on the drawings.

.19 Provide minimum four (4) hours of operating and maintenance instructions to Owner's designated personnel.

3.04 Installation of Washroom Emergency Call System

.1 Provide specified emergency call systems components and connect complete. Program sequence of operation as required and confirmed with Owner and Consultant. Exact programming requirements to be verified with local governing authority and coordinated with the Consultant and/or Owner.

.2 Obtain required training from manufacturer's representative on any special installation procedures.

.3 Install head end central equipment central console in location as confirmed with the Consultant. Connect complete with required power and communications wiring. Review mounting requirements with Consultant.

.4 Install devices in locations as coordinated with Consultant prior to roughing-in. Install components at mounting heights as noted on drawings and confirmed with Consultant. Generally, mount devices on recessed back boxes. Typically locate audible/visual devices above doorframe. Locate power supplies in service room accessible location confirmed with Consultant.

.5 Set sound level of interior audible devices at level acceptable to Owner and coordinated with Consultant. Adjust as required.

.6 Provide required system wiring. Wiring to be copper conductor, colour coded, and in accordance with system manufacturer's recommendations and instructions. Connect equipment in accordance with system manufacturer's certified wiring diagrams and instructions and under direct supervision of manufacturer. Run conductors in conduit.

.7 Install devices and perform work in accordance with manufacturer's instructions and requirements and in accordance to applicable codes of local governing bodies having jurisdiction.

.8 Confirm locations of devices prior to roughing-in.

.9 Provide a lamacoid identification nameplate for each enclosure. Confirm wording of identification nameplates and colour finishes of devices with Owner prior to ordering.

.10 Install signage as required. Locate in position and secure to wall with proper mechanical fasteners. Confirm exact nomenclature, sizing and locations with the Consultant with shop drawing submissions.

.11 After installation is complete, test, adjust and verify operation of system. Demonstrate system operation and maintenance with Owner's staff.

.12 Obtain approvals from local governing inspection authorities.

End of Section

1 General

1.01 Summary

.1 Provide commissioning of fire alarm and interconnected systems to verify that installations are in accordance with project requirements, and to ensure proper system operation.

1.02 Related Requirements

.1 Section 01 91 13 – Commissioning.

1.03 References

.1 CAN/ULC-S1001-11 – Integrated Systems Testing of Fire Protection and Life Safety Systems.

1.04 Submittals

.1 Commissioning plan.

1.05 Closeout Submittals

.1 Final commissioning and functional test report.

1.06 Qualifications

.1 Commissioning Organizations:

.1 Certified member of Electrical Contractors Association of Ontario (ECAO) or Canadian Fire Alarm Association (CFAA).

2 Products – Not Used

3 Execution

3.01 Site Tests and Inspections

.1 Perform Commissioning of integrated systems in accordance with CAN/ULC-S1001.

.2 Follow manufacturer's recommendations for testing.

.3 Inspect wiring connections to all devices comprising the system.

.4 Verify supervision of wiring at every device connection to a supervised circuit.

.5 Test operation of every device on a system to verify its function.

.6 Examine equipment for any apparent damage or tampering that may interfere with its intended operation.

.7 Test equipment with capabilities for field adjustment to establish that it functions as intended under the conditions prevailing at its point of installation.

.8 Examine devices for evidence of damage or obstructions which may interfere with their operating mechanisms.

.9 Test automatic devices by simulating an operating condition.

.10 Wiring:

.1 Inspect every device and test to demonstrate that disconnection of the device from the circuit or malfunction of the equipment or wiring activates the required supervisory signals. Inspection shall include verification that:

.1 Supervisory signals operate in response to open circuits, short circuits, ground faults and disconnection of plug-in components;

.2 Terminations of conductors entering and leaving equipment have been made;

.3 Circuit polarities are in accordance with the system design, where applicable.

.2 In addition, test to establish that the power supplied to any device is within its recommended operating range and that the required voltage levels are maintained and that the fusing is correct.

.11 Initiating Devices - Manual:

.1 Inspect manual alarm stations in consideration of the following:

.1 The device shall be mounted with sufficient clearance to facilitate ease of access and proper operation;

.2 Operate each manual alarm station, toggle switch and key switch to verify proper functions.

.12 Automatic heat detectors:

.1 Use a heat source reproducible in its intensity, as recommended by the manufacturer of the device, to initiate an alarm.

.2 Test equipment - Heat lamp or Air heater. DO NOT USE AN OPEN FLAME HEAT SOURCE.

.3 Apply heat source as to not damage or operate fusible disc parts.

.13 Automatic heat detectors - non-resettable:

.1 Test by simulating its electrical operation by jumpering the wiring points (creating a short) adjacent to its operating mechanism.

.14 Automatic smoke detectors - area type:

.1 Test by introducing smoke into its detecting chamber. This may consist of actual smoke from burning materials or artificially generated smoke aerosol spray as recommended by the manufacturer. The sensitivity should be noted and adjusted if necessary.

.15 Automatic smoke detectors:

.1 Examine the air sampling arrangements of the detectors under actual conditions of balanced air circulation by conducting a check of the field sensitivity and a check of the air velocity in accordance with the manufacturers' recommendations.

.2 Test gas to be used similar to Automatic Smoke Detector.

.16 Alarm signals - audible:

.1 Test on main power supply and standby power supply with the maximum expected load on the system.

.2 The audible signalling appliances shall function as intended and shall be audible throughout the building over the background noise present.

.3 Decibel recordings in each area covering 100 sq. metres shall be taken.

.4 The level of sound should usually be 15 dB above ambient noise level.

.17 Alarm signals - visual:

.1 The visual signal appliances shall function as intended and shall be clearly visible.

.18 Fire suppression supervision:

.1 Coordinate with the requirements of Section 21 13 00.

.2 Sprinkler and standpipe trade to active each sprinkler and standpipe supervisory and alarm device by operating valves and producing flows as required in conjunction with fire alarm technician to observe activation of flow switches, pressure switches, supervised valves, etc.

.19 Annunciators, printers and workstations:

.1 Inspect and operate to establish that their operation in conjunction with the control equipment and other system components, is as intended. The equipment shall be inspected to ensure:

.1 The zone of each alarm initiating device is properly indicated;

.2 The legend is clearly visible;

.3 Adequate voltage under local conditions is present;

.4 Wiring connections have been made in a workmanlike manner.

.5 Proper care must be taken to establish that each item is complete and satisfactory.

.20 Standby power supplies - batteries:

.1 Examine batteries for possible damage and consideration of the following:

.1 The charging system functions as intended;

.2 The installation has not resulted in the bypassing of a fuse or a similar protective device;

.3 The installation protects the batteries from accidental or mechanical damage.

.4 The batteries must be able to operate the fire alarm system with the charger input disconnected for one rated load cycle.

.21 Control equipment and transponders:

.1 Test to establish that they function as intended. The following examinations and tests shall be performed:

.1 A visual and physical inspection of all cables, plug interconnections, plug-in circuit components, lamps, sockets and controls to establish that their mechanical and electrical connections and mounting are as required for intended function and, where applicable, to confirm electrical supervision;

.2 Verification that all field wiring is terminated in a workman-like manner;

.3 All lamps and indicators shall be tested for operation and intended function;

.4 All keypad functions shall be tested for operation and intended function;

.5 All control unit functions shall be operated to verify appropriate response including all software routines and programme functions are simulated;

.6 Simulation of open circuits, short circuits and ground faults on all relevant internal circuits in order to confirm the appropriate supervisory response;

.2 Commissioning Report:

.1 Provide in accordance with requirements of Section 01 91 13, supplemented as specified herein.

.2 Report to include relevant information of the system including:

.3 Each system part described.

.4 How the system is operated.

.5 What functions the system performs.

.6 Requirements for tests and service.

.7 Itemization of all devices connected on the system, their general location.

.8 The date of the performed tests.

.9 All pertinent details of the report sheets requested.

.3 Verification:

.1 The Commissioning Report to be submitted to the Commissioning Manager upon completion of commissioning and will be subject to verification by the Commissioning Manager.

3.02 Simulations of Interconnected Systems

.1 Provide simulations of all interconnected systems in accordance with CAN/ULC-S1001.

End of Section

1 General

1.01 Summary

.1 Section includes security system general requirements and items required for installation.

.2 Refer to Sections with regards to Access Control System (ACS), Closed Circuit Television System (CCTV), other Sections of Electrical Divisions, drawings, schedules, and door elevations, for details of related work.

.3 Refer to door hardware list for supplied and installed hardware.

.4 Verify availability of power for electrical devices. If there is an inadequate power for security system electrical devices, contractor to provide power for fully operational security system.

.5 Verify fire alarm interface requirements for the security system.

.6 Verify elevator interface requirements for the security system.

1.02 Qualifications

.1 System Supplier Qualifications

.1 The supplier of respective systems and equipment to be an established security systems contractors that have and currently maintain a locally run and operated business for at least 5 years. The system supplier to hold applicable provincial and local licenses.

.2 The system supplier to be the regional Canadian authorized distributor for the product/system proposed with full manufacturer's warranty privileges.

.3 The system supplier to employ technicians who have attended and successfully completed the manufacturer's technical certification classes for the proposed system.

.4 The system supplier to show satisfactory evidence, upon request, that they maintain a fully equipped service organization capable of furnishing adequate inspection and service to the system on a 24-hour/7-day basis. The system supplier to maintain at their facility the necessary spare parts in the proper proportion as recommended by the manufacturer to maintain and service the equipment being supplied.

.2 Security Integrator Qualifications

.1 The security integrator to be responsible for provision of the ACS for this project and to have the following qualifications:

.1 Be an authorized approved vendor of the proposed solution having a minimum 3 years experience with the installation and maintenance of ACS system. Vendors must be in good standing with manufacturer and must have up to date certifications.

.2 Have a minimum of three years experience with the installation and maintenance of information technology networks and network components.

.3 Upon request, provide a list of previous successfully completed projects of similar installation, size, and scope and provide name of contact person at each site for verification. Additionally, upon request the Owner may request an onsite visit or photographs of similar jobs to verify vendor workmanship.

.4 Confirm explicitly that the personnel to be employed on the contract are suitably trained in the installation and maintenance of equipment of the type and model being provided so as to be able to carry out work in a competent manner.

.5 Submit, for approval, details, and copies of certification, training course completion, and Resumes for the Project Manager, Installation, and training personnel (include any sub-contracted work).

.2 acceptable systems and equipment are as specified in respective Sections and to be as recommended by the acceptable integrators and must at least meet the minimum standards and performance of the base specified system;

.3 security system integrators must be system manufacturer's current and valid authorized Canadian distributor/installer. Submit proof with shop drawings;

.4 the final system being supplied must include software upgrades up to point of turn over to Owner, and during the system warranty period, unless otherwise noted in the Specification.

1.03 Integrated Communication System and Systems Integrator

.1 Refer to Section entitled Integration, for requirements for the Integration System and Systems Integrator. The various security systems to be fully integrated with systems as per article requirements.

1.04 Installation Standards

.1 Work to be of professional quality and to not detract from the aesthetic qualities of the facility.

.2 Documentation and training for systems will be provided as detailed in this specification.

.3 Ensure system components comply with relevant requirements of ULC and CSA.

.4 Follow established guidelines for installation and termination of cabling and equipment as established by EIA/TIA-568-A, EIA/TIA-569, EIA-TIA-606, TSB-36 and TSB-40, BICSI

.5 Telecommunications Distribution Methods Manual, CEC and local electrical codes. Adhere to Quality Assurance requirements specified in this section.

.6 Verify raceways on site.

.7 Provide additional conduits and raceways where required, provide stainless steel cover plates for back boxes that are not being used.

1.05 Submittals

.1 Submitted drawings and documentation to become property of the Owner and the Contractor to have no rights over the entire documentation package or any parts of the documentation package.

.2 The drawings and documentation to be considered confidential documents and to not be disclosed or distributed to any other party except the Owner's personnel directly involved in the work.

.3 Documentation is to be provided in both hard and electronic format for each project deliverable four (4) hard, four (4) Soft. The electronic format to include for each document editable files (in its raw format, .xlsx, .docx, .dwg, .vsd, etc.).

.4 Submit the following documentation for review by the Consultant.

.1 Work Implementation Plan: The plan to identify the implementation milestones and detail each project task. It also identifies day/time, locations of work, and number of workers on site. Provide

at the beginning of the project prior to the start of any work and is to be updated and resubmitted on a bi-weekly basis.

.2 Shop Drawings:

.1 Submit shop drawings for equipment and accessories specified in this Section. Provide connection wiring schematic drawings for each system. Provide block system diagrams and sequence of operations. Provide samples of computer graphic displays, as applicable.

.2 Each drawing to include details necessary for the procurement, installation, maintenance, and repair of components or facilities equipment provided. Change Order notices that are attached to drawings to not constitute revised drawings. Each drawing to include changes and be upgraded to reflect the latest configuration.

.3 Submit drawings in the native (editable) electronic format (dwg, .xlsx, docx). Documents produced to be property of the Owner and the Contractor to have no rights over the entire documentation package or any parts of the documentation package.

.3 Drawing data to include but not be limited to:

.1 manufacturer's catalogue designation;

.2 complete data and wiring diagrams;

.3 point allocation tables;

.4 dimensions, capacities, ratings, weights, materials, finish, storage conditions;

.5 recommended installation procedures, performance, testing, and certifications if required.

.4 Each drawing to have the following information:

.1 Cover Sheet listing job name, date submitted;

.2 Table of Contents with columns;

.3 Device Name;

.4 Model #;

.5 reference specifications section;

.6 quantity provided.

.5 Acceptance Test Plan: Submit an Acceptance Test Plan in accordance with this section.

.6 Training Course Outline: Submit a Training Course Outline in accordance with this section.

.7 Operator/Maintenance Manuals: Provide Operator/Maintenance Manuals as described in this section.

.5 As-Built Drawings to be submitted and include but not be limited to:

.1 equipment list including the serial number, the part number and the manufacturer of installed equipment;

.2 all certificates required for the operation of the system;

.3 the final test report;

.4 final revision shop drawings;

.5 software licences and CDs.

.6 Refer to Section entitled Electrical Work General Instructions, for additional general submission requirements.

1.06 Quality Assurance

.1 Power Wiring: AC and DC power wiring to conform to local governing electrical code and other applicable local codes. Guards to be provided over high voltage or high current terminators.

.2 Wires and cables to be formed, neatly laced or tie wrapped, and clamped in position. No adhesive or stick-on clamps are permitted. The use of masking tape or electrical tape is not acceptable.

.3 Cable to not come in contact or be supported by conduit of other systems including water pipes and electrical conduit

.4 UTP cables to follow TIA/EIA Cat category standard as specified in Section entitled Structured Cabling Systems and as confirmed with the Consultant.

.5 Sufficient slack to be provided to:

.1 prevent undue stress and strain on connectors and cables;

.2 allow easy disconnection of equipment;

.3 allow a minimum of three re-terminations of each cable or wire in the event of breakage.

.4 in the case of CCTV cameras 3 m (10') of slack cable in flexible conduit to be provided to enable future relocation.

.6 Grommets: Where wires run through holes or conduit, be protect with suitable grommets.

.7 Conduit: Wires and cables external to equipment and enclosures to be run in conduit. PVC conduit may be used underground. Where free movement of equipment is required, flexible conduit to be employed. Once installed in the conduit, cable to be tested for continuity and insulation breakdown (skinning).

.8 Connectors and Splices: Wires and cables to be continuous between termination and connection points. Connectors and splices to be located within secure enclosures and are not permitted inside conduit.

.9 Cable Positioning: Wires and cables to be located so that inductive and capacitive effects do not degrade system operation. Take special care to avoid any Electro-Magnetic Interference (EMI) generating devices. The Contractor to avoid placing video wiring in spaces with electrical panels, transformers or other high voltage equipment.

.10 Outdoor Cabling: Outdoor cabling to have drip loops at the point of entry into enclosures, junction boxes, etc. and entries to have a weather tight seal. Where a cable connection is exposed to outdoor elements, protect with flooded heat shrink material.

.11 Solid or Stranded Conductors: Stranded wire only will be used. Shielded wiring to be jacketed with PVC and to have the shield braid terminated so that the insulation is not damaged by soldering, heat or mechanical pressure.

.12 Wire and cable to be FT6 (CMP) plenum rated conductors.

.13 Wire Termination: Wires to be terminated by soldering or by the use of solderless terminals. Crimp lug terminals to only be used on stranded wire. Solid wire to be soldered to the terminal and the soldered portion insulated. No more than one wire per lug is permitted.

.14 Terminal Lugs: Terminal lugs to be suitably electroplated or treated by commercially acceptable methods to ensure good electrical contact and prevent corrosion.

.15 Terminal Blocks: Terminal and connecting blocks to be of the screw type. As a minimum, terminal blocks to have 10% spare capacity. A barrier to separate each termination. No more than two terminal lugs to be clamped under each terminal screw. Solder, wire wrap and pressure termination type terminal blocks to only be used with prior approval and where the need for this type of device has been demonstrated. No more than one wire may be connected to each terminal, except in permanent daisy chaining requirements.

.16 Cable Connectors:

.1 No more than one wire to be connected to each pin of a cable connector unless that pin has been designed to accept more than one wire. Strands of the wires to fit into the pin receptacle. Cable connectors to be field replaceable. Provision to be made to fix the cable connector covers to a chassis or to each other by means of screws.

.2 Coax cable connectors must be crimp type installed with associated crimp installation tool.

.17 Cable and Equipment Labelling:

.1 Functional or alpha-numerical mechanically printed labelling to be installed on equipment including racks and cabinets. Visible wires and cables typically accessed for service to be labelled at both ends. As well, connecting strips, terminal blocks, plugs and sockets to be labelled. The marking on the labels to be consistent with the As-Built Drawings.

.2 Approved materials for labels include alphanumeric labels protected by clear heat shrink material, ty-wrap labels, lamacoid strips, etched metal, or indelible ink. The use of Dymo tape (or equivalent) labelling is not permitted.

.18 Fasteners: Panels, doors and access shields to be fastened with a suitable style of fastening compatible with the degree of security required for each enclosure and the frequency of access. There is to be no sign of cross-threading or mutilation on any screws or fasteners. Nuts to be of standard size and preferably of hexagonal design. Threaded parts to be secured by the use of lock washers except under counter sunk screw heads, coaxial plugs and similar connectors, terminal binding screws, etc.

.19 Replaceable Parts: Parts and components that may require replacing or removal for servicing to not be affixed by rivets, welds, metal tags on other similar means that would prevent ready removal.

.20 Materials: Materials used in installations to be selected with due regard to the intended use, durability, safety, retention of appearance and avoidance of corrosion or other chemical effects. The use of wood, natural rubber, toxic materials, and other materials capable of supporting fungus or insects is not permitted. The use of electrical tape or masking tape is prohibited.

.21 Soldering: Soldered joints to be made mechanically sound before soldering. Leads to not be wrapped more than once around a terminal. The wiring insulation to not be heat damaged or stripped back more than 2 mm from the joint or termination. Flux residue to be removed immediately after soldering by appropriate non-corrosive cleaners. Acid flux to not be used for soldering.

.22 Enclosures: Enclosures to be firmly fixed to floor or wall, be positioned for ease of maintenance, be lockable or secured with security fasteners and properly grounded. As well, outdoor enclosures to be dust tight and weatherproof. Size enclosures to allow easy access to work on any equipment or wiring contained within them.

.23 Protection of Services: Ensure that services in the immediate areas of the installation are protected against damage or interference.

.24 Damage to Property: Damage done to property (including equipment, buildings, etc.) during the course of installation or testing to be made good by the Contractor. Any damage whatsoever during installation or testing of equipment supplied by the Contractor to result in that equipment being replaced by new undamaged equipment.

.25 On-site Maintenance: At the end of each day during the installation period, the project Work areas to be cleaned, tidied and any waste material generated to be disposed off site. At the conclusion of an installation, the site and equipment to be thoroughly cleaned and damage to site or equipment made good.

1.07 Warranty

.1 Warranty the completed Security System including equipment, computer software, and documentation. Maintain the Security System during the warranty period, and implement the preventative maintenance procedures requested elsewhere in this specification package. This includes such items produced by Subcontractors or procured as off-the-shelf. This warranty to include the provision and implementation of software upgrades. Expose, and assign to the owner, any manufacturer's warranties which exceed 1 year. Include 1-year all inclusive parts and labour with 1 year warranty as part of the Bid price. Also, include software maintenance for the period of 12 months.

.2 As a minimum during the warranty period, provide a guaranteed response time of 8 hours for a major system failure and 24 hours for a minor system failure on a 24 hour per day, 7 days per week basis. A major system failure to be defined as the failure of any operator controls as well as any system controller, processor or communication link which renders more than 10% of a specific security subsystem of systems inoperative. A minor system failure to be defined as the failure of a single security device such as a card reader, egress device, camera, intercom unit, etc.

.3 As part of the submission, provide a complete list of recommended spare parts which should be held on the premises as well as a list of parts available on Company premises for fast system repairs and/or replacements.

2 Products

2.01 Security Intrusion Alarm System

.1 DSC Security 'Power Series Neo', CSA approved, ULC 561 listed and labelled, completely electrically supervised, solid state multiplexed microprocessor based electronic security system components consisting of the following:

.1 z6341 CiTeCII TCP/IP module;

.2 complete assembly (control panel and CiTec module) shall comply with ULC 561;

.3 required input/output nodes;

.4 magnetic door switches;

.5 motion detectors;

.6 combination motion/glass break detectors;

.7 remote program keypad;

.8 remote alarm horns;

.9 rechargeable battery backup and battery charger;

.10 wiring in conduit and ancillary devices;

.11 multi-colour passive display;

.12 high speed modem.

.2 The system shall have zone expander capacity for the number of zones as required for the connected devices and the required monitoring and control points of additional building systems including, but not limited to, the following:

.1 each detector;

.2 each set of door alarm contacts;

.3 fire alarm system alarm and trouble condition (separately);

.4 main A/C power failure;

.5 security system low battery;

.6 four connections to lighting circuits as designated;

.7 sump pit high water level sensor;

.8 sump pit chemical feeder sensor;

.9 building management system control panel.

.3 Control panel to be complete with zones as scheduled on drawings plus additional spare 8-zone expansion module nodes for future expansion.

.4 Initiation of the door alarm contacts or a detector shall cause the alarm horn to operate at the main control unit and shall indicate the zone of alarm on the control unit and shall be capable of sending a signal to a remote Central Monitoring Station and shall activate alarm horns in building. The system shall log all functions initiated through the applied system.

.5 Control Unit:

.1 The control unit shall be able to receive unique signals and interpret the coded signal to determine the response that shall occur. The following outputs shall be possible:

.1 signal a remote central station;

.2 sound a local alarm;

.3 signal the police or fire department;

.4 signal low temperature and loss of power;

.5 control of lighting;

.6 a combination of the above.

.2 The control shall be equipped with a multi-event memory containing the date and time of each event and this information shall be able to be printed on a line printer or displayed on the remote keypad LCD display.

.3 The systems functions shall be controlled by the remote keypad, designed for simplicity and ease of operation. The remote keypad shall be the primary means of interface between the system and the operator. It shall be possible to acknowledge status changes and control the system from the remote keypad.

.4 The control shall provide a multi-character LCD display in user selective English language to identify the various zone descriptions, changes of state, etc. It shall display, upon request, points in bypass, alarm, etc.

.5 The system shall be capable of being pre-programmed for time schedules. After a holiday schedule is executed, it shall automatically be cancelled, thus assuring that a holiday Monday is not repeated the following Monday without manual programming.

.6 The control shall be capable of operating a printer with a minimum print speed of 80 CPS.

.7 The control shall have the provision of a selectable duress (via an integral ULC S561 listed transmitting device) signal to a remote ULC Listed Central Monitoring Station. Provide ULC S561 listed wiring shall be provided for this interconnection.

.6 Remote Keypads:

.1 Remote keypads shall be complete with programming pushbuttons, LCD display and Lexan hinged cover box with lock/key set. Provide four (4) keys.

.7 Motion Detectors:

.1 Honeywell DT7450 (form c) passive infrared detector with wide angle lens for room area coverage and long narrow range lens for corridors. If at time of installation the DT7450 is not available, Contractor shall provide detector equal to or better than listed detector.

.2 Detectors shall be centrally powered by control panel power supply. Exact type of lenses provided shall be determined to best meet requirements of the application.

.8 Audible Alarms:

.1 Flush wall mounting in single gang boxes to provide minimum 85 dB at 3' (1 m) alarm of sound distinctly different from fire alarm audible devices and program bells. Units shall be complete with enamel painted grille cover finished to Architect's direction.

.9 Door Contacts:

.1 Sentrol 1078W, 1" (25 mm) flush mounting contacts for perimeter doors.

.2 Sentrol 2204A contacts for overhead type doors and mounted at top of door.

.10 Battery Backup System:

.1 Control panel batteries shall be 12V-7A rechargeable batteries. Batteries shall be provided with the device power supply units to provide continuous 24 hours of operation and supervision of the detectors and sensors upon loss of normal power supply.

.11 Graphic Display:

.1 Multicolour passive graphic display consisting of outline of building showing each floor, stairs, location of each detector, remote mounted modules/relays, zones, etc., as required by Owner. Display shall be minimum 11" x 17" mounted under frame acrylic sheet.

.2 Provide an electronic copy of the graphic display, in PDF format, to Owner.

.12 Wiring:

.1 Wiring shall be FT-6 rated, Teflon coated, copper conductors of minimum No. 22 AWG.

.13 Miscellaneous:

.1 Include for minimum one (1) year all inclusive parts and labour warranty;

.2 Include for minimum two (2) hours of operating and maintenance instructions to Owner's designated personnel.

.14 System Testing and Verification:

.1 Signed Testing and verification report (From the Security Contractor);

.15 Acceptable Supplier and Installers:

.1 The supply and installation of All security system work must be performed by ULC listed supplier/installers, who are certified and authorized manufacturers' representatives.

2.02 Access Control System (ACS)

.1 An access control system shall be provided to serve the building areas and shall form an integral part of the security system. System to be integrated to security intrusion system panel. The access control system shall be Kantech model KT400.

.2 The system's primary function is to regulate access through specific doors to secured areas of the facility and provide computer generated colour direct card credentials for that use. The system work shall be integrated to a database for both its access control and badging functionality.

