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## **Technical Specifications Issued for Tender**

**University of Guelph  
Building #046 Renovations  
Project No. 504034**

### **Volume 1 – Complete Set**



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T100	TITLE PAGE
T101	SCHEMATICS
T102	B-WING FLOOR 1 LAYOUT
T103	B-WING FLOOR 2 LAYOUT
T104	PATHWAYS DETAILS
T105	INSTALLATION DETAILS
T106	GROUNDING AND BONDING DETAILS
T107	RACK ELEVATIONS
T108	AV ELEVATIONS WING B LEVEL 1
T109	AV LAYOUT AND RISERS
T110	AV ELEVATIONS WING B LEVEL 2

END OF SECTION

## 1. INVITATION

- 1.1 Offers, signed, executed, dated, and in compliance with the Instructions to Bidders will be received by the Owner through the MERX Electronic Bid submission (EBS) system from pre-qualified General Contractors only.

## 2. COMPLIANCE

- 2.1 The Bidder acknowledges that by submitting a compliant bid, it has accepted an offer by the Owner to enter into a "bid contract" for the evaluation of bids and the award of the Contract, if an award is made. The Bidder acknowledges that the terms of the "bid contract" are represented by the Bid Documents.
- 2.2 Failure to submit a bid which complies with the requirements of these Instructions to Bidders may cause a bid to be declared non-compliant and therefore not considered by the Owner.
- 2.3 The Owner reserves the right to waive any non-compliance and accept such a Bid, if, in the Owner's opinion, any such non-compliance does not give such Bidder an unfair advantage over the other Bidders.

## 3. BID DOCUMENTS

### 3.1 Definitions:

- .1 Contract Documents: Defined in CCDC2-2008 Edition, Definitions, as amended.
- .2 Bid Documents: Contract Documents supplemented with Instructions to Bidders, Bid Form, bid securities, and Supplementary Bid Forms as identified herein.
- .3 Bid, Offer, or Bidding: Act of submitting an offer under signature.
- .4 Bid Price: Monetary sum identified by the Bid Form.

### 3.2 The following documents form the basis of this bid process (the "Bid Documents"):

- .1 Instructions to Bidders
- .2 Bid Forms comprising the Base Bid Form, the List of Subcontractors and Contract Breakdown, the Supplementary Bid Form – Itemized and Alternative Prices, the Supplementary Bid Form – Unit Prices
- .3 Agreement, Definitions and General Conditions of the CCDC 2 - 2008
- .4 Supplementary Conditions
- .5 Specifications (per table of contents)
- .6 Drawings (per list of drawings)
- .7 Addenda issued during bidding period

### 3.3 Check Bid Documents for completeness upon receipt. Inform Consultant/Owner immediately:

- .1 Should any documents be missing or incomplete.
- .2 Upon finding any discrepancies or omissions.

### 3.4 Complete sets of Bid Documents are only available through MERX. Copies will not be made available from Physical Resources, Hersey Building, University of Guelph (office of the Owner). Bid Documents will **not** be issued by e-mail, mail, or courier.

- 3.5 Pre-qualified general contractors and pre-qualified subcontractors may obtain complete sets of Bid Documents through MERX. All others shall refer to the General Contractor for information, or review the documents in the office of the Consultant or the Owner.
- 3.6 Bid Documents may be viewed at the office of the Owner. Bid documents may also be viewed at the offices of the:
- .1 Grand Valley Construction Association
  - .2 Hamilton Construction Association
  - .3 London Construction Association
  - .4 Mississauga Construction Association
- 3.7 The Bid Documents are made available only for the purpose of submitting bids for the Project. Availability and/or use of the Bid Documents do not confer a license or grant for any other purpose.
- 3.8 Except as otherwise defined in these Instructions to Bidders; the defined terms in these Bid Documents are taken from the Contract. The term Contract is defined in the Agreement.

#### 4. CONDITIONS OF THE PLACE OF THE WORK

- 4.1 The Place of the Work is located at Building 046, 50 College Avenue West, Guelph, ON N1G 4T6.
- 4.2 The following reports prepared or obtained with respect to the Place of the Work are available through the Consultant/Owner:
- Designated Substances Survey and Perchlorate Detection in Fume Hoods, OVC – Former VMI Building, prepared by LEX Scientific Inc., June 2018 (LEX Project No. 01180066).
  - Letter Report: Spray-Applied Beam Insulation Inspection – Former VMI Building – Ontario Veterinary College, prepared by Lex Scientific Inc., August 30, 2018.
  - Footing and Subgrade Inspection and Recommendations, prepared by Chung & Vander Doelen Engineering Ltd., July 7, 2018.
  - University of Guelph Standard Operating Procedures (SOP):
    - IU.324 – Procedures for Getting Supplies In and Out of the Facility
    - IU.326 – Donning and Doffing of Personal Protective Equipment (PPE)
    - IU.329 – Personal Items in the Containment Zone
  - EACO Mould Abatement Guidelines Edition 3 (2015)
- 4.3 Before submitting a bid, bidders are expected to investigate the Place of the Work to fully ascertain existing conditions, circumstances and limitations affecting the Work. No allowances will be made for additional costs and no claims will be entertained in connection with conditions which could reasonably have been ascertained by such investigation or other due diligence prior to submitting a bid. In submitting a bid, bidders warrant and certify that the Bidder has visited the site and ascertained site conditions.
- 4.4 *Conditions above acoustic tile ceilings:* conditions visible above existing suspended acoustic tile ceilings shall be considered exposed conditions for the purposes of making findings under the provisions of this Contract, and the bidder is solely responsible for ascertaining these conditions prior to bid submission.
- 4.