.3 The system provides the following general services:

.1 access control;

.2 alarm monitoring;

.3 cardholder management;

.4 badge creation;

.5 system administration;

.6 badge layout creation;

.7 data import;

.8 reporting Functions;

.9 future provisions for closed circuit television surveillance and assessment;

.10 operations and security intercommunications.

.4 Exterior emergency exit doors are equipped with unrestricted egress locking hardware and magnetic door alarm contact.

.5 The system functionality at doors described herein includes the basic door functions. The implementation for any technically required functionality that is not covered herein to be approved by the Consultant prior to implementation. The integrated functionality of each distinctive door type on each distinctive site to be reviewed and approved prior to security system implementation. The functional requirements included herein are additional to all applicable codes and statutes. The implementation of the functional requirements is not to interfere with the required legal compliance. The functional requirements include but are not limited to:

.1 normal state condition;

.2 door Release by panic hardware;

.3 door Release by card access;

.4 door release through intrusion.

.6 Access Control Reader: The proximity readers read the encoded data from the access card and transmit the data back to the host panel, giving an audible and visual indication of a properly read access device. The reader to have a typical read range of 10-14 cm, when used with an industry standard proximity device. The reader to be a single piece unit, narrow enough to be mounted onto a 4.45 cm metal door frame or mullion. The reader to have a built in anti-passback delay of one second. The reader to be fully weatherized, and have an operating temperature of -30°C to 65°C, and an operating humidity of 5-95% noncondensing. The reader to have a lifetime warranty. The reader to communicate in a Wiegand protocol interface, and be compatible with all standard access control systems. Supply a minimum quantity of 50 programmed access cards.

.7 Access readers in non-climate-controlled areas shall be weather-proof construction. Coordinate mounting with architectural/structural provisions supplied at entrance.

.8 The system to utilize integrated wireless proximity transmitter, access control card products designed specifically for security applications. The microchips are encoded and transmit the encoded information when activated.

.9 System controllers shall be of type to suit specific applications. Mount in lockable enclosures in designated closets. Enclosures to be keyed alike to existing standards. Provide required power wiring and control wring, all in conduit.

.10 Power supplies and wiring to be provided to system manufacturer's requirements.

.11 Coordinate work with Division and trade responsible for door hardware. Coordinate work to determine Division 26 responsibility and provide necessary electrical work.

.1 Acceptable system manufacturers shall be provided by security system vendors listed in previous article - Security Intrusion System.

.12 Acceptable Supplier and Installers:

.1 The supply and installation of All security system work must be performed by ULC listed supplier/installers, who are certified and authorized manufacturers' representatives.

2.03 Security Intercom Call Station System

.1 A complete security intercom door call station system shall be provided to serve the building, where shown on the drawings.

.2 The system's primary function is to provide two-way audio and video communications between remote door stations and the master station.

.3 The system components include:

.1 Central exchange unit;

.2 Master station consoles;

.3 Weather resistant door stations;

.4 Weather resistant 110 db sirens;

.5 Power supplies, mounting hardware and ancillary devices;

.6 System wiring as per system manufacturer's requirements, run in conduit.

.4 Master Station: Desk mounted at admin area, master station to provide two way communications with door stations and emergency call stations. Unit shall be complete with the following features:

.1 Minimum 3.5" LCD colour video display;

.2 Capability to accommodate minimum 3 master stations, 40 door stations and 40 emergency call stations;

.3 Individual station call buttons;

.4 Two talk channels;

.5 Hands free, "push to talk" pushbutton and handset;

.6 Normal and priority call levels;

.7 And other standard features inherent with the system.

.5 Door Stations: Hands free audio/video door stations complete with following features and accessories:

.1 stainless steel, vandal resistant, weather resistant;

.2 ¼" colour CCD camera (with lexan lens cover);

.3 "push to talk" button and speaker to provide two way communication between door station and master station;

.4 mounted in flush wall boxes to be provided at secured door locations.

.5 Power supplies and homerun system wiring to be provided to system manufacturer's requirements.

.6 Manufactures:

.1 Aiphone.

.2 Ring Master.

.3 Stentofon.

.4 Toa.

3 Execution

3.01 Installers

.1 Acceptable security system integrators/vendors are:

.1 API Alarms;

.2 Gunnebo;

.3 Advanced 360;

.4 Diebold;

.5 ADT;

.6 Pasword Protection;

.7 Barrie Communications;

.8 New Enterprise;

.9 AC Technical Systems.

.10 Paladin Technologies

3.02 Installation of Security Intrusion Alarm System

.1 Provide specified components for security system. Locate the control unit with LCD display unit, graphic display and alarm horn, and devices in locations as shown and as required. Connect with power wiring. Provide remote keypads at locations as shown. Confirm these locations with the Consultant prior to roughing-in.

.2 Be responsible for coordinating all aspects of the system which shall be supplied.

.3 All wiring shall be installed in conduit unless otherwise noted and shall be FT6, Teflon coated. All wiring shall be tagged to provide ease of reference on the "as-built" drawings. Wire type shall be to the equipment manufacturer's specifications.

.4 All zoning designations shall be subject to the approval of the Consultant.

.5 Provide key pads in locations as shown and/or directed.

.6 Provide door alarm contacts flush in doors/frames as detailed on drawings and as coordinated with General Contractor and Consultant. Coordinate installation with trade providing doors/frames such that frames are supplied with integral boxes for mounting of contacts.

.7 Mount motion detectors where shown and as required to provide suitable coverage of the areas in accordance with manufacturer's recommendations. Secure the base plate of each detector to a finish outlet box and connect with wiring. When decorating work is complete, adjust detector sensitivity as required and snap detectors into place.

.8 Wire each detector, sensor and door alarm contact as a separate zone. Wiring shall be separate runs and not "daisy chained" to each device.

.9 Confirm exact locations of all components prior to roughing in.

.10 Provide system wiring in conduit from the security control panel to telephone equipment backboard for system monitoring via a ULC Listed Central Monitoring Station. Connect complete.

.11 Provide wiring in conduit to integrate security system with low voltage lighting control.

.12 Provide system wiring in conduit from fire alarm panel to the security control panel for connection of the fire alarm and trouble outputs.

.13 The manufacturer's authorized technician shall test and verify the system.

.14 Include costs for repairing/replacing failed devices and for re-verification of these devices.

.15 Identify on as-built drawings at least the following:

.1 locations of central equipment and devices;

.2 expansion nodes; shall be installed in accessible locations in service areas such as mechanical rooms, LAN rooms and custodian room. Nodes shall not be installed in ceiling spaces.

.16 Included as a cash allowance in Division 01 is an amount to cover the costs for Owner's designated Contractor to additionally conduct a system testing, inspection and verification upon completion of the installation. The work shall comprise of the following:

.1 to verify that equipment installed is that designated by this specification;

.2 to verify the operation of the entire system is as specified;

.3 to verify that the installation of the system is in accordance with manufacturer's instructions and in accordance with all applicable Codes of governing bodies having jurisdiction;

.4 an acceptance test in the presence of and to the satisfaction of the Consultant and Owner;

.5 providing a copy of the Inspecting Technician's report showing location of each device and certifying the test results of each device, shall be forwarded to the Consultant;

.6 upon receipt of the inspection report, the Consultant shall set a date for on-site demonstration of the system to the Owners' designated representative and the designated alarm monitoring company technician. A representative of the system supplier shall conduct a demonstration with the electrical subcontractor and shall demonstrate all pertinent operation and maintenance procedures;

.7 include all costs for testing, verification, connection to the designated ULC Central Monitoring Station, attendance of the designated alarm monitoring company technician and demonstration of the systems;

.8 the installation shall include a 1 year warranty for all material and labour effective from the date of commissioning and acceptance;

.9 a certificate or letter of verification shall be provided on completion of the installation, commissioning and acceptance and shall be posted at the Control Equipment or left with the Head Caretaker to display prominently.

3.03 Adjusting

.1 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 the systems, but prior to turn over to Owner. After successful final verification of the work, confirm and obtain approval of final nomenclature in writing from Owner and Consultant. The software revisions to incorporate final room names/area names/building names and equipment identification.

3.04 Installation of ACS

.1 Include with the provision of the system components, the provision of required conduits, boxes, jacks, wiring, etc., to provide a full operational system to specified requirements and provision of system testing, inspection and verification work. Systems power requirements shall be coordinated with security specialist contractor. The installation requirements herein this article are intended for both Electrical Contractor and the system vendor. Coordinate exact requirements with system vendor.

.2 Connect system as required, and extend to cover control or interface panels and connect to security office controller. Program the head end equipment in accordance with the manufacturer's specifications ensuring that proper installation techniques are observed. Unit to be properly programmed and field tested to ensure optimum system performance and to accommodate additional devices.

.3 Wiring shall be installed in conduit. Wiring shall be of type, gauge and quantity as recommended by the system manufacturer. Exposed or loose run cabling shall not be permitted.

.4 Install access control readers as required for doors noted. Install the readers at a height of 1200 mm (48") above floor to centre line, unless otherwise shown. Confirm exact locations with the Consultant prior to roughing-in.

.5 Provide wiring from each electric strike to the respective security panel.

.6 Provide power connections and install the power supplies for the components as required. Power supplies shall be supplied hardware supplier.

.7 Provide head end components as required for integration of additional devices. Program system to accommodate additional devices, as per Owner's direction.

.8 Wiring, controllers and power supplies to be permanently tagged (wiring at both ends) with identification properly noted and cross referenced on the "As-Built" drawings.

.9 Inputs and outputs, and wiring runs to be properly identified, recorded and cross referenced on the "As-Built" drawings.

.10 Ground and bond system to code and manufacturer's requirements.

.11 Supply ACS cards programmed in accordance with Owner's instructions and approval.

.12 Provide for the system vendor to perform programming work and to make all final connections to devices. Arrange to test system in the presence of the Consultant. Refer to Part 1 article entitled "Systems Start-up, Testing, Inspection and Verification".

.13 Testing and verification of system shall be witnessed by the Consultant at times approved by the Consultant.

3.05 Installation of Security Intercom Call Station System

.1 Provide a complete, fully operational intercom call station system. Install devices in accordance with the manufacturer's instructions and recommendations to suit specific applications.

.2 Flush wall mount recessed door stations in back boxes in locations as confirmed with Consultant. Interconnect door stations complete and to power supplies. Interconnect system with door hardware and master station. Provide required wiring in conduit.

.3 Master station shall be desk mounted at the main office. Connect complete with required wiring in conduit.

.4 Program system to suit Owner's requirements.

.5 Run system wiring in conduit. Home run call station wiring back to central equipment unit.

.6 Co-ordinate work with trades responsible for construction in which stations are mounted.

.7 After installation is complete, test, adjust and verify operation of system. Demonstrate system operation and maintenance with Owner's staff.

End of Section

1 General

1.01 Section Includes

.1 Hands-free/handset color video intercom security system. (Aiphone JP Series)

1.02 References

.1 American National Standards Institute (ANSI/TIA/EIA) 568 - Commercial Building Telecommunications Cabling Standard.

.2 International Organization for Standards (ISO) 9001:2000 - Quality Management Systems - Requirements.

1.03 System Description

.1 The JP Series shall provide a large 180 mm (7 in) touch screen monitor for clear visitor identification and easy operation control. The JP Series shall be installed at a maximum of 4 door locations and connected to a maximum of 8 inside locations with internal communication between stations. Connection to and integration of CCTV cameras for surveillance capabilities shall be available.

.1 The system shall be hard wired and constructed with a 2-wire communication system for the door stations and a Cat5e/6 communication system for the video locations system.

.2 Hearing Assistance: Provide T-Coil connection for hearing aids.

.2 Functional Components: As indicated on the drawings or as required to complete system.

.1 Master Station.

.1 JP-4MED: Hands-free/Handset color video intercom master station.

.2 Sub Master Station:

.1 JP-4HD: Hands-free/Handset color video intercom sub master station.

.3 Video Door Station:

.1 JP-DA: Pan, Tilt & Zoom video door station, surface mount.

.2 JP-DV: Pan, Tilt & Zoom vandal-resistant video door station, surface mount.

.3 JP-DVF: Pan, Tilt & Zoom vandal-resistant video door station, flush mount.

.4 Door Station:

.1 GT-D: Audio only door station.

.5 Long Distance/CCTV Adaptor:

.1 JPW-BA: Long distance/CCTV adaptor.

.6 Distribution Adaptor:

.1 JP-8Z: Distribution adaptor.

.7 Power Supply:

.1 PS-2420UL: 24V DC Power supply.

.8 Call Extension Speaker:

.1 IER-2: Call extension speaker.

.9 External Devices:

.1 RY-3DL: Multiple door release adaptor.

.2 AC-10S: Access control keypad, surface mount.

.3 JP-DV + AC-10S: Pan, Tilt & Zoom vandal-resistant video door station. Surface mounted with access control keypad.

.3 System Design: Unless noted otherwise on drawings provide system layout as follows. Three wiring methods are possible; Station-to-Station, Centralized Wiring, or Combined Wiring, where both methods are employed in the same system.

.1 Provide Station-to-Station Wiring: Directly connect a master station to a sub master station.

.1 Maximum distance of farthest sub master from master station: 300 m (980 feet), cumulative.

.2 Maximum distance between sub master stations in station-to-station wiring: 98 feet (30 m) when 3 stations are powered off 1 power supply, or 165 feet (50 m) when 2 stations powered off of 1 power supply.

.2 Provide Centralized Wiring: Connect master stations, and sub master stations to a central wiring adaptor.

.1 Maximum distance of farthest sub master from distribution adapter (JP-8Z): 165 feet (50 m).

.2 Maximum distance of master from distribution adapter (JP-8Z): 650 feet (200 m).

.3 Maximum cumulative distance of master and sub masters from distribution adapter (JP-8Z): 980 feet (300m).

.3 Provide Combined Wiring: Connect a system using both station-to-station and centralized wiring to meet the requirements of the project.

.1 Maximum distance between sub master stations in station-to-station wiring: 98 feet (30 m) when 3 stations are powered off 1 power supply, or 165 feet (50 m) when 2 stations powered off of 1 power supply.

.2 Maximum distance of sub masters from distribution adapter (JP-8Z): 165 feet (50 m).

.4 Provide Expanded Performance:

.1 The wiring distance between the door and master stations by using the JPW-BA adaptor shall be a maximum distance of 980 feet (300 m).

.2 Connect CCTV and Audio Door Station: Provide security camera connection using the JPW-BA adaptor. Provide for two way communication as indicated or scheduled with a GT-D audio device.

.3 Alarm Inputs: The master station and all sub master stations shall send out an alarm notification when the sensor is triggered. Provide door/window contacts, water sensors, and PERS devices as indicated or scheduled.

1.04 Submittals

.1 Submit under provisions of Section 01 33 00.

.2 Product Data: Manufacturer's data sheets on each product to be used, including:

.1 Preparation instructions and recommendations.

.2 Storage and handling requirements and recommendations.

.3 Installation methods.

.3 Shop Drawings: Submit the following:

.1 Wiring Diagrams: Indicate wiring for each item of equipment and interconnections between items of equipment.

.2 Include manufacturer's names, model numbers, ratings, power requirements, equipment layout, device arrangement, complete wiring point-to-point diagrams, and conduit layouts.

.4 Installation and Operation Manuals:

.1 Submit manufacturer's installation and operation manual, including operation instructions and component wiring diagrams.

.2 Provide detailed information required for Owner to properly operate equipment.

.5 Warranty: Submit manufacturer's standard warranty.

.6 Selection Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns.

.7 Verification Samples: For each finish product specified, two samples, minimum size 6 inches (150 mm) square, representing actual product, color, and patterns.

1.05 Quality Assurance

.1 Manufacturer Qualifications: ISO 9001:2008 certified company.

.2 Installer Qualifications: Factory trained and experienced with system installations of scope and size required for the Project.

.3 Mock-Up: Provide a mock-up for evaluation of surface preparation techniques and application workmanship.

.1 Finish areas designated by Architect.

.2 Do not proceed with remaining work until workmanship is approved by Architect.

.3 Refinish mock-up area as required to produce acceptable work.

1.06 Delivery, Storage, and Handling

.1 Delivery: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.

.2 Storage: Store materials in clean, dry area indoors in accordance with manufacturer's instructions.

.3 Handling: Protect materials during handling and installation to prevent damage.

1.07 Project Conditions

.1 Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

2 Products

2.01 Manufacturers

.1 Acceptable Manufacturer: Aiphone Corp., which is located at: 6670 185th Ave. NE; Redmond, WA 98052 ; Toll Free Tel: 800-692-0200; Tel: 425-455-0510; Fax: 425-455-0071; Email: request info (marketing@aiphone.com); Web:www.aiphone.com

.2 Requests for substitutions will be considered in accordance with provisions of Section 01 60 00.

2.02 Hands-Free/Handset Colour Video Intercom System

.1 Color Video Intercom System: JP Series Intercom System as manufactured by Aiphone Corporation.

.2 Room Master Station: JP-4MED 7 inches (180 mm) Digital PTZ Video Master Station with Memory.

.1 The JP Series shall accommodate up to 4 Door Stations and 8 Master Stations in a single system.

.2 Provide icon driven One Touch Hands Free operation. Touch the screen to communicate with visitors using the built-in microphone and speaker or use the handset at any time during conversation for privacy.

.3 Operation: From Master Station. Provide the following.

.1 Room Call: Touch screen icon to call a single sub master station or all sub master stations simultaneously.

.2 Play: Touch screen icon to play recorded images from door stations.

.3 Settings: Touch screen icon to program settings and adjustments.

.4 Security: Touch screen icon to activate the security mode or to change security settings.

.5 Monitor: Touch screen icon to monitor a door station or sub master station.

.6 Option: Touch screen icon to activate the connected external device(s).

.4 Available Functions During Monitoring: Provide the following.

.1 Pan-Tilt-Zoom/Wide camera control.

.2 When monitoring is started, an image shall be shown in wide mode. Pan & Tilt and adjusting images shall be possible from the Master Station.

.3 Door release shall be possible from the Master Station.

.4 Volume control shall be possible from the Master Station.

.5 Manual recording shall be possible from the Master Station.

.6 If a CCTV camera is connected instead of a video door station at entrance, provide audio monitoring and communication via the GT-D.

.5 Physical Characteristics:

.1 Power supply: DC 24V (from power supply).

.2 Current Consumption: 390 mA.

.3 Communication: Handset - Simultaneous communication.

.4 Communication: Hands-free - Auto-voice actuation.

.5 Ambient Temperature 32 degree F to 104 degree F (0 to 40 degrees C).

.6 Monitor: 7 inches (180 mm) color LCD monitor.

.7 Mounting: Wall mount.

.8 Electrical box: 3-gang box

.9 Material: Flame resistant ABS resin.

.10 Color: White.

.11 Dimensions: 5-11/16 inches H x 10-1/16 inches W x 1-7/8 inches D (145 mm by 255 mm by 48 mm).

.12 Weight: Approx. 1.74 lbs (790 g).

.3 Room Station (Sub Master Station): JP-4HD.

.1 Provide icon driven One Touch Hands Free operation. Touch the screen to communicate using the built-in microphone and speaker or use the handset at any time during conversation for privacy.

.2 Physical Characteristics:

.1 Power supply: DC 24V (from power supply).

.2 Current Consumption: 200 mA.

.3 Communication: Handset - Simultaneous communication.

.4 Communication: Hands-free - Auto-voice actuation.

.5 Ambient Temperature: 32 degree F to 104 degrees F (0 to 40 degrees C).

.6 Monitor: 7 inch color LCD monitor.

.7 Electrical box: 3-gang box.

.8 Material: Flame resistant ABS resin.

.9 Color: White.

.10 Dimensions: 5-11/16 inches H x 10-1/16 inches W x 1-7/8 inches D (145 mm by 255 mm by 48 mm).

.11 Weight: Approx. 1.74 lbs (790 g).

.3 The JP-4MED shall automatically record images. Recording starts approximately 2 seconds after receiving a call.

.4 170 degree wide angle and 100 degree vertical angle camera to minimize blind spots, ensuring a clear view of the door station area.

.5 Zoom for Clarity/ Pan, Tilt for Control:

.1 Video door stations feature a wide angle camera to observe more activity behind the door. In addition, digital Pan, Tilt and Zoom can focus on an area for greater detail.

.2 Oversized buttons and intuitive icons allow for quick navigation and control. Conventional push buttons shall not be permitted.

.3 Equipped with an advanced light adjustment feature to compensate for varying light levels. If a picture is too dark, increase of the brightness level at the door station shall be controlled at the master station.

.6 Record Images of Visitors:

.1 After a call is placed, the JP Series records 6 images per call to internal memory.

.2 Provide an SD / SDHC card (not included) as the primary storage location, with which recording frequency increases to 4 pictures per second for up to 10 seconds per call.

.3 Provide documentation of outside disturbances by manually recording them at any time.

.7 Physical Characteristics:

.1 Operating Temperature: 14 degrees F to 140 degrees F (-10 to 60 degrees C).

.2 Dimensions:

.1 JP-DA 5-1/8 inches x 3-7/8 inches x 1-9/16 inches (131 x 99 x 40 mm).

.2 JP-DV 6-13/16 inches x 3-7/8 inches x 1 inch (173 x 98 x 25 mm).

.3 JP-DVF 8-1/4 inches x 5-5/16 inches x 7/32 inch (209 x 135 x 5.5 mm).

.4 JP-DVF back box 7-3/32 inches x 4-3/8 inches x 1-25/32 inches (180 x 110 x 45 mm)

.3 Power Supply: DC 24V (from master station).

.4 Current Consumption: 90 mA.

.5 Mounting:

.1 JP-DA: Surface mount to 2x4 electrical box.

.2 JP-DV: Surface mount direct to surface.

.3 JP-DVF: Flush mount with included back box.

.6 Weight:

.1 JP-DA: 0.46 lbs (210g).

.2 JP-DV: 1.3 lbs (550g).

.3 JP-DVF: 1.2 lbs (550g).

.4 Back Box: 0.95 lbs (430g).

.4 Power Supply: PS-2420UL, 24V DC Power supply.

.5 Call Extension Speaker: IER-2, Call extension speaker

.6 External Devices:

.1 RY-3DL: Multiple (3) door release adaptor.

.2 AC-10S: Access control keypad, surface mount.

.3 JP-DV+ AC-10S: Pan, Tilt & Zoom vandal-resistant video door station. Surface mounted with access control keypad.

.7 Long Distance Adaptor: JPW-BA.

.1 Power Supply: DC 24V (from power supply)

.2 Current Consumption: 90 mA

.3 Operating Temperature: 32 degree F to 104 degrees F (0 to 40 degrees C).

.4 Mounting: Wall-mount

.5 Weight: Approx. 7 oz (200 g).

.8 Distribution Adaptor: JP-8Z.

.1 Power Supply: DC 24V (from power supply)

.2 Current Consumption: 90 mA

.3 Operating Temperature: 32 degree F to 104 degrees F (0 to 40 degrees C).

.4 Mounting: Wall-mount.

.5 Weight: Approx. 7.5 oz (210 g).

3 Execution

3.01 Examination

.1 Examine areas to receive integrated security and communication system.

.2 Notify Architect of conditions that would adversely affect installation or subsequent use.

.3 Do not begin installation until unacceptable conditions are corrected.

3.02 Preparation

.1 Verify the following compliance before starting installation.

.1 All units, except for the entrance station and tenant door station, are designed for indoor use only. Do not use outdoors.

.2 The unit turns inoperative during power failure.

.3 In areas where broadcasting station antennas are close by, intercom system may be affected by radio frequency interference.

.4 Keep the intercom wires at least 1 foot (30 cm) away from strong electrical wiring (AC 100-240 V) including, in particular, wiring for inverter electrical appliances. Noise and malfunction could result.

.5 Keep the unit more than 3.3 feet (1 m) away from radio or TV set.

.6 If a strong light shines on the main unit screen, the picture may turn white or only silhouettes will be visible.

.7 Other manufacturer's devices (such as sensor, detectors, door releases) used with this system, comply with the manufacturer's installation requirements.

.8 The LCD panel is manufactured with very high precision techniques, inevitably will have a very small portion of its picture elements always lit or not lit at all. This is not considered a unit malfunction. Please be aware of this in advance.

3.03 Installation

.1 Install integrated security and communication system in accordance with manufacturer's instructions at locations indicated on the Drawings.

.2 Mount equipment plumb, level, square, and secure. For video entrance stations and video door stations, comply with manufacturer's design requirements to provide optimum picture quality of station monitoring.

3.04 Setup and Adjusting

.1 Adjust integrated security and communication system for proper operation in accordance with manufacturer's instructions.

3.05 Demonstration and Training

.1 Demonstration:

.1 Demonstrate that integrated security and communication system functions properly.

.2 Perform demonstration at final system inspection by qualified representative of manufacturer.

.2 Instruction and Training:

.1 Provide instruction and training of Owner's personnel as required for operation of integrated security and communication system.

.2 Provide hands-on demonstration of operation of system components and complete system, including user-level program changes and functions.

.3 Provide instruction and training by qualified representative of manufacturer.

3.06 Protection

.1 Protect installed integrated security and communication system from damage during construction.

End of Section

1 General

1.01 Section Includes

.1 Single stage addressable fire alarm systems.

.2 System testing and verification.

.3 Work to be done under this Section shall include furnishing of labour, materials, and equipment required for installation, testing, and putting into proper operation a complete Fire Alarm System as shown, as specified, and as otherwise required. Complete system shall be left ready for continuous and efficient satisfactory operation.

1.02 Related Requirements

.1 Section 08 70 00 – Finish Hardware: additional requirements for access control devices, magnetic door holders, etc.

.2 Section 21 13 00 – Fire-Suppression Sprinkler Systems.

.3 Section 26 05 00 – Common Work Results for Electrical.

.4 Section 26 05 83.14 – Wiring Connections for Elevators.

1.03 Unit Prices

.1 Refer to Document 00 43 00.26.

.2 Submit with Tender unit prices to provide the following. Include installation and verification in the unit price:

.1 Section 28 46 31:

.1 Fire detector (heat detector or smoke detector) complete with wiring and conduit, based on 10 metre distance.

.2 Duct type smoke detector complete with wiring and conduit on a separate zone, based on 30 metre distance.

.2 Section 28 46 31.31:

.1 Manual pull station, complete with wiring and conduit based on 10 metre distance.

.3 Section 28 46 31.41:

.1 Zone Addressable Module (ZAM).

.4 Section 28 46 41:

.1 Fire alarm horn complete with wiring and conduit, based on 10 metre distance.

.2 Combination Fire alarm horn/strobe complete with wiring and conduit, based on 10 metre distance.

.5 Unit cost of additional conduit and wire for the above items.

.6 Wire guard for any fire alarm device.

1.04 References

.1 Definitions

.1 FACP: Fire Alarm Control Panel. This is the central component of a fire alarm/detection/communication system and consists of a control panel(s) and contains the system power supply, system CPU, circuit terminations, and system annunciation functions.

.2 INITIATION DEVICE: Examples are smoke detectors, heat detectors, water flow switches, valve tamper switches, and manual pull stations. These are devices which initiate a signal and send it to the FACP telling it that an abnormal event has taken place. Data Centre extinguishing systems, kitchen hood extinguishing systems, and other special extinguishing system control panels are additional examples of initiating devices.

.3 NOTIFICATION DEVICE: Examples are alarm horns, alarm speakers, and strobe lights. These devices are used to indicate through visual and audible means the existence of an abnormal event throughout all areas of the protected premises.

.4 CONTROL DEVICE: Examples are electronic relays or solenoids. These devices allow the FACP to automatically take certain actions during an abnormal event. For example, the FACP may energize a relay which, in turn, shuts down an air handling unit.

.5 CENTRAL PROCESSING UNIT (CPU): The central computer of a multiplex fire alarm system.

.6 CONCEALED: Where used in connection with installation of piping or conduit and accessories shall mean "hidden from sight" as in shafts, furred spaces, soffits or above suspended ceilings.

.7 EXPOSED: Where used in connection with installation of piping or conduit and accessories shall mean "visible" or "not concealed."

.8 AHJ: Authority Having Jurisdiction.

.9 LISTED: Materials or equipment included in a list published by a nationally recognized laboratory that maintains periodic inspection of production of listed equipment and materials, and whose listing states either that the equipment or material meets nationally recognized standards or has been tested and found suitable for use in a specified manner.

.10 NFPA: National Fire Protection Association.

.11 CLASS A: Applies to wiring from transponder to central processing unit. The CPU will detect circuit trouble and transponder will retain the ability to transit alarm upon a single fault condition.

.12 CLASS B: Applies to wiring from initiating device to transponder. A trouble signal will be transmitted to the panel upon a single fault condition.

.13 TRANSPONDER: Single or multiple zone/point data collection panel used within a multiplex system.

.14 UL, and ULC: Underwriters Laboratories, Inc., and Underwriters Laboratories of Canada, Inc.

.15 ULC Listed: Materials or equipment listed by Underwriters Laboratories of Canada and included in the most recent edition of the UL and ULC Fire Protection Equipment Directory.

.16 AHU: Air Handling Unit.

.17 FM: Factory Mutual Research Corporation/Factory Mutual Engineering Association.

.2 Reference Standards

.1 The publications listed below form a part of this specification. The publications are referenced in text by the basic designation only. The equipment and installation shall comply with the latest edition/amendment referenced code, standard, or publication.

.1 Canadian Standards Association

.1 CSA C22.1-18, Canadian Electrical Code, Part 1 (24th edition), Safety Standard for Electrical Installations.

.2 Ontario Electrical Safety Code (OESC), 27th Edition, 2018.

.3 CSA C22.2 No. 208-14 - Fire Alarm and Signal Cable.

.2 Ontario Regulations

.1 2012 Ontario Building Code.

.2 2007 Ontario Fire Code.

.3 Underwriters Laboratories of Canada Standards

.1 CAN/ULC-S524-14 – Standard for Installation of Fire Alarm Systems.

.2 CAN/ULC-S525 – Audible Signal Appliances for Fire Alarm Systems.

.3 CAN/ULC-S526 – Visual Signal Appliances for Fire Alarm Systems.

.4 CAN/ULC-S527 – Control Units for Fire Alarm Systems.

.5 CAN/ULC-S528 – Manual Pull Stations for Fire Alarm Systems.

.6 CAN/ULC-S529 – Smoke Detectors for Fire Alarm Systems.

.7 CAN/ULC-S530 – Heat Detectors for Fire Alarm Systems.

.8 CAN/ULC-S533 – Egress Door Securing and Releasing Devices.

.9 CAN/ULC-S536 – Inspection and Testing of Fire Alarm Systems.

.10 CAN/ULC-S537 – Verification of Fire Alarm Systems.

.11 CAN/ULC-S548 – Alarm Initiating and Supervisory Devices for Water Type Extinguishing Systems.

.12 CAN/ULC-S561-13 – Standard for Installation and Services for Fire Signal Receiving Centres and Systems.

.13 CAN/ULC-S1001-11 (R2018) - Integrated Systems Testing of Fire Protection and Life Safety Systems.

.4 All requirements of the Authority Having Jurisdiction (AHJ).

.2 In the case of any discrepancy between these specifications, the project drawings, and any applicable local codes, the installed Fire Alarm / Life Safety System shall comply with the most stringent requirement.

1.05 Action Submittals

.1 In accordance with Section 01 33 00.

.2 Product Data: Provide electrical characteristics and connection requirements.

.3 Submit drawings to municipal Fire Department if required, showing annunciation devices, manual pull stations, complete wiring diagrams and annunciator details and obtain their approval.

.4 Shop Drawings:

.1 Sufficient information, clearly presented, shall be included to determine compliance with drawings and specifications.

.2 Include manufacturer's name(s), model numbers, ratings, power requirements, equipment layout, and device arrangement, and clearly showing ULC certification of all components.

.3 Show annunciator layout and main control panel module layout, configurations and terminations.

.4 Floor plan layouts showing all devices.

.5 Complete riser diagram, and auxiliary functions.

.6 The supplier of the system shall prepare a complete zoning schedule and artwork layout for passive graphic to be included with submittal package.

.7 Sequence of Operation narrative and zone chart.

1.06 Informational Submittals

.1 Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of products.

1.07 Closeout Submittals

.1 Maintenance Contracts

.1 Provide service and maintenance of fire alarm system for one year from Date of Substantial Completion.

.2 Operation and Maintenance Data

.1 Operation Data: Operating instructions.

.2 Maintenance Data: Maintenance and repair procedures.

.3 Record Documentation

.1 Record actual locations of initiating devices, signaling appliances, and end-of-line devices.

.2 Electrical Safety Authority (ESA) inspection certificate.

.3 Fire alarm verification report.

.4 Audibility test.

.4 Manuals

.1 Submit complete operating and maintenance manuals listing the manufacturer's name(s) including technical data sheets (with model numbers to be used indicated).

.2 Wiring diagrams shall indicate terminals and the interconnections between the items of equipment.

.3 Provide a clear and concise description of operation which gives, in detail, the information required to properly operate the equipment.

1.08 Spare Parts

.1 Supply the following additional equipment as spare parts in a proper metal enclosure sized to accept the equipment as listed herein. Label the enclosure fire alarm spare parts. Enclosure shall be placed in the same room as the FACP.

.1 Supply six keys of each type.

.2 Other spare parts as noted in other sections related to the fire alarm system.

1.09 Quality Assurance

.1 Manufacturer shall examine drawings and specifications prior to award of contract to ensure that detectors, control panels and miscellaneous devices being supplied will provide a satisfactory working installation.

.2 Each and all items of the fire alarm system shall be listed as the products of a single manufacturer under the appropriate category by Underwriters Laboratories of Canada and shall bear the "ULC" label.

.3 The fire alarm control, panel shall meet the modular listing requirements of ULC. Each subassembly of the FACP, including all printed circuit boards, shall include the appropriate ULC modular label.

.4 Each and all items of the fire alarm system shall be covered by a one-year parts and labour warranty covering defects resulting from faulty workmanship and materials. The warranty shall be deemed to begin on the date the system is accepted by the Project Manager on issuance of the substantial performance certificate for the project.

.5 Regulatory Requirements

.1 Provide products listed and classified by ULC as suitable for purpose specified and indicated.

.6 Qualifications of Manufacturer

.1 Equipment and materials shall be provided by an experienced reputable manufacturer to ensure proper specification adherence, final connection, test, turnover, warranty compliance, and service.

.2 The manufacturer is required to have been in the fire alarm industry (service and installation) for a minimum of ten years.

.3 The manufacturer shall have in-house engineering and project management capability consistent with the requirements of this project. Qualified and approved representatives of the system manufacturer shall perform the detailed engineering design of central and remote control equipment.

.4 International Standards Organization. The system and all components will be manufactured to ISO 9001 international Quality Management and Quality Assurance Standards.

.5 Manufacturer must have service facilities within a 50 km radius of the installation location.

.7 Qualifications of Installers

.1 All work performed to comply with this specification shall be carried out by and/or managed by a competent firm regularly engaged in the installation and testing of fire alarm systems for commercial buildings. Equipment manufacturer shall also be competent firms which are regularly

engaged in the design, installation, testing, and servicing of fire alarm systems for this type of building.

.2 Review of cut-sheets, shop drawings, calculations and other materials submitted by the contractor shall not relieve the contractor's responsibility for full compliance with the design drawings and specification unless written approval is requested by the contractor and obtained from the Consultant for each non-complying feature. Finalized agreements for all equipment deviations from the drawings and specification shall be completed prior to award of the installation contract.

.3 For those instances where the contractor cannot conform to the drawings and specification, a proposed variance shall be submitted in writing to the Consultant at least five working days prior to the bidding date. The Consultant will respond to all proposed variances within two working days of receipt.

.4 All questions concerning interpretation of the design drawings and specification shall be submitted to the Consultant in writing no later than three working days prior to the bidding date. Requests for interpretations received after this date will not be answered. The Consultant will respond to all requests for interpretations in writing and will provide a summary of each request and the response to all bidding contractors. The Consultant will respond to all requests for interpretations within two working days of receipt.

.5 The contractor shall utilize the services of a fire alarm equipment distributor who is a factory authorized representative and a full line stocking distributor of the equipment manufacturer and shall maintain a constant inventory of the parts typical of those used in the system installation covered under this specification.

.6 The contractor and the fire alarm equipment manufacturer or distributor shall each have a minimum of 7 years of continuous experience in the design and/or installation of fire alarm systems and shall have completed a minimum of five projects of similar scope and complexity which were completed using addressable/analog systems. It is intended that these projects incorporated the same equipment, manufacturer and model number, as is being proposed for this project. To verify the qualifications, the contractor and the fire alarm equipment distributor shall submit a brief design narrative which covers at least five fire alarm systems selected for references. This narrative shall indicate the project location, approximate contract value, system size by device counts, and a functional overview. These narratives shall provide an end-user contact name and telephone number for each referenced system. Where a fire alarm equipment distributor is a branch office of a fire alarm manufacturer, the references shall be chosen from projects in which the branch office completed both the design implementation and the installation.

.7 The Owner reserves the right to request documentation from the contractor with respect to any pending litigation against the contractor or any subcontractor. Further, the Owner reserves the right to review an audited financial statement of the contractor or any subcontractor for the most recently completed fiscal year.

.8 The Owner reserves the right to disqualify any contractor who does not comply with all requirements of the Contractor Performance Standard of this specification.

.9 Installer must be certified by the Province of Ontario as a fire alarm installer.

1.10 Delivery, Storage, and Handling

.1 In accordance with Section 01 60 00.

1.11 Warranty

.1 All work performed and all material and equipment furnished under this contract shall be free from defects and shall remain so for a period of at least one year from the date of Substantial Performance.

2 Products

2.01 Manufacturers

.1 All references to manufacturer's model numbers and other pertinent information herein is intended to establish minimum standards of performance, function and quality.

.2 Manufacturer List (TCDSB standard):

.1 Mircom; FX-2000 series.

.2 SimplexGrinnell by Tyco Integrated Fire & Security; 4100ES series.

.3 All equipment and components shall be the manufacturer's current model.

.4 The materials, appliances, equipment and devices shall be tested and listed by a nationally recognized approvals agency for use as part of a protected premises protective signaling (fire alarm) system.

.5 The authorized representative of the manufacturer of the major equipment, such as control panels, shall be responsible for the satisfactory installation of the complete system.

.6 The contractor shall provide, from the acceptable manufacturer's current product lines, equipment and components, which comply, with the requirements of these specifications.

.7 Manufacturer is to support a 20 year product.

2.02 Conduit and Wire for Fire Alarm System

.1 Conduit:

.1 In accordance with Section 26 05 33.13.

.2 Conduit shall be in accordance with the Electrical Safety Authority (ESA), local and provincial requirements.

.3 All wiring shall be installed in conduit or raceway.

.2 Terminal Boxes, Junction Boxes and Cabinets:

.1 All boxes and cabinets shall be listed for their purpose and use.

.3 Fire Alarm Cable

.1 To Section 27 15 01.19.

2.03 Addressable Fire Alarm System

.1 The system to be electrically supervised, non-coded, annunciated, single-stage, addressable fire alarm system using addressable devices.

.2 The Central Processing Unit (CPU) uses multiplex communication techniques to receive data from and transmit data to transponders remotely located throughout facility to minimize wiring costs, simplify design, to allow economical expansion and easy retrofit.

.3 Make provisions during detailed design for future expansion of the system.

.4 System to be complete with a minimum of three data loops per node.

.5 The CPU is microprocessor-based to increase system reliability, speed response to alarm conditions, and reduce cost. CPU response time to alarm conditions to be no more than four seconds, regardless of system size.

.6 Fire alarm system will be zoned as required plus 25 per cent spares.

.7 Basic Performance:

.1 Alarm signals arriving at the main FACP shall not be lost following a power failure (or outage) until the alarm signal is processed and recorded.

.2 Provided with an emergency power supply, i.e. batteries capable of providing supervisory power for not less than 24 hours, and immediately following, emergency power under full load for not less than two hours.

2.04 Fire Alarm Annunciator Panel (FAAP) and Graphic

.1 To Section 28 46 21.22.

2.05 ULC Monitoring Transmitter

.1 To Section 28 46 21.24.

2.06 Fire Alarm System Accessories

.1 To Section 28 46 25.

2.07 Fire Alarm Initiation Devices

.1 Automatic Initiating Devices to Section 28 46 31.

.2 Manual Pull Stations to Section 28 46 31 31.

.3 Supervisory Signal devices and Sprinkler Flow Switch alarms to Section 28 46 31.41.

2.08 Fire-Alarm Supervised Interface Hardware

.1 Door Hardware Fire Alarm Integration to Section 28 46 51.08.

.2 Elevator Interface to Section 28 46 51.14.

.3 HVAC Integration to Section 28 46 51.23.

2.09 Signalling Devices

.1 Horns and visual signal devices (strobes) to Section 28 46 41.

.1 Strobe Frequency: maximum 5 Hz.

.2 Programmable Electronic Sounders:

.1 Shall be flush mounted as required.

.3 Audible/Visual Combination Devices:

.1 Shall meet the applicable requirements listed above for audibility.

.2 Shall have a built in strobe, 75 candela.

.4 Strobe Synchronizing Modules:

.1 Synchronize strobes at 1 Hz and horns at temporal over single wire pan.

2.10 Operation Sequence

.1 To Section 28 46 15.

3 Execution

3.01 InStallers

.1 Use the following supplier for Verification of System (TCDSB standard approved for east Toronto schools). No substitution:
Mircom Engineered Systems
25 Interchange Way, Vaughan, ON L4K 3W3
Gustavo Osorio
gosorio@mircomgroup.com

3.02 Installation

.1 The entire system shall be installed in accordance with the edition of CAN/ULC-S524 as adopted by the applicable legislation, and the manufacturer's manuals and wiring diagrams.

.2 The contractor shall furnish all labour, conduit, wiring, outlet boxes, junction boxes, cabinets and similar devices necessary for a complete, functional life safety fire alarm system.

.3 Provide all necessary power supply, interconnecting and remote signal wire in dedicated conduit throughout and installed in accordance with the manufacturer's wiring diagrams and the requirements of the Canadian Electrical Code and the Inspection Authority.

.4 All penetration of floor slabs and fire walls shall be fire stopped in accordance with all local fire codes.

.5 Power supply:

.1 Connect fire alarm system power supply to a dedicated circuit.

.2 Circuit breaker(s) feeding fire alarm system to be coloured red, clearly labelled, and be locked in the ON position.

.6 Wiring:

.1 Install all wiring in metal raceways.

.2 Provide wiring suitable for fire alarm circuits.

.1 Class "A" wiring for initiating circuits.

.2 Class "A" wiring for signalling circuits unless noted otherwise.

.3 Provide fire rated cables for fire alarm circuits as required by applicable codes and standards.

.4 Provide separate signalling circuits for audible and visual devices.

.5 End-of-line resistors shall be furnished as required for mounting as directed by the manufacturer on Class B circuits.

.1 Install EOL resistors maximum 1800 mm above finished floor in interior spaces.

.7 Install manual pull stations at 1200 mm above finished floor.

.8 Install factory wire guards in gymnasium on pull stations, fire detectors, strobes and fire alarm horns.

.9 Identification

.1 Provide lamacoid label (white text on red background) for all supporting field devices indicating function of the device.

3.03 Field Quality Control

.1 The installing contractor shall provide a qualified project superintendent for the overall management and supervision of the work.

.2 The project superintendent shall assure that adequate supervision is provided during all periods of installation of the fire alarm system. The project superintendent and all job site supervisors shall have a minimum of five years of continuous experience in the installation of fire alarm systems of similar scope and complexity.

.3 Upon completion of the installation, the installing contractor shall test all alarm initiating devices, supervisory devices, control devices and notification devices for proper response and effectiveness. Operation of all annunciating devices including the FACP, printer and remote LCD panel shall be verified. Testing shall include thorough sound level measurements of audible notification devices. These tests shall be fully documented. All testing up to the point of conducting the final acceptance tests shall be recorded using a temporary printer. The permanent printer of the system, where such has been provided, shall not be installed prior to the final acceptance tests.

.4 All smoke detectors shall be suitably protected against contamination up to the time of the final acceptance tests.

.5 An itemized test report in accordance with CAN/ULC-S524, CAN/ULC-S536, and CAN/ULC-S537 shall be submitted to the Consultant. This report shall provide complete details of the testing completed for all devices as well as circuit testing parameters. Data shall be submitted indicating the sensitivity level of all system smoke detectors.

.6 Following completion of a 100 per cent system functional test, the contractor shall perform a thorough acceptance test of the system at the direction of and to the satisfaction of the Owner and Consultant. This test shall not be carried out until at least 15 days after completion of all contractor's testing, modification and repairs following the original contractor's functional test and submittal of the functional testing documentation to the Consultant. The 15 day interval is also intended to be a system "burn-in" period. Any false activations of the system which occur within the burn-in period which are determined to be the result of a system fault shall result in the restart of the 15 day period.

.7 In the event that the acceptance test of the system results in the need for system repair or modification, the contractor shall demonstrate the operability of the system to the full satisfaction of the Owner and Consultant following the completion of repairs or modification.

.8 In the event that the AHJ requires a separate demonstration of the operability of the system for acceptance purposes, these additional tests shall be carried out by the Contractor without expense to the Owner.

.9 The contractor shall conduct an independent quality assurance review of all developed "record" drawings to assure accuracy and completeness of these drawings. Any discrepancies shall be brought to the attention of the Consultant prior to construction start.

.10 Only directly prior to verification, remove smoke detector protectors, and clean smoke detectors thoroughly.

.11 Inspect and check each individual device in entire system for proper connection, supervision and function in accordance with CAN/ULC-S537. Identify detectors, manual pull stations and signal appliances not installed within requirements of CAN/ULC-S524 in remarks column of verification report.

.12 Obtain verification certificate and verification report from manufacturer showing each device checked, and that work has been carried out. Utilize standard verification forms similar to Canadian Fire Alarm Association (CFAA) forms.

3.04 Adjusting

.1 Contractor to verify programming of room names prior to fire alarm system programming, and allow for a revision to the fire alarm system programming should the Owner or AHJ wish to revise the room names.

3.05 Monitoring

.1 Fire alarm control panel to be located as indicated. Coordinate third party CUL Listed monitoring with Owner.

3.06 Manufacturer Services

.1 At the final inspection a factory trained representative of the manufacturer of the major equipment shall demonstrate that the systems function properly in every respect.

.2 The manufacturer's representative shall make an inspection of the fire alarm equipment, including those components necessary to the direct operation of the system such as manual stations, thermal and smoke actuated detectors and controls, whether or not manufactured by the manufacturer. The inspection shall comprise an examination and test of such equipment for the following:

.1 That the type of equipment installed is that designated by the specifications.

.2 That the wiring connections to all equipment components show that the installer undertook to have observed ULC requirements. That all products of combustion (smoke) detectors have been properly calibrated and adjustments set correctly.

.3 That the representative's equipment has been installed in accordance with the manufacturer's recommendations.

.4 That the supervisory wiring of all devices connected to a supervised circuit is operating and that the wiring, having been met to the satisfaction of the inspecting officials.

.3 Testing to be done in the presence of the local building inspector, and the local fire inspector.

.4 The manufacturer(s) of the fire alarm shall make a complete inspection of all components installed for system(s), such as manual stations, horns, and annunciators and sprinkler and standpipe valves and smoke detectors to ensure the following:

.1 That the system is complete in accordance with Specifications.

.2 That the system is connected according to ULC requirements.

.3 That the system is connected in accordance with the manufacturer's recommendations.

.4 That the regulations concerning the supervision of components have been adhered to (e.g. stations, detectors, supervised valves, bells), and are properly wired and supervised.

.5 That all valves are properly connected and displayed correctly on each annunciator.

.6 That any subsequent changes necessary to conform to the above will be carried out with technical advice supplied by the Manufacturer.

.7 That all thermal detectors, smoke detectors and manual pull stations have been operated and are in good working order.

.8 That all sprinkler system and standpipe system valves have been operated and are in good working order.

.9 That all annunciators correctly pin-pint the origin of any fire alarm.

.10 That actual smoke concentration of sufficient density, have been applied to each smoke detector to cause the detector to be set off and that the sensitivity of each smoke detector has been set.

.11 That all devices are in good working order. Include for replacing any defective/damaged devices at no extra cost to Owner.

.12 That signal audibility is acceptable in all areas. Submit audibility readings for every Room.

3.07 Site Tests and Inspections

.1 Provide the service of a competent, factory-trained engineer or technician authorized by the manufacturer of the fire alarm equipment to technically supervise and participate during all of the adjustments and tests for the system.

.2 All initial testing shall be in accordance with the latest issue of ULC-S537 Verification of Fire Alarm Systems standard.

.3 A representative of the electrical contractor shall be present to participate and assist the manufacturer representative during the course of the verification. The electrical contractor shall make good any deficiencies discovered during the verification. Verify all devices. The electrical contractor shall provide one person for assistance with the verification.

.4 The verification report shall be submitted for approval to the Consultant.

.1 Ensure verification report uses room numbers and space descriptions that are consistent with the drawings.

.5 On completion of the inspection the manufacturer shall supply a certificate, together with detailed inspection record sheets showing location of each device and certifying the test results per unit, confirming that the system is installed, supervised and operate in accordance with Article "System Verification".

.6 Audibility Test:

.1 Provide audibility test of signalling devices after other systems have been commissioned to verify operation at ambient sound levels.

.2 Provide audibility test report to the Consultant.

.3 Implement varied tone to suit audibility requirements.

3.08 Closeout Activities

.1 The System Supplier shall schedule and present documented formalized instruction for the building owner, detailing the proper operation and maintenance of the installed System.

.2 The instruction shall be presented in an organized and professional manner by a person factory trained in the operation and maintenance of the equipment and who is also thoroughly familiar with the installation.

.3 The instruction shall cover the schedule of maintenance required by ULC and any additional maintenance recommended by the system manufacturer.

.4 Instruction shall be made available to the Local Municipal Fire Department if requested by the Local Authority Having Jurisdiction.

.5 The contractor shall provide for a minimum of three training sessions of two hours in length. At least one of these training sessions shall be carried out for key personnel prior to the system being initially placed on-line for the beginning of the burn-in period.

.6 Three bound copies which summarize the training instruction shall be submitted to the Owner for future reference.

End of Section

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1 General

1.01 Section Includes

.1 Single stage addressable fire alarm system Sequence of Operation.

1.02 Related Requirements

.1 Section 28 46 13 – Fire-Alarm Systems.

1.03 Closeout Submittals

.1 Manuals

.1 Provide a clear and concise description of operation which gives, in detail, the information required to properly operate the equipment.

2 Products

2.01 General

.1 The sequence listed below is representative sequence of operation, based on typical buildings.

.2 The Contractor shall submit a project specific sequence of operation, as part of the submittal process.

2.02 Operation Sequences

.1 An alarm is caused by actuation of any one of the following devices:

.1 Pulling a manual station.

.2 Operation of an automatic fire alarm detector.

.3 Operation of a sprinkler flow switch.

.4 Operation of a smoke detector.

.2 If, in any area of the building, an alarm is caused by actuation of the aforementioned devices, the following shall occur:

.1 Signals in the building shall sound.

.2 Annunciators shall indicate exact zone where alarm originated.

.3 The activation of a manual pull station, automatic fire detector, automatic smoke detector, or sprinkler flow switch shall initiate the following sequence of operation:

.1 Sound an alarm signal throughout building.

.2 Control panel and remote annunciators shall indicate exact location of alarm via a zoned RED LED.

.3 Fans shall be automatically turned off.

.4 Initiate alarm origin on CPU and at graphic annunciator.

.5 Display the alarm event on all annunciator panels.

.6 Actuate CPU causes evacuation signal to sound and strobes to operate.

.7 The internal audible device shall sound at the control panel.

.8 Signal transmission to external systems:

.1 Transmit signal to monitoring station.

.2 Central station shall be automatically alerted via telephone lines connected for fire alarm system.

.3 Transmit signal to Building Automation System.

.4 Transmit signal to Access Control System.

.9 Door Releases:

.1 All stairwell/exit doors shall unlock throughout the building.

.2 All self-closing fire/smoke doors held open shall be released.

.3 Site entrance and exit gates open.

.10 Elevator:

.1 Provide elevator recall functions for primary and alternate floors and elevator power shunt trip activation for each elevator.

.2 Each elevator lobby smoke detector shall be complete with relay base. Provide five relays and interconnecting wiring to elevator controller for elevator recall. Coordinate requirements with elevator supplier.

.11 HVAC Shutdowns:

.1 Shut down air supply and return air fans.

.2 Activate smoke dampers.

.12 CPU indicates trouble when any fault occurs within the system

.4 Alarm

.1 Actuate CPU causes evacuation signal to sound and strobes to operate.

.2 The internal audible device shall sound at the control panel.

.3 Signal transmission to external systems:

.1 Transmit signal to monitoring station.

.2 Transmit signal to Building Automation System.

.3 Transmit signal to Access Control System.

.4 Door Releases:

.1 All stairwell/exit doors shall unlock throughout the building.

.2 All self-closing fire/smoke doors held open shall be released.

.3 Site entrance and exit gates open.

.5 Elevator:

.1 Provide elevator recall functions for primary and alternate floors and elevator power shunt trip activation for each elevator.

.2 Each elevator lobby smoke detector shall be complete with relay base. Provide five relays and interconnecting wiring to elevator controller for elevator recall. Coordinate requirements with elevator supplier.

.6 HVAC Shutdowns:

.1 Shut down air supply and return air fans.

.2 Activate smoke dampers.

.5 Supervisory

.1 If, in any area of the building, supervised valves of the sprinkler, systems are operated or exhibit short or open circuits, the following shall occur:

.1 The annunciator shall identify, as a separate zone, the item causing the trouble signal.

.2 The trouble buzzer on the annunciator(s) shall sound.

.3 The signals in the building shall not be sounded.

.2 The activation of a sprinkler supervised valve or pressure switch shall initiate the following sequence of operation:

.1 The control panel and remote annunciator shall indicate exact location of activity via a zoned AMBER LED

.2 Activate an audible tone on the control panel and remote annunciator

.3 The signals in the building shall <u>not</u> be sounded.

.6 Trouble

.1 A short, ground fault or open circuit to any fire alarm conductor, the tamper or removal of any field device or the loss of primary or standby power to any control equipment will result in the following trouble sequence of operation:

.1 The control panel and remote annunciator shall indicate exact location of activity via a zoned YELLOW LED.

.2 Activate an audible tone on the control panel and remote annunciator.

.3 The signals in the building shall <u>not</u> be sounded.

3 Execution – Not Used

End of Section

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1 General

1.01 Section Includes

.1 Fire alarm annunciator panels.

.1 Main annunicator panel and remote LCD annunicator panels.

.2 Firefighter entrances.

.3 Passive graphics.

1.02 Related Requirements

.1 Section 21 13 00 – Fire-Suppression Sprinkler Systems.

.2 Section 26 05 00 – Common Work Results for Electrical.

.3 Section 28 46 13 – Fire-Alarm Systems.

1.03 Reference Standards

.1 The publications listed below form a part of this specification. The publications are referenced in text by the basic designation only. Comply with the latest edition/amendment referenced code, standard, or publication.

.1 Ontario Regulations

.1 Ontario Building Code.

.2 Ontario Fire Code.

.2 Underwriters Laboratories of Canada

.1 CAN/ULC-S524 – Installation of Fire Alarm Systems.

.2 CAN/ULC-S525 – Audible Signal Appliances for Fire Alarm Systems.

.3 CAN/ULC-S526 – Visual Signal Appliances for Fire Alarm Systems.

.4 CAN/ULC-S527 – Control Units for Fire Alarm Systems.

.5 CAN/ULC-S528 – Manual Pull Stations for Fire Alarm Systems.

.6 CAN/ULC-S529 – Smoke Detectors for Fire Alarm Systems.

.7 CAN/ULC-S530 – Heat Detectors for Fire Alarm Systems.

.8 CAN/ULC-S533 – Egress Door Securing and Releasing Devices.

.9 CAN/ULC-S536 – Inspection and Testing of Fire Alarm Systems.

.10 CAN/ULC-S537 – Verification of Fire Alarm Systems.

.11 CAN/ULC-S548 – Alarm Initiating and Supervisory Devices for Water Type Extinguishing Systems.

.12 ULC/ORD 693 – Central Station Fire Protective Signaling.

.3 All requirements of the Authority Having Jurisdiction (AHJ).

.2 In the case of any discrepancy between these specifications, the project drawings, and any applicable local codes, comply with the most stringent requirement.

1.04 Coordination

.1 Coordinate between all trades for inclusion of information to be included on passive graphic.

1.05 Action Submittals

.1 In accordance with Section 01 33 00, and Section 28 46 13.

.2 Shop Drawings:

.1 Annunciator:

.1 Provide annunciator layout and system wiring diagram showing each device and wiring connection required.

.2 Show annunciator layout and main control panel module layout, configurations and terminations.

.2 Passive Graphic:

.1 Prepare a complete zoning schedule and artwork layout for each passive graphic to be included with submittal package.

.2 Submit colour PDF (electronic submittal) using the identical colours as will be used in a temporary graphic for use during occupancy review by municipal fire inspector.

.3 After occupancy review, incorporate comments from municipal fire inspector, and submit colour PDF (electronic submittal) using the identical colours as will be used in the final production graphic.

1.06 Delivery, Storage, and Handling

.1 In accordance with Section 01 60 00.

1.07 Warranty

.1 All work performed and all material and equipment furnished to be warranted as free from defects and for a period of at least one year from the date of acceptance.

2 Products

2.01 Manufacturers

.1 In accordance with Section 28 46 13.

2.02 Fire Alarm Annunciator Panel (FAAP)

.1 Annunciator panels will have an alphanumeric display for each detection device, and will identify the detection device initiating an alarm.

.2 Annunciator panel located at the firefighter's entrance will have separate zone indication for each zone.

.3 Install panel in a recessed enclosure with brushed aluminum finish. Coordinate exact location and dimensions with Architectural drawings.

.4 Identify emergency exit door numbers/identifiers, and on the control panel/annunciator panel LED labels in order to identify the manual pull stations adjacent to said doors when being activated when cross referenced with the passive graphic.

.1 Coordinate with architectural plans indicating door IDs.

2.03 Passive Graphic Displays

.1 Provide passive colour graphic display to be mounted adjacent to the fire alarm control panel and each annunciator panel as indicated on the drawings.

.1 Provides building and zone layout while defining zone boundaries.

.2 Visual reference of user's location within the building.

.2 Multicoloured Passive Graphics:

.1 Plastic laminate type, on white background, framed and under plexiglass, 600 mm by 600 mm (24 inch by 24 inch) minimum size.

.2 Different brilliant colours used to distinguish the various fire alarm zones and building outline from one another, silk-screened with durable acrylic-based inks on a white matte 3 mm (1/8 inch) thick acrylic sheet. Use UV protected inks to protect against fading or colour changes for life.

.3 Provide a minimum of six different colours.

.4 Uppercase text, minimum height of 4 mm (0.15 inches).

.5 Graphical display will indicate the following at minimum. Coordinate between all trades for inclusion of this information.

.1 "YOU ARE HERE" indicated in red (unique to each passive graphic location), and properly oriented to the viewer when standing in front of the graphic.

.2 Zone colours to clearly indicate the extents of all fire alarm zones.

.1 Define all egress corridors in a distinctive (dot) black hatch pattern.

.2 All enclosed stairs and elevators to be coloured yellow.

.3 Indicate the extents of zones served by air handling units with shut downs.

.4 Indicate the location of the fire alarm control panel, all annunciators, and network panels/nodes.

.5 Indicate the location and designation of sprinkler and standpipe monitoring devices.

.6 Indicate the location of Sprinkler Room(s), and all supervised fire protection devices. Coordinate with the fire protection trade(s) for exact locations of devices.

.7 Emergency exit doors with door numbers shown. These will be needed to cross reference with the annunciator panel labels for pull stations that are activated next to these doors.

.8 Label all Stair Letters. Designations to match Architectural drawings.

.9 Main gas shut off location.

.3 Frame

.1 Extruded aluminum frame with concealed mounting hardware and concealed screws

.2 Brushed silver finish.

.3 Concealed security mounting hardware.

.4 Frame to permit future replacement of graphic if the building or zone layouts change in future.

.4 Allow for other requirements per the Authorities Having Jurisdiction, including the Municipal Building Inspector, and Municipal Fire Inspector.

2.04 Fire Alarm Remote LCD Annunciators (FARA)

.1 Description: Remote Control and Annunciation provided using back-lit, alphanumeric display. Information is presented including:

.1 Point Status (alarm, trouble, etc.);

.2 Alarm Type (smoke detector, manual station, etc.);

.3 Number of System Alarms, Supervisory Conditions, and Trouble Conditions.

.2 Features:

.1 Display:

.1 LCD Display with two lines of 40 characters each.

.2 LED status indicators.

.2 Controls:

.1 Switches for system acknowledge, alarm silence, and system reset.

.2 Four programmable control switches.

.3 Lamp/LCD test

.3 Finish: brushed stainless steel trim.

3 Execution

3.01 Installation

.1 Installation in accordance with Section 28 46 13.

.2 Install annunciators and passive graphics with the top no greater than 1800 mm (70 in) above finished floor.

.3 Install main annunciators with temporary passive graphics in the following locations:

.1 Ground floor lobby (firefighter's entrance).

.2 Security desk.

.4 Install temporary passive graphic at fire alarm control panel.

.5 Install remote annunciators with temporary passive graphics in the following locations:

.1 Admin area.

3.02 Site Tests and Inspections

.1 Review passive graphics and annunciators with municipal fire inspector on site during occupancy review. Incorporate any comments and resubmit to the Consultant for review.

.2 Include reprogramming of zone nomenclature by system manufacturer to suit municipal review comments.

.3 After review by the Consultant, fabricate final passive graphics, and replace temporary graphics on site.

End of Section

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1 General

1.01 Section Includes

.1 ULC Monitoring equipment.

1.02 Related Requirements

.1 Section 28 46 13 – Fire-Alarm Systems.

1.03 References

.1 CAN/ULC-S561:2020 – Installation and Services for Fire Signal Receiving Centres and Systems.

1.04 Coordination

.1 Coordinate if the Owner has identified a ULC monitoring company to be used.

.2 Coordinate the installation of the fire alarm monitoring panel with the fire alarm system supplier.

1.05 Submittals

.1 In accordance with Section 01 33 00, and Section 28 46 13.

1.06 Closeout Submittals

.1 ULC "Fire Protective Signaling Certificate" certificate indicating the monitoring company is in compliance with CAN/ULC-S561.

1.07 Delivery, Storage, and Handling

.1 In accordance with Section 01 60 00.

2 Products

2.01 ULC Fire Alarm Monitoring Provider

.1 Provide ULC monitoring transmitter and connect to a monitoring station listed to CAN/ULC-S561.

2.02 Manufacturers

.1 Johnson Controls / Tyco | DSC.

.2 Approved equal.

.3 Exact model to be in accordance with Owner's monitoring company requirements.

2.03 Transmitter Panel

.1 The Fire alarm system shall be provided with a fire alarm monitoring system that meets ULC-S561 requirements.

.2 The Monitoring System shall be fully redundant cellular / dual internet alarm communication.

.3 Monitoring panel shall be certified for active or passive ULC monitoring and operate on the local cellular 3G networks. System must automatically switch to 2G service should the 3G service fail.

.4 Monitoring Panel shall have an LCD back lit display keypad with AC status indicator. Provide battery back-up for the monitoring panel and energize from a dedicated branch circuit. Provide a red lock-on device for the breaker.

.5 Monitoring shall be provided in a passive configuration to meet ULC S561 requirements. System shall have a dedicated primary telephone line and shall not be shared with any other system in the facility. Provide Category 6 voice and data cabling in EMT conduit to the telephone demark in the telecommunications entrance facility. Fire alarm system supplier shall be responsible to include a complete system with monitoring for two (2) years after substantial performance.

.6 As part of the fire alarm system shop drawing submission provide information on the monitoring company and confirmation that the monitoring company meets ULC-S561 requirements.

.7 The Monitoring System shall include cellular booster complete with lightning surge protector. Wilson Pro1050 or approved equivalent.

.8 The Contractor is responsible for all wiring from the fire alarm panel to the monitoring panel, and from the monitoring panel to the telecommunications entrance facility. Cabling shall be as per manufacturer's requirements. All cabling shall be run in conduit.

3 Execution

3.01 Installation

.1 Locate monitoring transmitter at communications entrance facility.

.2 Provide one dedicated 15 A, 120 volt circuit for monitoring transmitter for use by Monitoring Transmitter and connect fire alarm system outputs to ULC monitoring transmitter.

.3 Provide one voice line and one data outlet to the ULC monitoring transmitter.

.4 Post a copy of the ULC certificate at the location of the transmitter.

End of Section

1 General

1.01 Section Includes

.1 End-of-Line Devices.

.2 Fault Isolators.

.3 Wire Guards.

1.02 Related Requirements

.1 Section 28 46 13 – Fire-Alarm Systems.

.2 Section 28 46 31.31 – Fire-Alarm Manual Initiating Devices: manual pull station covers.

1.03 References

.1 CAN/ULC-S524-14 – Installation Standard for Fire Alarm Systems.

1.04 Unit Prices

.1 Refer to Document 00 43 00.26.

.2 Unit price to supply and install wire guard for any fire alarm device.

1.05 Closeout Documents

.1 As-Built Drawings: include location and zone of all End-of-Line devices.

1.06 Maintenance Material Submittals

.1 Extra Stock Materials

.1 Provide (supply and install) an additional five of each of the following devices as directed during construction. Turn over unused surplus in addition to those devices listed above:

.1 Fault Isolators.

.2 End-of-Line devices.

.3 Wire guard.

.2 Spare Parts

.1 Supply the following additional equipment as spare parts in a proper metal enclosure sized to accept the equipment as listed herein. Label the enclosure fire alarm spare parts. Enclosure shall be placed in the same room as the FACP.

.1 Supply three of each type of other installed initiating, notification, or controlling devices.

.3 Tools

.1 Supply three of each type of any special tools required for system use and maintenance.

2 Products

2.01 End of Line Devices

.1 One watt type resistors mounted within outlet boxes separate from those for other devices at the locations indicated. Provide on the cover plate for each such device on approved nameplate, engraved "END-OF-LINE RESISTOR" or with an approved symbol. Provide red lamacoid plate with white 6 mm letters identifying zone.

2.02 Fault Isolators

.1 Module shall detect and isolate a short-circuited segment of a fault-tolerant loop whilst allowing the rest of the addressing circuit to function normally.

2.03 Device Guards

.1 Description: Welded wire mesh of size and shape for the initiation, signaling, or other device requiring protection.

.1 Factory fabricated and furnished by manufacturer of device.

.2 Finish: Paint of color to match the protected device.

.2 Pull station covers: as described in Section 28 46 31.31.

3 Execution

3.01 Installation

.1 Installation to Section 28 46 13 and CAN/ULC-S524.

.2 End-of-Line devices:

.1 Provide End-of-Line devices as directed by the manufacturer on Class B circuits.

.2 Install 1800 mm above finished floor in interior spaces and provide a label indicating the zone service.

.3 Installation of End-of-Line devices within other field devices: not permitted.

.4 Provide a permanent mark to identify the zone or circuit served by the End-of-Line device.

.3 Fault Isolators:

.1 Provide fault isolators in accordance with CAN/ULC-S524.

3.02 Field Tests and Inspections

.1 Testing and inspection to Section 28 46 13.

.2 Verification to Section 28 46 13.

End of Section

1 General

1.01 Section Includes

.1 Spot type smoke detectors.

.2 Duct mounted smoke detectors.

.3 Heat detectors.

.4 Accessories.

1.02 Related Requirements

.1 Section 26 05 00 – Common Work Results for Electrical.

.2 Section 28 46 13 – Fire-Alarm Systems.

.3 Section 28 46 31.18 – Carbon Monoxide Detection Sensors.

1.03 Unit Prices

.1 Refer to Document 00 43 00.26.

.2 Submit with Tender unit prices to provide the following. Include installation and verification in the unit price:

.1 Fire detector (heat detector or smoke detector) complete with wiring and conduit, based on 10 metre distance.

.2 Duct type smoke detector complete with wiring and conduit on a separate zone, based on 30 metre distance.

.3 Unit cost of additional conduit and wire for the above items.

.4 Wire guard for any fire alarm device.

1.04 References

.1 CAN/ULC-S524-14 – Installation Standard for Fire Alarm Systems.

1.05 Maintenance Material Submittals

.1 Extra Stock Materials

.1 Provide (supply and install) an additional five of each of the following devices as directed during construction. Turn over unused surplus in addition to those devices listed below:

.1 Heat detectors.

.2 Smoke detectors.

.3 Duct smoke detectors.

.2 Spare Parts

.1 Supply the following additional equipment as spare parts in a proper metal enclosure sized to accept the equipment as listed herein. Label the enclosure fire alarm spare parts. Enclosure shall be placed in the same room as the FACP.

.1 Supply three of each:

.1 Addressable detector base.

.2 Smoke detector.

.3 Duct smoke detector.

.4 Heat detector.

.3 Tools

.1 Supply three of each type of any special tools required for system use and maintenance.

2 Products

2.01 Analytical Microprocessor Addressable Detectors – General

.1 Early warning analog addressable detectors shall use state-of-the-art multi-sensor technology. Each detector shall incorporate a microprocessor capable of making alarm decisions based on fire parameter algorithms stored in the detectors head. The microprocessor shall evaluate all sensing elements simultaneously and take into account real-time environmental conditions and the duration of an event, resulting in reliable and accurate decisions that distinguish real fire conditions from unwanted deceptive nuisance alarms. Digital filters shall eliminate signal patterns that are not typical of fires. Detectors that use the control panel processor to make alarm decisions are not acceptable.

.2 Addressable detectors shall be capable of full digital communications using both broadcast and polling protocols. The maximum total analog loop response time for detectors shall be 750 ms. The maximum alarm response time for the system to sound an alarm shall not be more than 3-seconds regardless of the detector location or the number of detectors on the addressable loop. The analog loop controller shall support up to 250 devices including 125 modules, 125 detectors and 125 isolator bases. The analog loop must not require shielded wire and shall be capable of a total distance of 4000 feet minimum using #18 AWG twisted pair when 100 addressable detectors and 100 addressable modules are connected. The analog loop shall support up to 124 wiring T-taps.

.3 The analog loop controller shall be able to "map" and supervise the location of each addressable device installed on the loop. Device supervision shall be provided for any device that is missing, added or changes to the device type, alarm settings, features, location or changes to the wiring layout or detector bases. It shall be possible to display or print the device "map" from a laptop. The "map" shall indicate all devices on the addressable loop complete with the customer defined device location name, device and base type, supervision information and wiring as-built layout including all T-taps. If two devices are inadvertently switched during routine maintenance, the loop controller shall be able to identify the change and if the device types are identical, it shall automatically download environmental information specific to that device location and all programming shall remain intact for the respective location of each device. No reprogramming or manual addressing shall be required. If the device types do not match, both devices shall still provide their inherent protection, programmed functions shall respond accordingly for that device location and a trouble shall be logged on the system. The "map" shall indicate which devices have been switched, what device type was expected and what device type is actually installed in that location.

.4 Each detector shall have the ability to learn its environment and automatically adjust its reference value for changes in its environment. Detectors that require adjustments to their sensitivity settings months after they are installed are not acceptable. Environmental compensation shall allow each sensing element to adapt to short and long term changes caused by dirt, dust, humidity, temperature and ageing. The detector shall adjust and update its sensitivity (% obscuration) and ambient temperature baselines for each sensing element approximately six times per hour. The detector shall utilise a 4-hour rolling average of the environmental information and for verification purposes also maintain a 24-hour average of the analog values, both of which may be taken into account in the alarm decision making process.

.5 The detector's on-board microprocessor shall monitor the environmental effects on its baseline and generate a "maintenance alert" message at the control panel when the detectors environmental compensation is 80% used up indicating it should be cleaned. This event shall be programmable to initiate any type of system response such as send an e-mail message to maintenance. When the environmental compensation head room is 100% used up, a trouble condition shall latch on the system to advise that the detector requires cleaning immediately. Up to this point the detectors sensitivity shall not have been compromised. Dirty detectors that continue to be ignored will eventually post an internal device fault and will not false alarm as a result of the accumulation of dirt. Dirty detectors that false alarm if not cleaned are not acceptable.

.6 The detector shall be capable of identifying up to 32 self-diagnostic codes including verification that the detectors reference value is within its prescribed factory and ULC limits. Sensitivity reports shall include the percent obscuration that the detectors alarm level is set at and the percentage of compensation used as a result of environmental factors (dirt, dust, humidity, etc.). This information shall be available for system maintenance and may be requested per device or generate reports based on only the detectors that require cleaning.

.7 The early warning analog addressable detectors and the analog loop controller shall provide increased reliability and inherent survivability through intelligent analog conventional operation. Detectors shall automatically change to stand alone, conventional device operation in the event of a loop controller polling communications failure. In the analog conventional detector mode, each detector shall continue to operate using its programmed sensitivity and "learned" environmental information stored in the detector's memory at the time of communication failure. The analog loop controller shall be capable of monitoring the loop and activating a loop alarm, without communicating to the devices, if any detector reaches its alarm sensitivity threshold.

.8 Each Signature Series device shall be capable of automatic electronic addressing and/or custom addressing without the use of DIP or rotary switches. Devices using DIP or rotary switches for addressing, either in the base or on the detector shall not be acceptable.

.9 Each detector shall have a separate means of displaying communication and alarm status. A green LED shall flash to confirm normal status communication with the analog loop controller. A red LED shall flash to display alarm status. Both LED's on steady shall indicate an alarm in the conventional stand-alone mode status. The LEDs shall be visible through a full 360 degree viewing angle.

.10 It shall be possible to matrix program Signature analog detectors. Responses shall be programmable based on activated detectors within the physical location to one another and/or the number of activated detectors in a programmable group or groups.

.11 All detectors shall be compatible with all Signature Series mounting bases.

2.02 Heat Detectors – Combination Fixed Temperature/Rate of Rise

.1 Heat Detector shall have a solid-state heat sensor, and shall transmit an alarm at a fixed temperature of 135 degrees F (57 degrees C) or due to a temperature Rate of Rise of 15 degrees F/minute (9 degrees C/minute). The detector shall continually monitor the temperature of the air in its surroundings to minimize thermal lag to the time required to process an alarm. The heat detector shall be rated for ceiling installation at 70 feet (21.3 m) centers and be suitable for wall mount applications.

2.03 Heat Detectors - Fixed Temperature

.1 Heat detector shall have a solid-state heat sensor, and shall transmit an alarm at a fixed temperature of 135 degrees F (57 degrees C). Detector shall continually monitor the temperature of the air in its surroundings to minimize thermal lag to the time required to process an alarm. Heat detector shall be rated for ceiling installation at 70 feet (21.3 m) centers and be suitable for wall mount applications.

2.04 Analogue Smoke Detection System

.1 The system shall maintain the sensitivity level set, for each sensor, over time by automatically compensating for environmental factors such as dust and dirt accumulations in a smoke sensor's chamber. The smoke sensor shall be a smoke density measuring device having no self-contained set-point. The alarm decision for each sensor shall be determined by the control panel.

.2 The system shall automatically indicate when an individual sensor needs cleaning. When a sensor's average value reaches a predetermined value a `Dirty Sensor' trouble condition shall be audibly and visually indicated at the control panel for the individual sensor. When `Dirty Sensor' trouble conditions are reported the sensor's sensitivity level will not have been compromised by the dust and dirt accumulation in its chamber.

.3 It shall be possible for the user to obtain a report of all smoke sensors that are `Almost Dirty' and will require cleaning in the near future Before they initiate a `Dirty Sensor' trouble condition.

.4 All data transmissions, including the analogue value, between the smoke sensors and the control panel shall be digitally transmitted and incorporate parity and checksum digital data checks of each transmission. The system must verify that the proper sensor type is in the base to match the desired software configuration.

.5 An operator from the control panel, having a proper access level, shall have the ability to manually access and print the following information for each sensor in a report format that can be easily understood by the user:

.1 Primary Status.

.2 Device Type.

.3 Present Average Value.

.4 Present Sensitivity Selected.

.5 Highest Peak Detection Values.

.6 Sensor Chamber Status (Normal, Almost Dirty, Dirty, Excessively Dirty).

.6 To manually control the following of each sensor:

.1 Clear Peak Detection Values.

.2 Enable or Disable the Point.

.3 Clear Verification Tally.

.4 Control a Sensor's Relay Driver Output.

.7 It shall be possible to program the control panel to automatically change the sensitivity settings of each sensor based on time-of-day and day-of-week.

.8 The control panel shall have the capability of programming each sensor for a two-stage function. This function allows a control function to occur when for example, a sensor programmed for 3% smoke obscuration reaches the threshold of 1.5% smoke obscuration.

2.05 Intelligent Photoelectric Smoke Detectors

.1 The detectors shall use the photoelectric (light scattering) principal to measure smoke density and shall, on command from the control panel, send data to the panel representing the analogue level of smoke density.

2.06 Intelligent Very Early Warning (VEW) Laser Detectors

.1 The VEW Detector shall be a laser type detector, which incorporates a laser diode and an integral lens. The photo sensor shall be activated by the scattering of smoke particles.

.2 The detector shall have multiple sensitivity levels and be capable of detecting a minimum obscuration of 0.03%/ft. At least two separate and distinct alarm thresholds shall be capable of being monitored by the fire alarm control panel.

2.07 Detectors - Photoelectric Smoke Detector, (Duct Detector Use)

.1 Photoelectric detector shall utilize a light scattering type photoelectric smoke sensor to detect visible particulates produced by combustion. The integral microprocessor shall dynamically examine values from the sensor and initiate a system alarm based on the analysis of data.

.2 The alarm set point shall be field selectable to any of five sensitivity settings ranging from 1.0% to 3.5% smoke obscuration per foot. The photo detector shall be suitable for operation in the following environment:

.1 Temperature: 0 degrees C to 49 degrees C (32 degrees F to 120 degrees F).

.2 Humidity: 0-93% RH, non-condensing.

.3 Elevation: no limit.

2.08 Duct Detector Housing

.1 The Analytical Microprocessor-based photoelectric smoke detector shall be readily adaptable for use in air duct smoke detection applications, using a housing that mounts to the outside of the duct. When used for duct smoke detection, the smoke detectors will not forfeit any of the system functionality that they have when used as area smoke detectors.

.2 The duct smoke detection housing shall allow the detector to sample and compensate for, variations in duct air velocity between 300 and 4 000 feet per minute.

.3 Remote alarm LEDs and Remote Test Stations shall be supported by the duct smoke detector and provided where indicated.

.4 Install duct smoke detectors in heated areas. If mounted outdoors, provide heater in duct smoke detector housing.

2.09 Detector Bases – Standard

.1 Mounting bases shall support all microprocessor-based detector types detailed in this specification.

.2 Removal of the respective detector shall not affect communications with other addressable devices.

.3 Field wiring connections shall be made to the room side of the base, so that wiring connections can be made or disconnected by the contractor without the need for remove the mounting base from the electrical box. Bases will have the option of external LED operation, Relay Base or Data Line Isolator Base.

2.10 Detector Base – Relay

.1 The relay base shall support all Addressable Detector types and have the following requirements:

.1 Form "C" contacts rated at 1 amp @ 30 VDC and listed for "pilot duty".

.2 The position of the contact shall be supervised.

.3 Separate power shall not be required to the relay base.

.4 The relay shall automatically de-energize when a detector is removed.

.5 The relay operation shall be exercised by the detector processor on power up.

.6 The relay shall be a bi-stable type and selectable for normally open or normally closed operation.

.2 For added survivability, relay operation shall be controlled by the detectors microprocessor. The relay shall be capable or operation in the conventional stand-alone mode in the event communication is lost with the loop controller. Relay bases not controlled by the detector's microprocessor shall not be acceptable.

3 Execution

3.01 Installation

.1 Installation to Section 28 46 13.

.2 Provide wire guards for detectors in gymnasiums.

3.02 Identification

.1 Provide an engraved phenolic nameplate, red text on red background at the ceiling location below any concealed duct mounted smoke detectors indicating "Smoke Detector Above – DSD-1" where DSD-1 is the identification of the detector. Locate on lay-in ceiling grid or access hatch where located.

3.03 Field Tests and Inspections

.1 Testing, and inspection to Section 28 46 13.

.2 Verification to Section 28 46 13.

End of Section

1 General

1.01 Section Includes

.1 Linear Heat Detection systems.

1.02 Related Requirements

.1 Section 28 46 13 – Fire-Alarm Systems.

1.03 References

.1 National Fire Protection Association (NFPA):

.1 NFPA 72, Standard for Protection Signaling Systems

.2 Factory Mutual Insurance (FM) Approval Guide

.3 Underwriters Laboratories Inc. (UL) Fire Protection Equipment Directory

.4 Underwriters Laboratories Canada (c-UL-us) Fire Protection Equipment Directory

1.04 Coordination

.1 Coordinate work performed under this section with work specified in other sections as noted.

1.05 Submittals

.1 Submit product data and shop drawings including isometric and plan view layouts of the system under provisions of Section 01 33 00.

.2 Supply one copy of the manufacturers Installation and Operation Manuals after completion of installation.

.3 Supply one copy of the manufacturers Start-Up forms within 30 days after installed and commissioned.

.4 Each bidder must supply their proposed system design for the area(s) to be protected together with a letter certifying that the design strictly complies with the limitations established by the manufacturer.

1.06 Maintenance Contract

.1 Maintenance Service: Shall be provided by a factory authorized and factory trained representative in accordance with the manufacturer, NFPA 72, and local requirements of the authority having jurisdiction.

1.07 Quality Assurance

.1 Qualifications:

.1 Contractor: The contractor shall have a minimum of 5 years experience in the design and installation of fire detection systems.

.2 Equipment suppliers: The equipment suppliers shall be factory authorized and trained by the manufacturer every other year to design, install and maintain all aspects of the system.

.2 Regulatory Requirements:

.1 Codes and approvals: Equipment supplier shall conform to the local code requirements and approvals applicable to this section. Supplier must obtain and pay all necessary permits prior to beginning work in this section.

.2 The system shall be Factory Mutual approved, and listed by Underwriters Laboratories and Underwriters Laboratories Canada.

1.08 Site Conditions

.1 Physical/Environmental Requirements:

.1 The cabinet shall be permanently mounted where specified on the shop drawings or in a location to facilitate access and ease of service.

.2 The cabinet must be mounted in an ambient temperature range of 0 degrees C (32 degrees F) to 52 degrees C (125 degrees F).

.3 Where the environment is harsh, the releasing control panel shall be fitted with a NEMA 12 enclosure.

2 Products

2.01 Manufacturers

.1 Safe Fire Detection
5915 Stockbridge Dr. Monroe, NC 28110, Ph.: 704-821-7920, Fax: 704-821-4327

.2 Approved equal.

2.02 Manufactured Units

.1 The Linear Heat Detector:

.1 68°C (155°F) Linear Heat Detector: Model #: TC155 Series.

2.03 Description

.1 Detection Method: Linear Heat Detection

.2 Design Requirements:

.1 Shall consist of an approved linear heat detector and control/releasing panel that are designed and installed to detect the heat from a fire as it was designed.

.2 The control/releasing panel shall be any approved self-contained, micro-controlled base technology that indicates alarms, faults and system integrity or as approved by the manufacturer. The intent of the panel is to alarm when the linear heat detector senses a fire and either alarm, or alarm and release an extinguishing agent. The panel shall also have 24 hour battery backup.

.3 The linear heat detection systems spacing shall be determined by NFPA, State Codes, Local Codes and the manufacturer's recommendations.

.3 Performance Requirements:

.1 Shall be UL, C-UL-US, FM, MEA and CSFM tested and approved.

.2 Shall be listed for up to 10 m (35 foot) spacing.

.3 Shall be compatible with any ULC listed fire alarm panel.

.4 Must not require proprietary panel.

.5 Shall detect a fire at its approved temperature.

.6 Shall report any equipment related fault through a fault output relays.

.7 Shall be installed to comply with NFPA standards (and the authority having jurisdiction).

2.04 Components

.1 The Linear Heat Detection System:

.1 UL listed Addressable Panel or Conventional panel.

.2 The detection principle shall be linear heat type, and be capable of detecting fires as it was designed at a fixed temperature.

2.05 Equipment

.1 The control panel for the linear heat detection releasing system must be a microprocessor-based control capable of protecting multiple hazards in one control panel. It shall be UL listed under Standard 864 for Local Control Units for Releasing Service. The control must also be approved by FM and be compatible with the requirements of NFPA 72 (Local: A, M, SS service types; NC signaling type) and NFPA 13, NFPA 15, and NFPA 16.

.2 The Linear Heat Detector shall be a fixed temperature single line-sensing element consisting of two electrical current carrying wires separated by a heat sensitive coating. The temperature must be clearly printed on the detector.

3 Execution

3.01 Installation

.1 Installation to Section 28 46 13.

.2 The Linear Heat Detection System: The contractor shall install the system in accordance with the manufacturer's installation recommendations and Operational Manual.

3.02 Field Quality Control

.1 The contractor shall commission the complete installation in the presence of the end user or their appointed representative.

.2 The contractor shall provide materials all necessary instrumentation, test equipment, labor.

.3 The contractor shall record all test and commissioning requirements and a copy shall be provided to the end user or an authorized representative.

.4 Checks must be made to ensure that all ancillary equipment and warning devices are operational as designed and specified with care taken not to discharge a suppression system.

.5 The contractor shall upon completion of commissioning and testing provide the end user or authorized representative with the isometric as-built drawings as well as the System Start-Up forms, Installation and Operation manuals.

.6 The contractor shall be or be represented by an authorized representative of the manufacturer. This person must have successfully completed manufacturer's training and show proof of it by means of a valid certificate. The company listed on the certificate at the time of the testing and commissioning must employ, this person who must be present or the certificate is not valid. The certificate is valid for a period of two years from the date on the certificate.

3.03 Site Tests and Inspections

.1 Testing, and inspection, to Section 28 46 13.

.2 Verification to Section 28 46 13.

End of Section

1 General

1.01 Section Includes

.1 Sensors for the detection of Carbon Monoxide (CO) gas.

1.02 Related Requirements

.1 Section 28 46 13 – Fire-Alarm Systems.

1.03 References

.1 CSA 6.19-17 – Residential Carbon Monoxide Alarming Devices.

.2 Ontario Building Code.

.3 CAN/ULC-S529:2016 – Smoke Detectors for Fire Alarm Systems.

1.04 Certifications

.1 The CO detector shall be ULC-S529 and CSA 6.19 as Carbon Monoxide alarm device.

2 Products

2.01 Manufacturers

.1 Edwards signature series "SIGA2" devices.

.2 S-Tech.

.3 CO detectors shall be compatible with the system in Section 28 46 13.

2.02 Carbon Monoxide Sensors

.1 The CO element shall be modular and can be replaced when the CO detector reaches end of life, so that the whole detector does not need to be replaced. Detectors that require the complete device to be replaced are not be acceptable.

.2 The CO detector element shall have an integral count-down timer that counts down from 6 years (expected life span of the CO detector component). The detector's processor shall monitor the CO detector component to ensure that if the CO device is out of tolerance before the 6-year time frame, the device will register a trouble condition and identify itself to the control panel.

.3 Devices include, SIGA2-COS, carbon monoxide detector, SIGA2-PCOS, combination Photoelectric/CO detector, SIGA2-PHCOS combination Photo/Thermal/ CO detector as well as SIGA2-HCOS combination Heat/CO detector. The combination devices shall only utilize one detector address and have the ability to separate the device types to a maximum of two different inputs from each addressable detector. It shall be possible to have the smoke detector activate the sounder base only like a smoke alarm and have the heat detector activate the general alarm condition. And if the CO sensor activates, the sounder base must sound the ISO Temporal 4 CO alarm code.

.4 The CO sensor in a sounder base shall be listed as a Carbon Monoxide Alarm to CSA-6.19. Addressable Carbon Monoxide (CO) Detector, EST model SIGA2-COS with audible sounder base. Provide intelligent addressable Carbon Monoxide Detector with Temporal 4 Audible Base.

.5 The CO detection element shall indicate a trouble condition at the FACP signaling end of life and the CO element of the detector shall be field replaceable. It shall be programmed at the main control panel as a supervisory indication and transmit a separate supervisory signal to the central station.

.6 Alternate product for mechanical rooms: S-Tech STCH-1000HW (hard wired alarm, wall mount), and STCH-100HWR (hard wired alarm with relay).

3 Execution

3.01 Installation

.1 Installation to Section 28 46 13.

.2 Install CO detectors in accordance with 2012 Ontario Building Code, section 6.2.12, and as indicated on the drawings.

3.02 Site Tests and Inspections

.1 Testing, and inspection to Section 28 46 13.

.2 Verification to Section 28 46 13.

End of Section

1 General

1.01 Section Includes

.1 Intelligent Modules.

1.02 Related Requirements

.1 Section 21 13 00 – Fire-Suppression Sprinkler Systems.

.2 Section 21 31 00 – Centrifugal Fire Pumps.

.3 Section 23 38 13 – Commercial-Kitchen Hoods.

.4 Section 26 05 00 – Common Work Results for Electrical.

.5 Section 26 32 13.16 – Gas-Engine-Driven Generator Sets.

.6 Section 26 36 23.13 – Bypass-Isolation Automatic Transfer Switches.

.7 Section 28 46 13 – Fire-Alarm Systems.

1.03 Unit Prices

.1 To Section 28 46 13.

1.04 References

.1 CAN/ULC-S548-15 (R2020), Standard for devices and accessories for water type extinguishing systems.

.2 NFPA 13, Standard for the Installation of Sprinkler Systems.

1.05 Maintenance Material Submittals

.1 Extra Stock Materials

.1 Provide (supply and install) an additional 10 of each of the following fire alarm devices as directed during construction. Turn over unused surplus in addition to those devices listed below:

.1 Zone Addressable Modules (ZAMs).

.2 Spare Parts

.1 Supply the following additional equipment as spare parts in a proper metal enclosure sized to accept the equipment as listed herein. Label the enclosure fire alarm spare parts. Enclosure shall be placed in the same room as the FACP.

.1 Supply three of each type of other installed initiating, notification, or controlling devices.

.3 Tools

.1 Supply three of each type of any special tools required for system use and maintenance.

2 Products

2.01 Microprocessor Based Intelligent Modules

.1 General

.1 Zone Addressable Modules (ZAM) shall be used for the monitoring of water flow, valve tamper, fire suppression control panels, non-addressable detectors, and for control of fans or dampers that require shutdown or manual control in an alarm condition.

.2 Monitor ZAM's shall monitor any N/O contact device and be capable of powering 2-wire smoke detectors. The ZAM will communicate the zone's status (normal, alarm, trouble) to the transponder. The ZAM's zone address shall be set at the time of installation via a dip switch package.

.3 Control ZAM's shall be able to provide supervised or non-supervised control of any control function. The ZAM will communicate the zone's status (normal, trouble) to the transponder. Each control ZAM shall provide a double pole double throw relay for switching loads of up to 120 VAC. Each common leg of the relay shall be equipped with a replaceable 2 Amp fuse. The ZAM's zone address shall be set at the time of installation via a dip switch package.

.4 Fire Alarm / Life Safety System shall incorporate microprocessor-based addressable modules for the monitoring and control of system Input and Output functions over a 2-wire electronic communications loop, using both broadcast and serial polling protocols. All modules shall display communications and alarm status via LED indicators. The function of each connected module shall be determined by the module type, and shall be defined in the system software through the application of a personality code. All addressing of the Microprocessor-based Addressable Modules shall be done electronically, and the electrical location of each module shall be automatically reported to the Fire Alarm Control Panel, where it may be downloaded into a PC, or printed out. The addressing of the modules will not be dependent on their electrical location on the circuit. All field wiring to the Microprocessor-based Addressable Modules shall be supervised for opens and ground faults and shall be location identified to the module of incidence. Diagnostic circuitry, and their associated indicators, with reviewable Trouble Codes, shall be integral to the Microprocessor-based Addressable Modules to assist in troubleshooting system faults. Each module shall be suitable for operation in the following environment:

.1 Temperature: 0°C to 49°C (32°F to 120°F)

.2 Humidity: 0-93% RH, non-condensing

.2 Single Input Module:

.1 Microprocessor-based Addressable Modules shall be used to provide one (1) supervised Class A input circuit capable of latching operation for use with contact devices, non-damped Waterflow Switches, non-latching supervisory sprinkler switches.

.3 Dual Input Module:

.1 Microprocessor-based Addressable Modules shall be used to provide two (2) independent supervised Class A input circuits capable of operation with contact devices. Both of the input circuits shall be terminated to, and operated from, the same microprocessor-based addressable module.

.2 Modules configured for water flow operation shall have an automatic delay of 15 seconds before reporting the water flow alarm condition to the Fire Alarm Control Panel. The module shall monitor sprinkler supervisory switches and shall automatically report the supervisory function to the Fire Alarm Control Panel each time the associated dry contact closes.

.4 Monitor Module:

.1 The Microprocessor-based Addressable Monitor Module shall be factory set to support one (1) supervised Class A Normally-Open active non-latching monitor circuit. The module shall automatically report the monitor function to the Fire Alarm Control Panel each time the associated dry contact closes.

.5 Control Relay Module:

.1 Microprocessor-based Addressable Control Relay Modules shall provide one form "C" dry relay contact rated at 2 amps @ 24 VDC or 0.5 amps at 120 VAC to, control external appliances or equipment processes. The control relay module shall be rated for pilot duty applications. The position of the relay contact shall be confirmed by the system firmware.

3 Execution

3.01 Installation

.1 Installation to Section 28 46 13.

3.02 Site Tests and Inspections

.1 Testing, and inspection to Section 28 46 13.

.2 Verification to Section 28 46 13.

End of Section

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1 General

1.01 Section Includes

.1 Fire Alarm Horns.

.2 Fire Alarm Strobes.

.3 Combination Horn/Strobes.

.4 Boosters.

1.02 Related Requirements

.1 Section 26 05 00 – Common Work Results for Electrical.

.2 Section 28 46 13 – Fire-Alarm Systems.

1.03 Unit Prices

.1 Refer to Document 00 43 00.26.

.2 Submit with Tender unit prices to provide the following. Include installation and verification in the unit price:

.1 Fire alarm horn complete with wiring and conduit, based on 10 metre distance.

.2 Fire alarm strobe complete with wiring and conduit, based on 10 metre distance.

.3 Combination fire alarm horn/strobe complete with wiring and conduit, based on 10 metre distance.

.4 Unit cost of additional conduit and wire for the above items.

1.04 References

.1 CAN/ULC-S525:2016, Audible signaling devices for fire alarm and signaling systems, including accessories.

.2 CAN/ULC-S526:2016, Visible signaling devices for fire alarm and signaling systems, including accessories.

1.05 Submittals

.1 Booster battery calculations, booster power supply voltage drop calculations.

1.06 Maintenance Material Submittals

.1 Extra Stock Materials

.1 Supply the following additional equipment as spare parts in a proper metal enclosure sized to accept the equipment as listed herein. Label the enclosure fire alarm spare parts. Enclosure shall be placed in the same room as the FACP.

.1 Supply three of each type of signalling device used on the project.

.2 Spare Parts

.1 Provide (supply and install) an additional five of each of the following devices as directed during construction. Turn over unused surplus in addition to those devices listed above:

.1 Fire alarm horn.

.2 Fire alarm strobes.

.3 Combination horn/strobes.

.3 Tools

.1 Supply three of each type of any special tools required for system use and maintenance.

1.07 Certifications

.1 All appliances which are supplied for the requirements of this specification shall be ULC Listed.

.2 All appliances of the same manufacturer as the Fire Alarm Control Panel specified to ensure absolute compatibility between the appliances and the control panels, and to ensure that the application of the appliances are done in accordance with the single manufacturer's instructions.

.3 Any appliances that do not meet the above requirements, and are submitted for use must show written proof of their compatibility for the purpose intended. Such proof shall be in the form of documentation from all manufacturers that clearly states that their equipment (as submitted) is 100% compatible with each other for the purpose intended.

2 Products

2.01 Horns

.1 Vibrating horn: semi-flush mounted, 24 VDC, selectable 94 dBA or 98 dBA, suitable for installation in a standard electrical box.

.2 Red enamel typical, or white enamel as indicated on the drawings, and as confirmed by the Owner.

2.02 Mini Horns

.1 Vibrating horn: semi-flush mounted, 24 VDC, 91 dBA, suitable for installation in a standard electrical box.

.2 Red enamel typical, or white enamel as indicated on the drawings, and as confirmed by the Owner.

2.03 Horn-Strobes

.1 Vibrating horn: semi-flush mounted, 24 VDC, selectable 94 dBA or 98 dBA, suitable for installation in a standard electrical box.

.2 Red enamel typical, or white enamel as indicated on the drawings, and as confirmed by the Owner.

.3 Provide horn-strobes where shown on plans and drawings. Strobe output shall be determined as required by its specific location and application from a family of 15/75 cd, 30 cd, and 110 cd devices. Strobes shall provide a synchronized flash.

.4 Strobes shall be 24 VDC and ULC listed.

.5 Strobe circuits shall be coordinated with audible circuits such that activation of an audible circuit results in activation of the companion strobe circuit. The strobe circuits shall be capable of being arranged such that they continue to operate in the event that the audible circuits have been silenced and remain operating until the FACP has been reset. Strobe circuits should also be coordinated with the audible circuits such that they are zoned in the same manner as the audible circuits

.6 All strobes and combination horn strobes shall be mounted such that the bottom of the device is mounted 80 inches above the finished floor or 6 inches below the ceiling, whichever is lower.

2.04 Strobes

.1 Strobes shall be supplied where shown on plans and drawings. Strobe output shall be determined as required by its specific location and application from a family of 15/75 cd, 30 cd, and 110 cd devices. Strobes shall provide a synchronized flash.

.2 Size strobe power supplies based on all strobes set at 75 cd with exact setting determined in the field to provide adequate visual signals in accordance with CAN/ULC-S524.

2.05 Remote Booster Power Supplies

.1 Power supply booster designed to extend power available to notification appliance circuits.

.2 Enclosure: Steel, with lockable front panel allowing access to all interior components, surface mounted.

.3 Functions: Contains circuits to monitor and charge batteries, control and supervise 4 Class B appliance circuits, and monitor two controlling inputs from external sources.

.1 Configurable to operate at any one of three signaling rates, or to follow the main panel's notification appliance circuit.

.2 Trouble contact with 16-second delay.

.4 Batteries: Two, sized for 24 hours of standby followed by 15 minutes of alarm.

.5 Indicators: LEDs, one for each circuit, one for battery supervision, one for ground fault, and one for power.

.6 Input: 120 volt circuit.

3 Execution

3.01 Installation

.1 Installation to Section 28 46 13.

3.02 Site Tests and Inspections

.1 Testing, and inspection to Section 28 46.21 11.

.2 Verification to Section 28 46 13.

End of Section

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1 General

1.01 Section Includes

.1 Fire alarm interfaces to other systems.

1.02 Related Requirements

.1 Section 26 09 43 – Network Lighting Controls.

.2 Section 27 41 16.01 – Integrated Audio-Video Systems and Equipment for Gymnasiums.

.3 Section 27 51 16 – Public Address Systems.

1.03 References

.1 Ontario Building Code.

1.04 Submittals

.1 Submit under provisions of Section 01 33 00.

.2 Product Data: Manufacturer's data sheets on each product to be used, including:

.1 Preparation instructions and recommendations.

.2 Storage and handling requirements and recommendations.

.3 Installation methods.

.3 Operating and Maintenance Data: Include operating, troubleshooting, maintenance, and repair instructions for each item, with lists of spare parts, if any, and name, address, and phone number of local stocking distributors.

1.05 Quality Assurance

.1 Installer Qualifications: experienced door hardware installer.

1.06 Delivery, Storage, and Handling

.1 Store products in manufacturer's unopened packaging until ready for installation.

1.07 Warranty

.1 Provide manufacturer's standard warranties:

.1 Magnets: Lifetime warranty.

2 Products

2.01 System Interfaces

.1 Provide relays to interface with the following systems upon fire alarm signal:

.1 Lighting Controls: activate all emergency lighting upon alarm.

.2 Audio-Video Systems and Public Address Systems: deactivate sound systems upon fire alarm.

3 Execution

3.01 Examination

.1 Do not begin installation until substrates have been properly prepared.

.2 If substrate preparation is the responsibility of another installer, notify the Consultant of unsatisfactory preparation before proceeding.

3.02 Preparation

.1 Clean surfaces thoroughly prior to installation.

.2 Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.03 Installation

.1 Install in accordance with manufacturer's instructions.

.2 Test for proper operation with building power energized; coordinate with start-up procedures of other installers.

3.04 Site Tests and Inspections

.1 Perform functional test in accordance with CAN/ULC-S1001 and Section 28 08 46 to confirm that systems operate as described. Perform test in the presence of the Contractor, sub-trades, Consultant, and applicable vendors.

3.05 Protection

.1 Protect installed products until completion of project.

.2 Repair or replace damaged products before Substantial Performance.

.3 Three bound copies which summarize the training instruction shall be submitted to the Owner for future reference.

End of Section

1 General

1.01 Section Includes

.1 Electromagnetic door holders ("hold opens").

.2 Transformers, power supplies, and accessories.

1.02 Related Requirements

.1 Door Hardware Schedule.

.2 Section 08 70 00 – Finish Hardware: Locksets, exit devices, and other door hardware.

.3 Section 28 46 13 – Fire-Alarm Systems.

.4 Section 28 46 31 – Fire-Alarm Initiating Devices: smoke detectors.

1.03 References

.1 Ontario Building Code.

.2 Ontario Building Code – Supplementary Standard SB-4.

.3 CAN/ULC-S533-15, Standard for egress door securing and releasing devices.

.4 CAN/ULC-S567, Door closers and electromagnetic door holders.

.5 NFPA 80-13, Standard for Fire Doors and Other Opening Protectives.

1.04 Submittals

.1 Submit under provisions of Section 01 33 00.

.2 Product Data: Manufacturer's data sheets on each product to be used, including:

.1 Preparation instructions and recommendations.

.2 Storage and handling requirements and recommendations.

.3 Installation methods.

.3 Shop Drawings: Door Schedule showing each item of hardware to be installed on each door.

.1 Use door numbers on door schedule.

.2 Schedule may be combined with submittals required in other door hardware sections.

.4 Operating and Maintenance Data: Include operating, troubleshooting, maintenance, and repair instructions for each item, with lists of spare parts, if any, and name, address, and phone number of local stocking distributors.

1.05 Maintenance Material Submittals

.1 Extra Stock Materials:

.1 Provide (supply and install) an additional five of each door hold open device as directed during construction.

.2 Turn over unused surplus in addition as spare parts.

.2 Tools:

.1 Supply three of each type of any special tools required for system use and maintenance.

1.06 Quality Assurance

.1 Installer Qualifications: experienced door hardware installer.

1.07 Delivery, Storage, and Handling

.1 Store products in manufacturer's unopened packaging until ready for installation.

1.08 Warranty

.1 Provide manufacturer's standard warranties:

.1 Magnets: Lifetime warranty.

2 Products

2.01 Materials

.1 General Requirements: Provide devices suitable for door type, lock type, frame type, dimensions and overall operation.

.1 Coordinate with doors, frames, and hardware specified in other sections.

.2 Provide all brackets, spacers, shims, lip extensions, strike boxes, and other accessory parts necessary to complete the installation.

.3 Power Supplies or Transformers: Provide all necessary components to supply power to devices from building power distribution system.

2.02 Electromagnetic Door Hold Open Devices

.1 Manufacturers

.1 Allegion/LCN.

.2 SimplexGrinnell.

.3 Fire alarm system manufacturers as noted in Section 28 46 13.

.4 Requests for substitutions will be considered in accordance with provisions of Section 01 60 00.

.2 Coordinate with Section 08 70 00.

.3 Provide auxiliary relay to disconnect door holders upon fire alarm.

.4 Description: Units shall be listed under ULC Fire Door Holders Certified for Canada (GTPR7) for wall or floor mounting as indicated and are complete with matching door plate. Unit shall operate from a 120 VAC, a 24 VAC or a 24 VDC source, and develop a minimum of 11.4 kg (25 lbs) of holding force.

.5 Material and Finish: Match door hardware.

.6 Furnish and install where shown on the drawings, magnetic door holders designed for positive release to secure openings as indicated for limiting smoke spread. The units furnished shall be brushed aluminum finish, compatible with the doors as listed in the door schedule as follows:

.1 120 Vac concealed wiring with 11.4 kg (25 lbs) holding force.

.2 120 Vac surface wiring with 11.4 kg (25 lbs) holding force.

.3 120 Vac recessed door with 11.4 kg (25 lbs) holding force.

.4 120 Vac floor mounting, single door with 11.4 kg (25 lbs) holding force.

.5 120 Vac floor mounting, double door with 11.4 kg (25 lbs) holding force.

.6 120 Vac sliding door with 54.4 kg (120 lbs) holding force, grey hammer-tone finish.

.7 120 Vac overhead door with 54.4 kg (120 lbs) holding force, grey hammer-tone finish.

.7 Smoke detectors shall be provided on both sides of doors with hold open devices. Smoke detectors shall be complete with auxiliary relay bases, connected to release the respective hold open device.

.8 Accessories: Provide extension and misalignment rods (various lengths) enabling parallelism between door and wall at distances greater than 300 mm (12 inches) and misalignment over 100 mm (4 inches).

.9 Operation Sequence

.1 Upon detection of smoke at any smoke detector located within 1500 mm (59 in) of the electromagnetically held door, release the door holder. Mechanical closer on the door will close the door to maintain required fire separation.

2.03 Powered Door Operators in Fire Separations

.1 References: 2012 OBC 3.1.8.5.(2)(a), NFPA 80.

.2 Sequence of operation: Power-operated fire doors shall be equipped with a releasing device that shall automatically disconnect the power operator at the time of fire, allowing a self-closing or automatic device to close the door regardless of power failure or manual operation.

.3 Provide fire alarm relay to disable each power door operator as noted.

3 Execution

3.01 Examination

.1 Do not begin installation until substrates have been properly prepared.

.2 If substrate preparation is the responsibility of another installer, notify the Consultant of unsatisfactory preparation before proceeding.

3.02 Preparation

.1 Clean surfaces thoroughly prior to installation.

.2 Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.03 Installation

.1 Install in accordance with manufacturer's instructions.

.2 Coordinate with installers of other door hardware.

.3 Adjust installed items to operate properly without interfering with operation of door and other hardware.

.4 Test for proper operation with building power energized; coordinate with start-up procedures of other installers.

3.04 Interface with Other Work

.1 Connect hold opens to fire alarm system described in Section 28 46 13.

.2 Provide spot smoke detectors to Section 28 46 31.

3.05 Site Tests and Inspections

.1 Perform functional test in accordance with CAN/ULC-S1001 and Section 28 08 46 to confirm that held doors and fire shutters release and close upon smoke detection with the presence of the Contractor, sub-trades, Consultant, and the door hardware vendor.

3.06 Protection

.1 Protect installed products until completion of project.

.2 Repair or replace damaged products before Substantial Performance.

.3 Three bound copies which summarize the training instruction shall be submitted to the Owner for future reference.

End of Section

1 General

1.01 Section Includes

.1 Fire alarm signal for elevator car homing relays.

1.02 Related Requirements

.1 Division 14 – Conveying Equipment: Elevators.

.2 Section 26 05 83.14 – Wiring Connections for Elevators.

.3 Section 28 46 13 –Fire-Alarm Systems.

1.03 Work Not Described in this Section

.1 Elevator control wiring, down drop cables, and interlock controls and wiring.

1.04 References

.1 CSA B44-13, Safety code for elevators and escalators (Bi-national standard, with ASME A17.1).

.2 CSA C22.1-18, Canadian Electrical Code, Part 1 (24th Edition), Safety Standard for Electrical Installations.

.3 Ontario Electrical Safety Code (27th edition/2018).

.1 OESC Section 38: Elevators, dumbwaiters, material lifts, escalators, moving walks, lifts for person with physical disabilities, and similar equipment.

.4 Ontario Building Code.

.5 CAN/ULC-S1001-11.

.6 ULC-S527 – Control Units for Fire Alarm Systems.

1.05 Delivery, Storage, and Handling

.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 00.

2 Products

2.01 Intelligent Fire Alarm Relay Module

.1 Basis of Design: Mircom intelligent six-relay control module, model number CR-6, or equal to suit manufacturer of fire alarm system.

.2 Addressable relay modules are intended for use in an intelligent fire alarm system and shall allow a compatible control panel to switch discrete contacts by code command. The control module shall provide the required quantity of isolated sets of Form-C contacts, which operate as a double-pole double-throw switches. The module shall allow the control panel to switch these contacts on command. Module shall have both normally open and normally closed connections available for field wiring.

.3 Each module shall have its own address.

.4 Each module responds to regular polls from the system and reports its type and status. Each module address shall have an associated LED that is controlled by the panel to indicate module status. Coded signals, transmitted from the panel, can cause the LED to blink, latch on, or latch off. Refer to the control panel technical documentation for module LED status operation.

.5 Wiring terminals shall be easily accessible for troubleshooting while installed.

3 Execution

3.01 Installation

.1 In accordance with Reference Standards.

3.02 Site Tests and Inspections

.1 Install smoke detectors, heat detectors, and relays in accordance with CAN/ULC-S524.

.2 Verify to CAN/ULC-S536.

.3 Provide functional testing in accordance with CAN/ULC-S1001 including elevator automatic recall.

End of Section

1 General

1.01 Section Includes

.1 Shutdown relays.

.2 Smoke Control.

1.02 Related Requirements

.1 Section 23 30 00 – HVAC Air Distribution.

.2 Section 23 34 00 – HVAC Fans.

.3 Section 23 74 13.01 – Packaged, Outdoor, Gas and DX Air Handling Units.

.4 Section 23 74 13.02 – Packaged, Outdoor, Hydronic Air Handling Units.

.5 Section 23 74 23 – Packaged, Outdoor, Heating-Only Makeup-Air Units.

.6 Section 28 46 13 – Fire-Alarm Systems.

.7 Section 28 46 31 – Fire-Alarm Initiating Devices: duct mounted smoke detectors.

1.03 References

.1 Ontario Building Code.

1.04 Submittals

.1 Submit under provisions of Section 01 33 00.

.2 Product Data: Manufacturer's data sheets on each product to be used, including:

.1 Preparation instructions and recommendations.

.2 Storage and handling requirements and recommendations.

.3 Installation methods.

.3 Shop Drawings: Door Schedule showing each item of hardware to be installed on each door.

.1 Use door numbers on door schedule.

.2 Schedule may be combined with submittals required in other door hardware sections.

.4 Operating and Maintenance Data: Include operating, troubleshooting, maintenance, and repair instructions for each item, with lists of spare parts, if any, and name, address, and phone number of local stocking distributors.

1.05 Quality Assurance

.1 Installer Qualifications: experienced door hardware installer.

1.06 Delivery, Storage, and Handling

.1 Store products in manufacturer's unopened packaging until ready for installation.

1.07 Warranty

.1 Provide manufacturer's standard warranties:

.1 Magnets: Lifetime warranty.

2 Products

2.01 Materials

.1 General Requirements: Provide devices suitable for door type, lock type, frame type, dimensions and overall operation.

.1 Coordinate with doors, frames, and hardware specified in other sections.

.2 Provide all brackets, spacers, shims, lip extensions, strike boxes, and other accessory parts necessary to complete the installation.

.3 Power Supplies or Transformers: Provide all necessary components to supply power to devices from building power distribution system.

2.02 Air Handling Unit Shutdown Relays

.1 Provide duct smoke detectors in the supply air duct of air handling units feeding more than one storey, or more than one suite in a storey.

.2 Provide a relay to shut down the air handling system upon detection of smoke at the aforementioned smoke detector.

2.03 Smoke Dampers

.1 Smoke dampers and combination smoke and fire dampers shall be configured so as to close automatically upon a signal from an adjacent smoke detector located as described in CAN/ULC-S524, "Installation of Fire Alarm Systems", within 1.5 m horizontally of the duct or air-transfer opening in the fire separation**,**

.1 on both sides of the air-transfer opening, or

.2 in the duct downstream of the smoke damper or combination smoke and fire damper.

.2 Provide smoke detectors in accordance with code requirements for control of smoke dampers.

3 Execution

3.01 Examination

.1 Do not begin installation until substrates have been properly prepared.

.2 If substrate preparation is the responsibility of another installer, notify Consultant of unsatisfactory preparation before proceeding.

3.02 Preparation

.1 Clean surfaces thoroughly prior to installation.

.2 Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.03 Installation

.1 Install in accordance with manufacturer's instructions.

.2 Coordinate with installers of other door hardware.

.3 Adjust installed items to operate properly without interfering with operation of door and other hardware.

.4 Test for proper operation with building power energized; coordinate with start-up procedures of other installers.

3.04 Site Tests and Inspections

.1 Perform functional test to confirm that held doors release upon smoke detection.

3.05 Protection

.1 Protect installed products until completion of project.

.2 Repair or replace damaged products before Substantial Performance.

.3 Three bound copies which summarize the training instruction shall be submitted to the Owner for future reference.

End of Section

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1 General

1.1 **SECTION INCLUDES**

.1 Labour, Products, equipment and services necessary for earthwork Work in accordance with the Contract Documents.

1.2 **SUBMITTALS**

.1 Submit to Consultant details of locations where surplus soils and other materials are to be disposed of or reused. Include each disposal/reuse Site and type of surplus soil or other material, location of the disposal/reuse Site, operator's name and business address, type of license under which Site operates, and criteria used by Site to access suitability of surplus material for disposal.

.2 Submit dewatering methods 30 days in advance for review by Consultant. If well point system is required, Engineer shall design system and supervise installation.

1.3 **SITE CONDITIONS**

.1 Cultural heritage resources: If Cultural Heritage Resources (such as archaeological sites, artifacts, building and structural remains, and/or human burials) are encountered during performance of Work, contact Consultant immediately and suspend Work in immediate area until assessment has been completed by Ministry of Culture, Tourism and Recreation. Perform required measures to mitigate negative impacts on found resources to acceptance of Consultant.

1.4 **PROTECTION**

.1 Existing buried utilities and structures:
- .1 Size, depth and location of known existing utilities and structures are indicated for guidance only. Completeness and accuracy is not guaranteed.
- .2 Prior to commencing any excavation Work, have authorities stake out utility locations to prevent disturbance during Work.
- .3 Confirm locations of buried utilities by careful test excavations. Hand dig test excavations as necessary.
- .4 Maintain and protect from damage, water, sewer, gas, electric, telephone and other utilities and structures encountered. Obtain permission of Consultant before moving or otherwise disturbing utilities or structures.

.2 Existing buildings and surface features:
- .1 Conduct with Consultant, a condition survey of existing buildings, trees and other plants, lawns, fencing, service poles, wires, rail tracks and paving, survey bench marks and monuments which may be affected by Work.
- .2 Protect existing buildings and surface features which may be affected by Work from damage while Work is in progress and repair damage resulting from Work.
- .3 Where excavation necessitates root or branch cutting, perform Work in accordance with Authorities having Jurisdiction.
- .4 Confirm with Consultant, condition Survey of buildings and structures undertaken by Consultant.

.3 Temporarily cover local existing catch basins and maintenance holes to prevent entry of earth or debris. Ensure adequate surface drainage in affected area is maintained.

.4 Protect Work or work of other Contracts in progress or completed and protect existing properties, stored Products, services, utilities, trees, landscaping and natural features from damage.

.5 Protect excavations against flooding and damage and install and maintain appropriate warning devices during construction and during time when Work is closed down for any cause.

.6 Protect bottom of excavations that will support foundations, slabs, pavements etc. from frost or freezing.

.7 Keep access roads clear of debris and dirt resulting from Work of this Section to acceptance of Authorities having jurisdiction.

2 Products

2.1 **MATERIALS**

.1 Select fill: Subject to approval of Geotechnical Consultant consisting of imported fill that is free of organic matter, rubble and material other than soil. Maximum particle size of half thickness of lift specified, moisture content at time of placing 2% maximum over its optimum moisture content and is either non plastic or has a plasticity index of 25% maximum. Suitable soil from within building envelope can be reused to fill excavation after building demolition subject to approval by Geotechnical Consultant.

.2 Granular A fill: Imported Granular A fill, free of organic matter and, in accordance with OPSS 1010.

.3 Granular B Fill: Imported Granular B fill free of organic matter and in accordance with OPSS 1010.

.4 Dewatering/groundwater control equipment: Equip submersible pumps with filters and/or screens to prevent ground loss. Maintain filters in good operating condition.

3 Execution

3.1 **EXAMINATION**

.1 Verify condition and dimensions of previously installed Work upon which this Section depends. Report defects to Consultant. Commencement of Work means acceptance of existing conditions.

3.2 **LINES AND ELEVATIONS**

.1 Establish lines and elevations from Control Points shown on Contract Drawings.

.2 Have lines and elevations established by Registered Ontario Land Surveyor or qualified Civil Engineer registered in Province of Ontario.

.3 Protect and maintain Control Points and Bench Marks as long as they are required.

3.3 CLEARING AND GRUBBING

.1 Clear and grub as necessary to remove trees and roots from area designated on Contract Drawings. Tag and adequately protect trees shown on Contract Drawings to be preserved.

.2 Leave ground surface in condition suitable for stripping of topsoil.

3.4 STRIPPING

.1 Do not handle topsoil while in wet or frozen condition or in manner in which soil composition is adversely affected.

.2 Strip topsoil from working area in locations shown.

.3 Strip topsoil to depths indicated. Avoid mixing topsoil with subsoil.

.4 Stockpile topsoil in locations directed by Consultant. Stockpile to height not exceeding 2 m.

3.5 REMOVAL OF WATER

.1 Obtain letter of conditional approval from Authorities having Jurisdiction to dispose of ground water into storm sewer drainage system. Apply for and pay for water disposal permit.

.2 Keep excavations and trenches free of water throughout construction period.

.3 Groundwater removal:

- .1 Lower groundwater level where required and maintain at depth below lowest point of excavation to ensure a dry stable surface.
- .2 Dewater/control groundwater to prevent loss of soil and maintain stability of sides and bottom of excavation and of adjacent structures.
- .3 Dispose of water in conformance with applicable by-laws and in a manner not detrimental to public and private property, or portion of Work completed or under construction.
- .4 Supply and install flocculation tanks, settling basins, or other treatment facilities to remove suspended solids or other materials before discharging to sewers, water courses or drainage areas in accordance with authorities having jurisdiction. Perform testing on settlement tank discharge to confirm that effluent meets sewer bylaw requirements. Locate tanks to acceptable area determined by Consultant.
- .5 Should method of dewatering/groundwater control fail to achieve conditions specified above, Consultant reserves right to revise methods and procedures at no cost to Owner.

.4 Surface water removal:

.1 Remove surface run-off in a manner that will prevent loss of soil and maintain stability of sides and bottom of excavation. Obtain Consultant's approval of dewatering method to be used.

.2 Discharge surface water into existing storm drainage system to acceptance of Consultant and local authorities.

.5 Do not obstruct flow of surface drainage or natural water courses.

3.6 EXCAVATION

.1 Remove concrete, masonry, paving, demolished foundations and rubble and other obstructions encountered during excavation Work.

.2 Do not disturb soil within drip line of trees or shrubs that are to remain. If excavating through roots, excavate by hand and cut roots with sharp axe or saw in a manner acceptable to authorities having jurisdiction.

.3 Excavate to required lines and grades shown on Contract Drawings with allowance for subsequent Work including shoring, bracing and formwork. Make excavation clean and clear of loose material and true to size.

.4 Protect stockpiles of fill against contamination and moisture absorption.

.5 Do not undermine adjacent structures. Where it is necessary to have footings at different levels, found upper footing below imaginary 10-horizontal-to-7 vertical line, or as otherwise indicated, drawn up from base of lower footing. Protect adjacent foundations from frost.

.6 Have excavations in excess of 1200 mm in depth conform to requirements of Occupational Health and Safety Act, and Regulations for Construction Projects.

.7 Fill excavations for foundations which are, through error, carried below elevation shown or approved depth, with 15 MPa concrete, or as directed by Consultant.

.8 Trim, and remove loose material, debris and organic material from excavations. Where material at bottom of excavation is disturbed, remove disturbed material and re-compact to density equal to or better than undisturbed soil or backfill with lean concrete as directed by Geotechnical Consultant.

.9 When excavations are complete, prior to commencement of subsequent Work, request Consultant for inspection of excavation Work.

3.7 TRENCHING

.1 Excavate trenches to lines and grades indicated and in accordance with OPSS 401, and backfill to invert elevation of pipe with specified granular material.

.2 Unless otherwise authorized by Consultant, do not excavate more than 30 m of trench in advance of installation operations and do not leave open more than 15 m at end of day's operation. Remove unsuitable material from trench bottom to extent and depth as directed by Geotechnical Consultant.

.3 Backfill Over-excavation with granular material and compact.

.4 If unstable soil conditions are encountered, excavate trenches to depth directed by Consultant and backfill to correct elevation with backfill material.

.5 Remove loose material from bottom of trenches to ensure granular material is placed against undisturbed soil.

.6 Compact bedding and grade as required for even and uniform support on each length of pipe.

.7 Where excavating is required adjacent to and parallel with and below any footing, submit excavation and backfill procedures to Consultant for review prior to start of excavating.

.8 Keep width of trenches to a minimum to ensure minimum span for pipe to be supported.

.9 Make excavations for fire hydrants of sufficient size and depth to accommodate a minimum 0.75 m^3 of crushed stone. Hand place stone and tamp around and below hydrant elbow to ensure proper drainage of hydrant.

3.8 EXCAVATED MATERIAL DISPOSAL

.1 Except for material to be used as select fill for building envelope, immediately remove and dispose of excavated material from Site.

.2 Remove and dispose of construction rubble, abandoned gas, water and sewer pipes, valves, valve boxes and fittings, maintenance holes, frames and covers and other material which may be encountered during excavation but not indicated on Contract Drawings.

.3 Refer to Terraprobe's Phase Two ESA Report and Soil Analytical Results Summary (appended) and the following for additional direction regarding conformance with Ontario Regulation 406/19 as it pertains to the management of on-site and excess soils:

.4 All earth moving operations shall be completed in accordance with O.Reg. 406/19, regarding management of access soil. Fill material shall be tested to determine suitability to provincial standards of intended use / destination. The contractor shall be responsible for properly disposing of unsuitable or contaminated soils.

.5 It is the intent of the design that all existing vegetation that is to be removed on the site, including stumps, trees, saplings, shrubs, grasses, etc. will be disposed of in accordance with applicable regulations.

.6 Determination of the suitability of soils for reuse for various fill conditions is to be completed under the direction and supervision of the geotechnical engineer. Moreover, with specific regards to O.Reg. 406/19, the following applies:

.1 Definitions:

.1 "project leader": representative of the ALCDSB (Owner) who is ultimately responsible for making decisions relating to the planning and implementation of the project.

.2 "operator": the successful general contractor or their subcontractor

.3 "qualified person": appointed by and under the employ of the successful general contractor or their subcontractor. QP has the meanings given in Section 5 of O.Reg.153/04 under the Environmental Protection Act (Ontario).

.2 RULES FOR SOIL MANAGEMENT AND EXCESS SOIL QUALITY STANDARDS – Section B – Excess Soil Reuse Planning:

.1 Item 1 to be completed by "project leader".

.2 Items 2 – 5 to be completed by "qualified person".

.7 All costs associated with on-site and excess soil management shall be borne by the successful general contractor including the development of a "Source Site Acceptance Protocol" and "Sampling and Analysis Plan" if applicable which will be prepared by the "qualified person" and approved by the Owner. Costs associated with: obtaining, sampling, testing and analyzing soil samples and subsequent laboratory reports, required through the approved "Sampling and Analysis Plan" will be paid through the cash allowance under Inspection and Testing.

.8 It is also the responsibility of the successful general contractor and their subcontractors that should fill material be brought in from sites that are not regulated under the Aggregate Resources Act, the "qualified person" will be required to conform to all requirements of O.Reg. 406/19 as it pertains to the deposit of excess fill if the project site is going to be used as a reuse site. The "project leader" shall be the only party with authority to consent in writing to receive excess soil from a project area.The "operator" or their "qualified person" shall be responsible for the retention of all records generated in the excess soil movement and management activities undertaken on behalf of the "project leader". The same records shall be delivered to the "project Leader" in full upon completion of the project.

3.9 BACKFILLING

.1 Do not proceed with backfilling operations until walls, slabs, waterproofing and below grade Work has been inspected and accepted by Consultant.

.2 Backfill areas which are free from debris, snow, ice, water and frozen ground.

.3 Do not use backfill material which is frozen or contains ice, snow or debris.

.4 Do not backfill on or against any membrane or protection board covered waterproofing with jagged rock or other sharp objects which might damage waterproofing.

.5 Limit vertical drop of backfill material to 2000 mm.

.6 To avoid pockets and voids, remove sheathing and shoring materials that require removal, as backfilling progresses.

.7 Prior to backfilling or placing concrete on exposed soil subgrade, proof roll subgrade to identify soft or loose areas. Proceed with placing backfill or concrete only after inconsistencies identified by above procedure have been reworked and compacted or excavated, backfilled and compacted as required to eliminate such conditions to acceptance of Consultant.

.8 Place backfill material, grade and compact to levels shown on Contract Drawings.

.9 Place backfill materials in uniform layers 200 mm maximum loose thickness unless specified otherwise.

.10 Ensure each layer is compacted, and accepted by Consultant, before placing succeeding layers.

.11 Unless otherwise indicated, use specified granular material from bottom of trench to 300 mm above top of pipe or 150 mm above top of electrical conduits. Hand place in 150 mm layers and compact carefully to ensure proper backfilling and compaction around bottom quadrants and sides of pipe.

.12 For backfill from 300 mm above top of pipe or 150 mm above electrical conduits to sub-grade level, use select fill unless otherwise noted. Compact either by hand or by machine.

.13 Do not backfill trenches until piping, conduits and cables therein have been inspected, tested, and approved by inspection authorities having jurisdiction and Consultant.

.14 Prior to backfilling of trenches, remove wood block or wedges used to prevent movement of piping during tests.

.15 Where there is a common boundary between select fill and granular fill or unshrinkable fill, place select fill after granular fill has been compacted. Place and compact fill around free standing structures evenly on all sides of structure simultaneously in layers sloping away from structure.

.16 During backfilling, take care to avoid displacing or damaging Utilities Work and Services.

.17 Notify Consultant prior to commencement of backfilling and compacting operations.

3.10 COMPACTION

.1 Refer to Geotechnical Report for compaction densities.

.2 Add water if necessary to obtain required densities. Correct irregularities or depressions that may develop during compaction by removing or adding material to form a smooth and uniform surface.

.3 Shape and roll alternately to obtain smooth, even and uniformly compacted base.

.4 If material is excessively moist, aerate by scarifying with suitable equipment until moisture content is corrected.

.5 In areas not accessible to rolling equipment, compact to specified density with mechanical tampers acceptable to Consultant.

3.11 **ROUGH GRADING**

.1 Place material only on clean unfrozen surface, properly shaped and compacted and free from snow and ice. Ensure no frozen material is used in placing.

.2 Grade as necessary to bring Work areas to required elevations. Supply additional material required to obtain new grade levels. Place and compact as specified.

.3 Grade drainage ditches to elevations indicated on Contract Drawings.

.4 Maintain positive drainage.

.5 Grade materials using methods which do not lead to segregation or degradation of aggregate.

.6 Shape each layer to smooth contour and compact to specified density before succeeding layer is placed.

.7 Remove and replace that portion of layer in which material becomes segregated during spreading.

.8 Slope grade away from buildings 1:50 minimum.

.9 Make graded areas smooth to profile, free of debris, with local excavations and depressions filled and compacted.

.10 Do not disturb soil within branch spread of trees and shrubs remaining.

.11 Cultivate entire area which is to receive topsoil to a depth of 100 mm. Repeat cultivation in those areas where equipment used for hauling and spreading has compacted soil.

.12 Remove surface debris, roots, vegetation, branches and stones in excess of 50 mm in diameter.

3.12 **RESTORATION**

.1 Upon completion of Work, remove surplus materials and debris, trim slopes, and correct defects as directed by Consultant.

.2 Replace topsoil and reinstate existing pavement to elevation and condition which existed before excavation.

.3 Clean and reinstate areas affected to acceptance of Consultant.

END OF SECTION

1 General

1.1 **SECTION INCLUDES**

.1 Labour, Products, equipment, tools, and services necessary for asphaltic concrete paving Work in accordance with the Contract Documents.

1.2 **REFERENCES**

.1 ASTM D698, Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort.

.2 ASTM D1559, Test Method for Resistance to Plastic flow of Bituminous Mixtures Using Marshall Apparatus.

.3 CAN/CGSB 1.74, Alkyd Traffic Paint.

.4 OPSS, Ontario Provincial Standard Specification.

1.3 **SUBMITTALS**

.1 Shop drawings: Submit shop drawings in accordance with the Conditions of the Contract indicating sections, materials, dimensions, and relation to adjacent construction.

.2 Reports:
- .1 Submit written mix designs for each type of asphalt concrete for acceptance.
- .2 8 weeks prior to commencing Work test materials for conformance with requirements of Specifications. Submit written test report verifying compliance 4 weeks minimum prior to commencing Work.
- .3 Submit written field inspection and test reports.
- .4 Submit certification that testing laboratory is accredited for asphalt mix design through the Canadian Council of Independent Laboratories (CCIL).

1.4 **QUALITY ASSURANCE**

.1 Pre-installation meetings: Arrange with Contractor, asphalt Subcontractor, and Consultant to inspect substrates, and to review installation procedures 48 hours in advance of installation.

1.5 **SITE CONDITIONS**

.1 Do not install Work of this Section outside of following environmental ranges without Consultant's and Product manufacturer's written acceptance:
- .1 Air and surface temperature: OPSS 310.
- .2 Precipitation: None within 24 hours prior to placement.

1.6 **EXTENDED WARRANTY**

.1 Submit a extended warranty for Work of this Section in accordance with General Conditions, except that warranty period is extended to two years.

2 Products

2.1 **MATERIALS**

.1 Granular base and sub-base material: Granular "A" OPSS 1010, crushed or screened stone or gravel.

.2 Asphalt materials:
- .1 Hot mixed, hot laid asphalt meeting OPSS 1150, designation H.L. 8 for binder course and H.L. 3 for surface course.
- .2 Tack and primer coat: OPSS 1103 Grade SS-1.

.3 Traffic paint: CAN/CGSB 1.74, new pavement markings, white or yellow as selected by Consultant.

2.2 **MIXES**

.1 Mix asphalt materials in accordance with OPSS 1003 for H.L. 8 and H.L. 3.

.2 Do not change mix without prior approval of Consultant.

2.3 **SOURCE QUALITY CONTROL**

.1 Source approval:
- .1 Inform Consultant of proposed source of Products and afford access for sampling and testing of quality of Products at least 4 weeks prior to commencing production.
- .2 Ensure that source of Products to be incorporated into Work or stockpiled is acceptable to Consultant.
- .3 Submit laboratory test results for samples of specified Products to be supplied by this Section. Include in laboratory test results those tests required to demonstrate that Product meets requirements of this Section.
- .4 If Products from proposed source do not meet, or cannot reasonably be processed to meet specified requirements, locate an alternative source or demonstrate that Products source in questions can be processed to meet specified requirements.
- .5 Should a change of Products source be proposed during Work, advise Consultant 14 days in advance of proposed change to allow sampling and testing.
- .6 Acceptance of Product at source does not preclude future rejection if it is subsequently found to lack uniformity, or if it fails to conform to requirements specified, or if its field performance is found to be unacceptable. Remove and dispose rejected material.

.2 Production sampling:
- .1 Products may be subject to continual sampling by Consultant during production.
- .2 Afford Consultant ready access to source and processed Products for sampling and testing.
- .3 If Products fail to meet Specifications, bear cost of additional sampling and testing of aggregates and fill.
- .4 Supply necessary personnel and equipment to permit adequate investigation and sampling. Advise Consultant at least 14 days in advance of use of Products, to allow sufficient time for sampling and testing.

3 Execution

3.1 **EXAMINATION**

.1 Verify condition and dimensions of previously installed Work upon which this Section depends. Report defects to Consultant. Commencement of Work means acceptance of existing conditions.

3.2 **PREPARATION**

.1 Verify grades of items set in paving area for conformity with elevations and sections before placing granular base and subbase material.

.2 Obtain approval of subgrade by Consultant before placing granular subbase and base.

.3 Coordinate elevations of maintenance holes and other appurtenances and make flush with top of finish asphalt concrete paving.

3.3 **SUBBASE AND BASE**

.1 Comply with OPSS 314.

.2 Prior to placing subbase and base proof roll subgrade to identify soft spots. Excavate soft spots and backfill with granular material to 100% standard Proctor maximum dry density in accordance with ASTM D698.

.3 Place granular base and subbase material on clean unfrozen surface, free from snow and ice.

.4 Place granular base and subbase to compacted thicknesses as indicated. Do not place frozen material.

.5 Place in layers not exceeding 150 mm compacted thickness. Compact to density not less than 100 % standard Proctor maximum dry density in accordance with ASTM D698.

.6 Finished base surface to be within 5 mm of specified grade, but not uniformly high or low.

3.4 ASPHALT PRIMER

.1 Apply primer coat in accordance with OPSS 302.

.2 Do not apply primer when air temperature is less than 5°C or when rain is forecast within 2 hours.

.3 If asphalt primer fails to cure within 24 hours, spread sand blotter material in amounts required to absorb excess material. Sweep and remove excess blotter material.

3.5 EQUIPMENT

.1 Pavers: mechanical grade controlled self-powered pavers capable of spreading mix within specified tolerances, true to line, grade and crown indicated.

.2 Rollers: sufficient number of rollers of type and weight to obtain specified density of compacted mix.

.3 Vibratory rollers:
- .1 Minimum drum diameter: 750 mm.
- .2 Maximum amplitude of vibration (machine setting): 0.5 mm for lifts less than 40 mm thick.

.4 Haul trucks: of sufficient number and of adequate size, speed and condition to ensure orderly and continuous operation and as follows.

.5 Suitable hand tools.

3.6 ASPHALT PAVING

.1 Comply with requirements of OPSS 310.

.2 Obtain approval of tack coat base and primer from Consultant before placing asphalt mix.

.3 Place asphalt mix only when base or previous course is dry and air temperature is above 5°C.

.4 Place asphalt concrete in compacted layers not exceeding 50 mm per lift.

.5 Minimum 135°C mix temperature required when spreading.

.6 Maximum 160°C mix temperature permitted at any time.

.7 Compact each course with roller as soon as it can support roller weight without undue cracking or displacement.

.8 Compact paving to density not less than 97% of density obtained with Marshall specimens prepared in accordance with ASTM D1559. Roll until roller marks are eliminated.

.9 Keep roller speed slow enough to avoid mix displacement and do not stop roller on fresh pavement.

.10 Moisten roller wheels with water to prevent pick up of material.

.11 Compact mix with hot tampers or other equipment approved by Consultant, in areas inaccessible to roller.

.12 Finish surface to be within 5 mm of design elevation and with no irregularities greater than 10 mm in 4.5 m.

.13 Repair areas showing checking, rippling or segregation as directed by Consultant.

3.7 JOINTS

.1 Remove surplus material from surface of previously laid strip. Do not deposit on surface of freshly laid strip.

.2 Paint contact surfaces of existing structures such as catchbasins, manholes, curbs or gutters with tack coat prior to placing adjacent pavement.

.3 For cold joints, cut back to full depth vertical face and tack face with hot asphalt.

.4 For longitudinal joints, overlap previously laid strip with spreader by 25 to 50 mm.

3.8 PAVEMENT MARKINGS

.1 Spray paint parking zone lines and other pavement markings indicated, included, but not limited to, hash marks for no parking areas, direction arrows and handicap parking symbols.

.2 Use suitable compressor type striping machine. Use templates for symbols, arrows, lettering.

.3 Unless otherwise indicated, paint lines 125 mm wide.

.4 Paint lines straight, or uniformly curved, with well defined edges and full paint coverage in all locations.

3.9 FIELD QUALITY CONTROL

.1 Conduct following field tests, submit report to Consultant:
- .1 Granular materials for composition and gradation.
- .2 Granular material and asphalt concrete compaction.

3.10 PROTECTION

.1 Keep vehicular traffic off newly paved areas until paving surface temperature has cooled below 38°C. Do not permit stationary loads on pavement until 24 hours after placement.

3.11 **SCHEDULE**

.1 Refer to Geotechnical Report for compacted thicknesses of pavement structures for asphaltic concrete paving, unless otherwise indicated.

.2 Paving on public property, meet requirements of municipality.

END OF SECTION

1 General

1.1 **SECTION INCLUDES**

.1 Design, labour, Products, equipment and services necessary for concrete curbs and pavements Work in accordance with the Contract Documents.

1.2 **REFERENCES**

.1 ASTM A1064/A1064M, Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.

.2 ASTM C260, Specification For Air-Entraining Admixtures For Concrete.

.3 ASTM C309, Specification For Membrane-Forming Compounds for Curing Concrete.

.4 ASTM C494/C494-M, Specification For Chemical Admixtures For Concrete.

.5 ASTM D994, Specification For Preformed Expansion Joint Filler For Concrete (Bituminous Type).

.6 CAN/CSA A23.1/A23.2-M, Concrete Materials and Methods of Concrete Construction/Methods of Tests For Concrete.

.7 CAN/CSA A3000, Cementitious Materials Compendium.

.8 CAN/CSA G30.18-M, Billet-Steel Bars for Concrete Reinforcement.

.9 CSA O121, Douglas Fir Plywood.

.10 CAN/CSA S269.3-M, Concrete Formwork.

1.3 **DESIGN REQUIREMENTS**

.1 Concrete: 30 Mpa unless otherwise indicated on drawings. Exterior concrete to have 5-7% entrained air.

.2 Design concrete so that material will not segregate and excessive bleeding will not occur.

.3 Comply to the MTC Manual of Uniform Traffic Control Devices for signs and flagging when working within existing road ways. Any requirements to restrict local traffic due to the contractors works, must be reviewed and approved by the Consultant.

1.4 **SUBMITTALS**

.1 Product data:
- .1 Submit duplicate copies of manufacturer's Product data in accordance with the Conditions of the Contract for each material indicating:
  - .1 Performance criteria, compliance with appropriate reference standard(s), and characteristics.

.2 Product transportation, storage, handling and installation requirements.

.2 Shop drawings: Submit shop drawings in accordance with the Conditions of the Contract indicating elevations, sections, details, materials, joint assemblies, finishes and relationships to adjacent construction.

1.5 **QUALITY ASSURANCE**

.1 Inspection and testing:
.1 Materials: CAN/CSA A23.1/A23.2-M; Inspect and test for conformance to requirements of this Standard and to Specifications.
.2 Tests will be made in accordance with CAN/CSA A23.2-M.
.3 Remove defective materials and completed Work which do not conform to the Contract Documents.

1.6 **DELIVERY, STORAGE, AND HANDLING**

.1 Deliver and store materials on Site in accordance with CAN/CSA A23.1/A23.2-M.

1.7 **SITE CONDITIONS**

.1 Conform to CAN/CSA A23.1/A23.2-M.

.2 Do not deposit concrete on frozen ground. When deposited in forms concrete shall have a temperature between 10°C and 30°C and these limits shall be maintained for 72 hours.

2 Products

2.1 **MATERIALS**

.1 Forms: Plywood to CSA O121, G1S; Douglas Fir plywood, seven ply, exterior grade, waterproof glue, edges sealed with oil based sealer.

.2 Form ties: Adjustable snap ties, formed to break 25 mm or more from surface of concrete after form removal, with a minimum working strength of 1360 kg.

.3 Form release agent: 100% biodegradable, chemically active, VOC compliant, 'Bioform' by Universal Building Product or approved alternative by Allied Chemical or W.R. Meadows.

.4 Reinforcing steel: CAN/CSA G30.18-M; Billet-steel bars, deformed unless indicated otherwise, Grade 400R.
.5 Welded steel wire fabric: ASTM A1064/A1064M; Resistance welded in size and spacing shown for smooth wire fabric, in flat sheets only.

.6 Chairs, bolsters, supports, spacers: CAN/CSA A23.1-M with sufficient strength to rigidly support weight of reinforcement and construction loads. Manufactured by NCA/Acrow - Richmond or Dayton Superior.

.7 Cement: CAN/CSA A3000; Portland, Type 10.

.8 Coarse and fine aggregate: CAN/CSA A23.1/A23.2-M.

.9 Water: CAN/CSA A23.1/A23.2-M.

.10 Water reducing admixture: ASTM C494/C494-M, Type A.

.11 Set retarding admixture: ASTM C494/C494-M, Type D.

.12 Air entraining admixture: CAN/CSA A23.1/A23.2-M and ASTM C260.

.13 Pigmented curing compound: ASTM C309, Type 2, Class B; White pigmented resin based.

.14 Joint filler: ASTM D994, Asphalt impregnated; 'Asphalt Joint Expansion Joint Filler' by W. R. Meadows Ltd., in thickness shown on Contract Drawings. Furnish kraft paper or polyethylene sheet as bond breaker between sealant and joint filler

.15 Joint Sealant: Cold applied, rubberized asphalt sealer; 'Sealer #158' by W. R. Meadows Ltd. or approved alternative.

.16 Bonding Agent: Furnish 'Sika-Dur' by Sika, or 'Intralock' by W. R. Meadows.

.17 Tactile walking surface: Cast in place tile formed of glass, carbon and fiberglass reinforced composite, with integral non-slip surface stamped into tile and on top of domes. Tile shall have minimum thickness of 6 mm. 'Cast-in-Place Tactile Panels' as manufactured by ADA Solutions Inc. or approved alternative.

2.2 MIXES

.1 Acceptance of any concrete mix proportion or material, does not preclude its future rejection if it is subsequently found to lack uniformity, or if it fails to conform to requirements specified, or if its field performance is found to be unacceptable.

.2 Mix concrete and concrete proportions in accordance with CAN/CSA A23.1/A23.2-M.

2.3 ADMIXTURES

.1 Use admixtures for concrete from single manufacturer, unless otherwise acceptable to Consultant.

.2 Have manufacturer certify that admixtures are compatible.

.3 Add admixtures to concrete mix in accordance with manufacturer's recommendations.

.4 Except as specified otherwise, comply with requirements of CAN/CSA A23.1/A23.2-M.

.5 Use of calcium chloride or additional admixtures, other than those specified, is not acceptable.

3 Execution

3.1 **EXAMINATION**

.1 Verify condition and dimensions of previously installed Work upon which this Section depends. Report defects to Consultant. Commencement of Work means acceptance of existing conditions.

3.2 **GENERAL**

.1 Give Consultant at least 2 working days notice prior to placement of concrete to permit a review of compaction, placement of formwork, reinforcing steel, and associated items embedded in concrete for conformance to reviewed shop drawings and Contract Documents.

.2 Do not place concrete on surfaces which contain frost, water or debris.

.3 Provide concrete curb cuts and sidewalk handicap access ramps as indicated, in accordance with the authorities having jurisdiction.

3.3 **PREPARATION**

.1 Verify grades of items set in paving area for conformity with elevations and sections before placing granular base and subbase material.

.2 Obtain approval of subgrade by Consultant before placing granular subbase and base.

.3 Set out work from lines and levels shown on drawings.

.4 Prevent damage to adjacent and/or existing buildings and/or properties, and existing curbs, sidewalks and asphalt paving.

.5 Accurately saw-cut and modify existing sidewalks to nearest adjacent dummy/expansion joint as directed on site by Consultant.

.6 Remove and dispose of debris from the work of this section in accordance with authorities having jurisdiction.

.7 Fine grade, shape and compact subgrade to minimum of 95% Standard Proctor Density.

.8 Wet base immediately in advance of concreting to ensure a firm moist surface without ponding.

.9 Repair damage to base resulting from hauling or equipment operations.

3.4 **FORMWORK**

.1 Construct formwork in accordance with CAN/CSA S269.3-M to produce finished concrete conforming to shape, dimensions, locations and elevations indicated. Ensure no lumber remains in concrete.

.2 Set forms true to line and grade, join neatly and tightly, and stake securely to resist concrete pressure and impact from tampers without springing.

.3 Apply release agent by spray in accordance with manufacturer's recommendations. Ensure form surfaces receive a uniform coating.

3.5 REINFORCING

.1 Place reinforcing steel as shown on reviewed shop drawings and in accordance with CAN/CSA A23.1-M. Make bars as long as possible.

.2 Make splices in locations shown on Drawings. Lap lengths in accordance with CSA A23.3 unless otherwise shown.

.3 Lap ends and sides of wire fabric not less than 150 mm.

3.6 PLACING OF CONCRETE

.1 Before placing fresh concrete against set or partially set concrete, clean surfaces to remove dirt, scum, shavings, debris, laitance, etc. on set surfaces, brush generously with bonding agent.

.2 Place concrete in accordance with CAN/CSA A23.1/A23.2-M.

.3 Slope concrete to levels shown on Contract Drawings.

.4 Do not place concrete at such a rate as to endanger formwork or to prevent proper compaction.

.5 Place concrete to prevent cold joints and segregation and vibrate sufficiently to ensure thorough compaction, maximum density in accordance to CAN/CSA A23.1/A23.2-M

.6 Check Work frequently with accurate instruments during placing of concrete.

.7 When completing concrete placement for day, carry placement through to a scheduled joint location.

.8 Where concrete placement is stopped for more than 30 minutes due to breakdowns, weather or any other reasons, construct extra bulkhead and construction joint as directed.

3.7 CONCRETE CURBS

.1 Align concrete curbs with curves and tangents indicated on drawings. Concrete curb to be in accordance to details indicated on drawings.

.2 Where existing curb is met, the contractor must make the required transition to style and grade of existing curb to the satisfaction of the Consultant.

.3 Curbs shall have expansion joints at minimum 4500 mm o.c. and in accordance with authorities having jurisdiction. Place reinforcing bars at top and base of curb, with minimum 50 mm concrete cover.

.4 All restoration of the existing road structure for the transition to existing curb is the responsibility of the contractor.

.5 Finish edges of dummy joints and expansion joints with 3 mm radius edging tool.

3.8 CONCRETE PAVEMENTS

.1 Concrete sidewalk to be in accordance with details indicated on drawings.

.2 Concrete for standard sidewalk to be 150 mm thick, except through entrances where the concrete shall be 200 mm thick with wire mesh. The compacted granular 'A' is to be 150 mm thick at all locations.

.3 Where existing sidewalk is met, make the required transition to grade, to the satisfaction of the Consultant. Furthermore, co-ordinate with the City and Consultant, to insure compatibility of existing and or future adjacent works by City forces.

.4 All structural concrete, such as but not limited to, concrete walkway adjacent to building, concrete pads for loading docks, and concrete slabs for loading areas to be constructed in accordance with reviewed shop drawings.

.5 Dummy joints: 6 mm deep at 1500 mm o.c. Tool joints with 6 mm wide steel trowel, radiusing edges 6 mm.

.6 Expansion joints: 6000 mm o.c. maximum.

.7 Tool edges of sidewalk with 50 mm wide steel trowel, radiusing edges 6 mm.

.8 Install sealant in expansion/isolation joints as shown and specified.

3.9 CONSOLIDATING

.1 Consolidate concrete in accordance with CAN/CSA A23.1/A23.2-M

.2 Work concrete into complete contact with forms and embedded items. Consolidate concrete adjacent to side forms and along entire length of forms to ensure a smooth surface finish after stripping of formwork.

3.10 CURING AND PROTECTION

.1 Cure and protect concrete in accordance with CAN/CSA A23.1/A23.2-M.

.2 Apply curing compound after finishing operations have been completed, at rate recommended by compound manufacturer. Ensure compound application is uniform and continuous over entire area being cured.

3.11 CONSTRUCTION JOINTS

.1 Obtain Consultant's acceptance to install construction joints in locations other than those shown.

.2 Construct construction joints to CAN/CSA A23.1-M and as shown. Supply and install dowels in construction joints unless otherwise detailed.

.3 Joints at building face or other abutments: place 12 mm joint filler keeping top 12 mm below concrete surface; apply kraft paper or polyethylene bond over filler and fill with self-levelling sealant applied in accordance with manufacturer's printed instructions.

.4 For sawn joints:
- .1 Do sawn joints in accordance with drawing details. Prepare sample sawn joint for approval by Consultant.
- .2 Ensure joints are straight. Mark alignment with chalk line or other suitable guide. Layout to be approved by Consultant.
- .3 Saw joints using approved equipment and methods to produce joint dimensions indicated.
- .4 Supply sufficient men and equipment including standby equipment, to maintain a satisfactory sawing schedule.
- .5 Schedule sawing operations on 24 hour basis and consistent with concrete placing.
- .6 Make initial saw cuts in a progressive manner and as soon as possible without excessive ravelling.
- .7 If a crack occurs ahead of saw cut, stop immediately. Move ahead several joints and cut one or more joints before returning to saw intermediate joints. Where cracking persists, make 1060 mm saw cut from one edge and complete sawing from opposite edge. Adjust sawing schedule accordingly.
- .8 If uncontrolled cracking or other surface damage results from inadequate or improper sawing techniques suspend further concrete operations until situation is corrected and immediately remove and replace damaged slabs.
- .9 Immediately on completion of sawing, flush joints with water to remove laitance.

3.12 FINISHING

.1 When striking off concrete surface, maintain a uniform roll of concrete ahead of first screed for it's full length when finishing machine is on first pass.

.2 Where joints are formed rather than sawn, form longitudinal and transverse joints after final pass of finishing machine.

.3 Hand finish areas inaccessible to finishing machine to same quality and surface characteristics as machine finished surfaces.

.4 Finish concrete surface with an approved float at proper time. Operate from edge to edge with a wiping motion while advancing , with each succeeding pass overlapping previous one.

.5 Check surface with approved straightedge 4500 mm long. Correct irregularities exceeding 5 mm before concrete takes initial set.

.6 Finish edges of slabs with edging tool to form a smooth squared surface. Do not patch with cement paste.

3.13 IDENTIFICATION STAMP

.1 For sidewalks in the public right-of-way, mark concrete at each end of the work and at least every 18000 mm or such other places as the Consultant may select.

.2 The stamp shall be located on the centre of the bay of walk, next to and parallel to a transverse joint.

.3 The size and shape of the stamp shall be as shown on City of Napanee Drawings.

.4 The imprint shall be clear and legible and satisfactory to the Consultant.

3.14 BROOM FINISH

.1 Commence texturing immediately after float finishing.

.2 Use soft bristled broom to produce an approved light, non-slip concrete surface finish with fine granular or sandy texture free from disfigurations. Finishes to be approved by Consultant.

.3 Apply broom finish at right angles to curb and parallel to joints. All trowel and tool marks to be removed with broom. Do not contaminate joints by over-brooming.

3.15 REMOVAL OF FORMS

.1 Do not disturb forms until concrete has hardened and developed sufficient strength to safely support its own weight and load on it.

.2 Strip formwork in accordance with CAN/CSA A23.1-M.

3.16 DEFECTIVE CONCRETE

.1 Concrete is defective when:
- .1 Containing excessive honeycombing or embedded debris.
- .2 Concrete damaged by freezing or which is unsatisfactory due to placement at too high a temperature.
- .3 Average 28 day strength of any three consecutive strength tests is less than specified minimum 28 day strength.
- .4 Any 28 day strength test result is less than 80% of specified minimum 28 day strength.
- .5 Surface texturing, joint type and placement and tolerances are unacceptable in the opinion of the Consultant.

.2 Repair of defective concrete work:
- .1 Repair defective areas while concrete is still plastic, otherwise wait until curing is completed. Use repair methods approved by Consultant.
- .2 Grind off high surface variations where directed.

.3 Remove and replace defective concrete where directed.
- .1 Remove minimum 3000 mm of pavement by sawing through concrete across full lane width.
- .2 Replace with new concrete to this specification.
- .3 Construct dummy contraction joint between sawn face of existing concrete and face of new concrete.

3.17 PROTECTION

.1 Do not open concrete pavement to traffic or construction equipment until concrete reaches 70% of specified strength or until approved by Consultant.

END OF SECTION

1 General

1.1 **SECTION INCLUDES**

.1 Labour, Products, equipment and services necessary for foundation drainage Work in accordance with the Contract Documents.

1.2 **REFERENCES**

.1 ASTM D3350, Standard Specification for Polyethylene Plastics Pipe and Fittings Materials.

.2 ASTM F449, Standard Practice for Subsurface Installation of Corrugated Polyethylene Pipe for Agricultural Drainage or Water Table Control.

.3 ASTM F667, Standard Specification for 3 through 24 in. Corrugated Polyethylene Pipe and Fittings.

1.3 **SUBMITTALS**

.1 Product data:
- .1 Submit manufacturer's Product data in accordance with the Conditions of the Contract indicating:
  - .1 Performance criteria, compliance with appropriate reference standard(s), characteristics, and limitations.
  - .2 Product transportation, storage, handling and installation requirements.

.2 Samples:
- .1 Submit following samples in accordance with the Conditions of the Contract:
  - .1 Two 300 x 300 mm samples of drainage board.
  - .2 Two 300 mm long samples of perimeter drainage and/or pipe.

2 Products

2.1 **MATERIALS**

.1 Perimeter drainage:
- .1 ASTM D3350 and ASTM F667, 100 mm diameter HDPE, perforated with fittings prewrapped with filter cloth by Ideal Pipe or approved alternative or 'TREMDrain Total Drain' by Tremco Inc, or approved alternative by Cosella-Dorken or W. R. Meadows.
- .2 Perimeter drainage system to be complete with accessories as required for complete installation including but not limited to corner guard pieces and outlet pipe connections.

.2 Drainage board: Three-dimensional dimpled core and geotextile fabric complete with adhesive or fasteners as required for installation. 'Miradrain 6000' by Carlisle Coatings and Waterproofing, 'Delta-Drain 6000' by Cosella-Dorken, 'TREMDrain' by Tremco Inc. or 'Mel-Drain 5035' by W. R. Meadows.

.3 Drainage pipe: ASTM D3350 and ASTM F667, 100 mm diameter HDPE by Ideal Pipe or approved alternative, unperforated with fittings, and perforated with fittings prewrapped with filter cloth in locations as indicated on drawings or as specified herein.

.4 Clean outs: 100 mm HDPE outlets , tees, extension pipes, reducers, flush plugs, etc. suitable for use with drainage pipe as manufactured by Canron Inc, Ideal Pipe, or approved alterative.

.5 Foundation drainage Pipe Fill: 19 mm clear stone in accordance with OPSS 1004.

.6 Granular fill: Free draining, sharp, hard, durable, granular material conforming to OPSS 1010, Type A.

.7 Filter cloth: Terrafix 270R as manufactured by Terrafix Geosynthetics Inc., or approved alternative by Foundation Geotextiles or US Fabrics Inc.

3 Execution

3.1 **EXAMINATION**

.1 Verify condition and dimensions of previously installed Work upon which this Section depends. Report defects to Consultant. Commencement of Work means acceptance of existing conditions.

3.2 **PREPARATION**

.1 Verify substrate surfaces are solid, free from surface water, frozen matter, dust, oil, grease, scaling or laitance, projections and any other foreign matter detrimental to installation.

3.3 **INSTALLATION**

.1 Install perimeter drainage around perimeter of basement and elevator pits and where indicated on Drawings.

.2 Install drainage board in accordance with ASTM F449 and manufacturer's recommendations. Drainage board shall extend full height of foundation wall to top of footing where indicated on Drawings. Install drainage board after installation of waterproofing membrane is complete. Position panel with flat side against wall and filter fabric toward soil/drainage side and attach to foundation wall using manufacturer approved fastening system.

.3 Provide unperforated drainage pipe between perforated drainage pipe and drain connection installed by Division 22 and 23.

.4 Install drainage pipe on a bed of foundation drainage fill, minimum 100 mm deep where pipe is not placed over footing, and surround with same fill 150 mm thick at sides and over top of pipe and for under floor drainage extend fill to under side of slab.

.5 Provide cleanouts on non-perforated pipe at all changes of direction and in pipe runs greater than 15 metres. Provide flush cleanouts where indicated.

.6 Cover foundation drainage fill with filter cloth. Cover filter cloth with sand 300 mm thick at top and sides.

END OF SECTION

1 NOTES

1. Read Room Finish Schedule & Colour and Material Schedule in conjunction with full specifications and drawings.

2. It is the sub trades' responsibility to review the Room Finish & Colour Schedule and bring to the attention of the consultant any discrepancies, errors or inconsistencies. Those proceeding with work are responsible to correct mistakes.

3. Where specified products have more than one approved manufacturer, colour selections are indicated for each manufacturer. No alternates will be allowed where finishes are single sourced.

4. Provide paint finish on all exposed interior surfaces and components as described in specification section 09 91 00 - Painting. This includes architectural, structural, mechanical and some electrical components. Exposed deck and structure throughout to be painted PT3 including all mechanical/electrical exposed conduit, ducts, piping and sprinkler piping. All exposed ceiling services must be painted out.

5. Tubular steel framing for basketball backstop TBD.

6. Millwork laminate colours in Learning Commons refer to drawings for locations.

7. All interior Hollow Metal doors, frames and screens in Corridors to be painted PT-2 unless noted otherwise. Accent colours used on Learning Studio door frames as indicated on finish plan (TBD). All exterior HM doors and frames to be painted EXPT-1 (colour to be confirmed).

8. Prefinished parapet flashing to be Vic West Charcoal QC16072 or approved equal.

9. Fire extinguisher cabinets – PT-2.

10. Heart Wall Graphic TBD. Assume 8 Accent paint colours for tender.

2 ABBREVIATIONS

*	REFER TO REMARKS COLUMN
AL or ALUM	ALUMINUM
A.BLK	ARCHITECTURAL BLOCK
ACT	ACOUSTIC CEILING TILE
BFPB	BARRIER FREE PUSH BUTTON
BH	BREAKAWAY HOOKS
BL or BLK	BLOCK
BKHD	BULKHEAD
BN	BULLNOSE
BR	BRICK
CL or CLR	CLEAR (NO FINISH)
CONC	CONCRETE
CPT	CARPET TILE
CT	CERAMIC TILE

CW	CURTAIN WALL
EP	EPOXY PAINT
EPC	EXPOSED PRECAST CONCRETE
ES	EXPOSED STRUCTURE
EX or EXIST	EXISTING
EXP	EXPOSED
FEC	FIRE EXTINGUISHER CABINET
FF	FACTORY FINISH
GL	GLAZING
GWB	GYPSUM WALL BOARD
HM	HOLLOW METAL
HT	HEIGHT
LVT	LUXURY VINYL TILE
OWSJ	OPEN WEB STEEL JOIST
PT	PAINT
PL or PLAM	PLASTIC LAMINATE
RB	RESILIENT BASE
RSF	RESILIENT SHEET FLOORING
STN	STAIN
W/	WITH
WD	WOOD

3 FINISH SELECTIONS

06 20 00 Finish Carpentry

Plastic Laminate (Reception Desk, Window Stools and Front Face of Control Panels Throughout) **PL-1**	**PL-1** – Formica Colour: Natural Birch 7481-58 Finish: Matte
Plastic Laminate (Reception Desk Countertop) **PL-2**	**PL-2** – Formica Colour: Citadel Warp 5882-58 Finish: Matte Or **PL-2**- Wilsonart Colour: Evening Tigris 4674-60 Finish: Velvet Finish Or **PL-2**- Arborite Colour: Chambray Ombre P414-CA Finish: Cashmere Finish

Plastic Laminate (Millwork Learning Commons 127, 137 & 206 as Noted) **PL-3**	**PL-3** – Wilsonart Colour: Island D498-60 Finish: Matte Finish
Plastic Laminate (Millwork Learning Commons 127, 144 & 217 as Noted) **PL-4**	**PL-4** – Wilsonart Colour: Sunny Side Up 13089-60 Finish: Matte Finish
Plastic Laminate (Millwork Learning Commons 127, 137 & 206 as Noted) **PL-5**	**PL-5** – Wilsonart Colour: Catalina 13092-60 Finish: Matte Finish
Plastic Laminate (Millwork Learning Commons 137 & 226 as Noted) **PL-6**	**PL-6** – Wilsonart Colour: Dragon Fire 13088-60 Finish: Matte Finish
Plastic Laminate (Millwork Learning Commons 137, 144 & 226 as Noted) **PL-7**	**PL-7** – Wilsonart Colour: Candy Apple 13096-60 Finish: Matte Finish
Plastic Laminate (Millwork Learning Commons 144 & 217 as Noted) **PL-8**	**PL-8** – Wilsonart Colour: Gumball 13012-60 Finish: Matte Finish
Plastic Laminate (Countertops in Childcare As Noted) **PL-9**	**PL-9** –Pionite Colour: Estrella AG011 SD Finish: Textured Suede
Plastic Laminate (Millwork in Childcare) **PL-10**	**PL-10** – Nevamar Colour: Planetree Maple WM2640-T Finish: Textured
Fabric (Seating Nooks) **FAB-1**	**FAB-1** – TPE Fabric Manufacturer: LDI Interiors Pattern: California Colour: Rust Contents: 55% TPE, 35% Polyester, 10% Cotton Backing: Polyester Width: 54" Repeat: None Durability: Exceeds 500,000 double rubs (Wyzenbeek)

Fabric (Seating Nooks) **FAB-2**	**FAB-2** – TPE Fabric Manufacturer: LDI Interiors Pattern: California Colour: Silicon Valley Contents: 55% TPE, 35% Polyester, 10% Cotton Backing: Polyester Width: 54" Repeat: None Durability: Exceeds 500,000 double rubs (Wyzenbeek)
Fabric (Seating Nooks) **FAB-3**	**FAB-3** – TPE Fabric Manufacturer: LDI Interiors Pattern: California Colour: Mauve Contents: 55% TPE, 35% Polyester, 10% Cotton Backing: Polyester Width: 54" Repeat: None Durability: Exceeds 500,000 double rubs (Wyzenbeek)
Fabric (Seating Nooks) **FAB-4**	**FAB-4** – TPE Fabric Manufacturer: LDI Interiors Pattern: California Colour: Solstice Contents: 55% TPE, 35% Polyester, 10% Cotton Backing: Polyester Width: 54" Repeat: None Durability: Exceeds 500,000 double rubs (Wyzenbeek)
Fabric (Seating Nooks) **FAB-5**	**FAB-5** – TPE Fabric Manufacturer: LDI Interiors Pattern: California Colour: Royal Contents: 55% TPE, 35% Polyester, 10% Cotton Backing: Polyester Width: 54" Repeat: None Durability: Exceeds 500,000 double rubs (Wyzenbeek)
Fabric (Seating Nooks)	**FAB-6** – TPE Fabric Manufacturer: LDI Interiors Pattern: California Colour: Tucson Contents: 55% TPE, 35% Polyester, 10% Cotton

FAB-6	Backing: Polyester Width: 54" Repeat: None Durability: Exceeds 500,000 double rubs (Wyzenbeek)
High Density Upholstery Memory Foam	Firm Density 3.0 lbs. min To exceed 10 years Life Expectancy
Breakaway Hooks (Coat Areas) **BH**	**BH1 –** Henkel Hooks Colour: HD001 Graphite
Millwork Corner Guards (Corners of Learning Commons bookcases) **DM-1**	Inpro Corp. ½" Satin Aluminum Corner Guard Code: #DW-AL01212-CLR Finish: Clear **Or Approved Equal**
Wood – Solid	Hardwood Birch
Wood Veneer	Birch hardwood veneer c/w solid Birch edging.

06 61 00 – Solid Surfacing Fabrication

Solid Polymer Surfacing (Countertops throughout school as noted with the exception of Childcare) Note: Backsplashes and Sidesplashes to be coved. **SPS-1**	**SPS-1** – Avonite Colour: Signal 7826 12 mm thick **OR** **SPS-1** – LX Hausys Colour: Naples N904 12 mm thick
Solid Polymer Surfacing (Countertops in 114 Teaching Kitchen) **Note: Backsplashes and Sidesplashes to be coved.** **SPS-1**	**SPS-2 –** Avonite Colour: Artica 9015 12 mm thick **OR** **SPS-2 –** LX Hausys Colour: Aurora Frost M702 12 mm thick

09 67 70 Waterproof Flooring

Cold Fluid-Applied Waterproofing **CFAW1**	**CFAW1** –Sikafloor Resoclad MRW Type III Colour: Telegrey 2 - RAL 7046 **Or Approved Equal**

09 51 00 Acoustical Ceilings

Acoustical Ceiling Tile **ACT-1**	**ACT-1 –** Armstrong Ceilings # 1913 Ultima Fine Texture Square Lay-in tile With HumiGuard Plus and BioBlock Plus 610mm x 1220mm x 16mm thick Suspension Grid System: Prelude XL - 23mm wide exposed T-grid, colour - White OR **ACT-1** – CGC Inc. Mars ClimaPlus 88185 Square Lay-in tile 610mm x 1220mm x 16mm thick Suspension Grid System: Donn DX- 23mm wide exposed T-grid, colour - White OR **ACT-1** – CertainTeed Ceilings Symphony m 1220-75-1 Trim (Square Lay-in tile) 610mm x 1220mm x 19mm thick Suspension Grid System: 24mm Classic Hook System Exposed T-grid, colour – White
Acoustical Ceiling Tile (Learning Studios and Corridors as Noted) **ACT-2**	**ACT-2 –** Armstrong Ceilings # 1913 Ultima Fine Texture Square Lay-in tile With HumiGuard Plus and BioBlock Plus with Axiom Knife Edge 6" Trim 610mm x 1220mm x 16mm thick Suspension Grid System: Prelude XL - 23mm wide exposed T-grid, colour - White OR **ACT-2** – CGC Inc. Mars ClimaPlus 88185 Square Lay-in tile With Compasso Slim Perimeter Trim 6" 610mm x 1220mm x 16mm thick Suspension Grid System: Donn DX- 23mm wide exposed T-grid, colour - White

Acoustical Ceiling Tile (Learning Commons) **ACT -3**	**ACT-3 –** Armstrong Ceilings # 1913 Ultima Fine Texture Square Lay-in tile With HumiGuard Plus and BioBlock Plus with Axiom Vector Inverted 4" Trim 610mm x 1220mm x 16mm thick Suspension Grid System: Prelude XL - 23mm wide exposed T-grid, colour - White OR **ACT-3** – CGC Inc. Mars ClimaPlus 88185 Square Lay-in tile With Compasso Perimeter Trim 4" 610mm x 1220mm x 16mm thick Suspension Grid System: Donn DX- 23mm wide exposed T-grid, colour – White
Acoustical Ceiling Tile (Heart) **ACT -4**	**ACT-4 –** Armstrong Ceilings Formations Floating Clouds with Axiom Knife Edge 6" Trim Note: Existing Decorated Ceiling Tiles will be added to clouds 610mm x 1220mm x 19mm thick Suspension Grid System: Prelude XL - 23mm wide exposed T-grid, colour - White **Or Approved Equal**

09 65 16 Resilient Flooring

Resilient Sheet Flooring (Washrooms) **Note: Colours to be confirmed prior to ordering**	**RSF-1A** –Mannington BioSpec MD Colour: 15514 Snowy Owl OR **RSF-1A** – Tarkett iQ Optima Colour: S0248 Cool Light Beige **RSF-1B** –Mannington BioSpec MD Colour: 15409 Sapphire OR **RSF-1B** – Tarkett iQ Optima Colour: 0847 Light Red Blue

RSF-1	**RSF-1C** –Mannington BioSpec MD Colour: 15432 Buzzy Bee OR **RSF-1C** – Tarkett iQ Optima Colour: 0824 Yellow **RSF-1D** – Mannington BioSpec MD Colour: 15436 Snow Pea OR **RSF-1D** – Tarkett iQ Optima Colour: 0861 Green **RSF-1E** – Mannington BioSpec MD Colour: 15431 Zucca OR **RSF-1E** – Tarkett iQ Optima Colour: 0257 Orange
Resilient Sheet Flooring (Kindergarten) • **NOTE: RSF-2 to be feathered up to join flush at CPT1.** **RSF-2**	**RSF-2 –**Tarkett Omnisports Speed Colour: Golden Maple 3.5 mm thick ASTM F2772: Class 1
Rubberized Sports Flooring (Gymnasium) • **NOTE: RSF1 to be feathered up to join flush at CT1/VCT1.** **RSF-3**	**RSF-3 –** Tarkett Omnisports Multiflex Colour: Pure Maple 6.5 mm thick ASTM F2772: Class 2

Resilient Sheet Flooring (Mudrooms) **Note: Colours to be confirmed prior to ordering** **RSF-4**	**RSF-4A** – Tarkett LinoFloor xf² Colour: Veneto Grey 793 **RSF-4B** – Tarkett LinoFloor xf² Colour: Veneto Lavender 670 **RSF-4C** – Tarkett LinoFloor xf² Colour: Veneto Corn 612 **RSF-4D** – Gerflor DLW Linoleum Colorette Colour: Apple Green 754 **RSF-4E** – Tarkett LinoFloor xf² Colour: Veneto Copper 634
Resilient Sheet Flooring (Childcare) **RSF-5**	**RSF-5** – Tarkett iQ Optima Colour: Slate 0897
Luxury Vinyl Tile (Main Office As Noted) **LVT - 1**	**LVT-1 –** True North Luxury Vinyl as Distributed by C.D.S. Distribution 416-669-6647 Colour: 2111 Aged Sterling Oak Size: 6" x 48" 2.5 mm Thick/ 0.7 mm Wear Layer 15 Year Heavy Commercial Warranty OR **LVT-1 –** Tarkett Contour Wood Colour: Modern Wood Loft Oak 3732 Size: 6" x 48" – Ref: 251075006 3.0 mm Thick/ 0.8 mm Wear Layer 25 Year Limited Warranty **OR** **LVT-1 –** Mannington Amtico Signature Xpress Collection Colour: AROW8430 Toulouse Oak 2.5 mm Thick/ 40 mil Wear Layer 25 Year Limited Commercial Warranty

Luxury Vinyl Tile (At all Corridor Millwork Sink Stations and Corridors at Washrooms As Noted) **LVT - 2**	**LVT-2 –** True North Luxury Vinyl as Distributed by C.D.S. Distribution 416-669-6647 Colour: 9109 White Oak Size: 9" x 48" 5.0 mm Thick/ 0.7 mm Wear Layer 15 Year Heavy Commercial Warranty **OR APPROVED EQUAL**
Rubber Base **RB-1**	**RB1** – Johnsonite Colour: 32 Pebble WG Or **RB1** – Roppe 700 Series Colour: 178 Pewter
Rubber Wall Base (With Carpet Floor) **Note: Colours are for Tender Only. TBD once flooring manufacturers are awarded.** **RB-2**	**RB-2 -**Johnsonite/Tarkett Toeless Wall Base Colour: DC – 20 Charcoal WG Height: 4" H X 0.125" Thick OR **RB-2 -** Roppe 700 Series No Toe Colour: 125– Fig Height: 4" H X 0.125" Thick
Stair Treads /Rubber Tiles On Landings (Stair Tread Nosing and Rubber Tile on Landings to match for Stairs A, B, C & D) **RT-1**	**RT-1** Johnsonite/Tarkett Rubber Tread with Integrated Riser For the Visually Impaired Raised Round Profile Colour: RTR-32-RD Pebble Solid Colour Rubber Insert 40 Black **OR** **RT-1** Roppe #92 Low Profile Raised Circular Design 178 Pewter Solid Rubber Insert in 40- Black For the Visually Impaired
Static Dissipative Tile (Communications Room, Data Rooms) **SDT-1**	**SDT-1** – Tarkett iQ Granit SD Colour: 0948 Grey 610mm X 610mm **OR Approved Equal**
Vinyl Composition Tile (Temporary Staff Room Infill) **VCT-1**	**VCT-1** – Armstrong Imperial Texture Colour: 57508 Blue Dreams **OR Approved Equal**

09 67 23 Seamless Epoxy Flooring

Epoxy Flooring (Vestibules) **EPX-1**	**EPX-1** –Stoneshield HRI Colour: Frappe or Gotham Gray with a clear top coat. Cove to match with SS end cap **OR** **EPX-1** - Sikafloor Quartzite HDB system Colour: 530 with clear top coat - Sikafloor Duochem 942 clear Cove to match with SS end cap

09 68 16 Tile Carpeting

Tile Carpeting (Field Carpet) **CPT-1**	**CPT-1 –** Mannington Product: Visible Light Colour: Frequency Size: 18" X 36" modular tile **OR Approved Equal**
Tile Carpeting (Accent Carpet) **CPT-2**	**CPT-2** – Mannington Product: Visible Light Colour: Full Spectrum Size: 18" X 36" modular tile **OR Approved Equal**

09 84 10 – Acoustic Treatment – Walls*

Acoustical Wall Panels* (Learning Commons and Gymnasium as Noted) • **Note: Sheets to be cut according to drawing** **AWP-1**	**AWP-1-** Hush Acoustics Rectangular Sheet – Square Profile Colour: Oyster Sheet Size: 1220 mm x 2743 mm x 12mm for walls **OR Approved Equal**
Acoustical Wall Panels* (Learning Commons and Gymnasium as Noted) • **Note: Sheets to be cut according to drawing** **AWP-2**	**AWP-2** – Hush Acoustics Rectangular Sheet – Square Profile Colour: Moss Sheet Size: 1220 mm x 2743 mm x 12mm for walls **OR Approved Equal**
Acoustical Wall Panels* (Learning Commons and Gymnasium as Noted) • **Note: Sheets to be cut according to drawing** **AWP-3**	**AWP-3** Hush Acoustics Rectangular Sheet – Square Profile Colour: Sunflower Sheet Size: 1220 mm x 2743 mm x 12mm for walls **OR Approved Equal**

Acoustical Wall Panels* (Learning Commons As Noted) • **Note: Sheets to be cut according to drawing** **AWP-4**	**AWP-4** Hush Acoustics Rectangular Sheet – Square Profile Colour: Apricot Sheet Size: 1220 mm x 2743 mm x 12mm for walls **OR Approved Equal**
Acoustical Wall Panels* (Learning Commons As Noted) • **Note: Sheets to be cut according to drawing** **AWP-5**	**AWP-5** Hush Acoustics Rectangular Sheet – Square Profile Colour: Ocean Sheet Size: 1220 mm x 2743 mm x 12mm for walls **OR Approved Equal**
Acoustical Wall Panels* (Learning Commons and Gymnasium as Noted) • **Note: Sheets to be cut according to drawing** **AWP-6**	**AWP–6** Hush Acoustics Rectangular Sheet – Square Profile Colour: Wine Sheet Size: 1220 mm x 2743 mm x 12mm for walls **OR Approved Equal**
Acoustical Wall Panels* (Learning Commons As Noted) • **Note: Sheets to be cut according to drawing** **AWP-7**	**AWP–7** Hush Acoustics Rectangular Sheet – Square Profile Colour: Lilac Sheet Size: 1220 mm x 2743 mm x 12mm for walls **OR Approved Equal**
Acoustical Wall Panels* (Heart As Noted) • **Note: Sheets to be cut according to drawing** **AWP-8**	**AWP–8** Hush Acoustics Rectangular Sheet – Square Profile Colour: Antique Oak Sheet Size: 1220 mm x 2743 mm x 12mm for walls **OR Approved Equal**

09 84 36 – Sound Absorbing Ceiling Units*

Acoustical Ceiling Panels* (Learning Commons Corridors 127, 137, 144, 206, 217 and 226 As Noted) • **Note: Refer to Drawings for Colour Layout** **ACP-1**	**ACP-1** – Hush Acoustics Rectangular Sheet – Square Profile **CUSTOM SIZE** Colour: Oyster Sheet Size: 1500mm X 750mm x 200mm Thickness: x 12mm With All suspension hardware **OR Approved Equal**

Acoustical Ceiling Panels* (Learning Commons Corridors 127 and 206 As Noted) • **Note: Refer to Drawings for Colour Layout** **ACP-2**	**ACP-2** –Hush Acoustics Rectangular Sheet – Square Profile **CUSTOM SIZE** Colour: Moss Sheet Size: 1500mm X 750mm x 200mm Thickness: x 12mm With All suspension hardware **OR Approved Equal**
Acoustical Ceiling Panels* (Learning Commons Corridors 127 and 217 As Noted) • **Note: Refer to Drawings for Colour Layout** **ACP-3**	**ACP-3** – Hush Acoustics Rectangular Sheet – Square Profile **CUSTOM SIZE** Colour: Sunflower Sheet Size: 1500mm X 750mm x 200mm Thickness: x 12mm With All suspension hardware **OR Approved Equal**
Acoustical Ceiling Panels* (Learning Commons Corridors 137 and 226 As Noted) • **Note: Refer to Drawings for Colour Layout** **ACP-4**	**ACP-4** – Hush Acoustics Rectangular Sheet – Square Profile **CUSTOM SIZE** Colour: Apricot Sheet Size: 1500mm X 750mm x 200mm Thickness: x 12mm With all suspension hardware **OR Approved Equal**
Acoustical Ceiling Panels* (Learning Commons Corridors 137 and 206 As Noted) • **Note: Refer to Drawings for Colour Layout** **ACP-5**	**ACP-5** – Hush Acoustics Rectangular Sheet – Square Profile **CUSTOM SIZE** Colour: Ocean Sheet Size: 1500mm X 750mm x 200mm Thickness: x 12mm With all suspension hardware **OR Approved Equal**
Acoustical Ceiling Panels* (Learning Commons Corridors 144 and 217 As Noted) • **Note: Refer to Drawings for Colour Layout** **ACP-6**	**ACP-6** – Hush Acoustics Rectangular Sheet – Square Profile **CUSTOM SIZE** Colour: Lilac Sheet Size: 1500mm X 750mm x 200mm Thickness: x 12mm With all suspension hardware **OR Approved Equal**
Acoustical Ceiling Panels* (Learning Commons Corridors 144 and 226 As Noted) • **Note: Refer to Drawings for Colour Layout** **ACP-7**	**ACP-7** – Hush Acoustics Rectangular Sheet – Square Profile **CUSTOM SIZE** Colour: Wine Sheet Size: 1500mm X 750mm x 200mm Thickness: x 12mm With all suspension hardware **OR Approved Equal**

09 91 00 Painting

Interior Painting **NOTE: All Exposed Steel Columns to be painted out with wall colour unless noted otherwise.**	**Dulux & Scuffmaster Interior Paint Colours Given for Reference. Successful Paint Manufacturer to colour match:** **PT-1/EP-1** –Dulux DLX1001-1 Delicate White - Typical colour for painted walls and ceilings - Handrails Stair D and Stage Ramp – Semi Gloss **PT-2** – DLX1022-4 Rock Slide - Hollow metal doors & frames, Tubular steel framing for Basketball Backstop **PT-3** – Dulux DLX1001-1 Delicate White - Typical colour for painted ceilings – Flat Finish -Moisture & mildew resistant paint in Washroom 115A **PT-5** – Dulux DLX1222-5 Lime Green - Accent Paint Colour **PT-6** - DLX1206-5 Spiced Butternut **-**Accent Wall Colour **PT-7** - DLX1194-6 Clay Pot **-**Accent Wall Colour **PT-8** - DLX1243-5 Blue Dart **-**Accent Wall Colour **PT-9** - DLX1248-6 Magic Carpet **-**Accent Wall Colour **PT-10** - DLX1185-6 Cranberry Splash **-**Accent Wall Colour **PT-11** – Dulux DLX1022-2 Intuitive -Nib Walls in Childcare **PT-12** – Dulux DLX1022-6 Granite -Handrails, Stringers, Risers @ Heart Stair **Scuffmaster Paint Colour:** **PT4 -** Armor Custom to match Dulux DLX1022-1 Hourglass

PT/EP1 **ST**	For Exposed Columns Round and Square Corner Columns in Stairwells. **STN1** – Clear Polyurethane, satin finish per specification. **Dulux Exterior Paint Colours:** **EXPT6** – Dulux DLX1001-6 Knight's Armor **(TBC)** Hollow metal doors & frames, Galvanized Steel Channel and Canopy Framing.

10 80 00 Miscellaneous Specialties

Student Coat Racks (Kindergartens)	ASI Visual Display Products Student Line Coat Racks Rack Colour: STL – Gray Hook Colour : Blue

10 80 00 – Miscellaneous Specialties - Wall and Door Protection – **By Millworker**

Semi Rigid Wall Cladding (Surrounding Seating Nooks in Corridors Levels 1 & 2 and Upper Hall as Noted) **SRWC-1**	**SRWC -1** – INPRO Woodland Collection Colour: 0531 Natural Maple Sheet Thickness: 1mm (0.040")
Cornerguards (Throughout Corridors As Noted) **CG-1**	**CG-1 –** INPRO 150BN BluNose High Impact Corner Guard 154BN - 90° Corner Colour: 0101 Designer White
Cornerguards (Throughout Corridor System as Noted) **CG-2**	**CG-2 –** INPRO High Impact End Wall protector G2-150RD G2 Bioblend Retainer Surface Mount End Wall Protector 3" Wings Colour: 0101 Designer White

11 66 53 Gymnasium Dividers

Gymnasium Divider Curtain	Forum Athletic products F3500 Centre Drive Divider Curtain Curtain Colour: 4131 C Navy Blue with Grey Mesh

12 21 19 Window Shades

Roller Shades Manual Chain Shade System (Classrooms, Offices As Noted) **Note: Ceiling Mount, Clear Anodized Aluminum Fascia and Weight Bar to be Included** **RS-1**	**RS-1** – Altex Sun Project Altex Deko S-70 Chainless Single Cassette Roller Shade System with Vision Shade Location: All Exterior Windows Unless Noted Otherwise Phifer Sheerweave 2410 3% visibility shade cloth with Microban® Colour: P14 Oyster/Pearl Gray **OR Approved Equal**
Roller Shades Manual Dual Shade System with Blackout (Childcare) **Note: Ceiling Mount, Clear Anodized Aluminum Fascia and Weight Bar to be Included** **RS-2**	**RS-2** – Altex Sun Project Altex Deko S-70 Chainless Double Cassette Roller Shade System with Blackout Shade and Vision Shade Location: Childcare Phifer Sheerweave 2410 3% visibility shade cloth with Microban® Colour: P14 Oyster/Pearl Gray Tex Opaque Eco 6100 Blackout Fabric Colour: 6100-01 **OR Approved Equal**
Window Shades ***Note: Wall Mount, Clear Anodized Aluminum Fascia and Weight Bar to be Included** **RS-3**	**RS-3** – Altex Sun Project Deko Elektra Tandem 105 Ultra Quiet 120VAC UQM 40 RTS Motor Operated Roller Systems with Fascia 105, Channel T-460 Cassette System Location: Gymnasium Tex Opaque Eco 6100 Blackout Fabric Colour: 6100-01 **OR Approved Equal**
Roller Shades Manual Chain Shade System (All interior PC350 wall systems and Classroom Screens throughout school to have RS-4) Note: Wall Mount, Clear Anodized Aluminum Fascia and Weight Bar to be Included **RS-4**	**RS-4 –** Altex Sun Project Newton High-Speed Lite Lift with Fascia Location: All Classrooms with PC350 Wall System and Classroom Screens Unless Noted Otherwise Tex Opaque Eco 6100 Blackout Fabric Colour: 6100-01 **OR Approved Equal**

4 **SCHEDULE**

.1 See schedule on drawing 800.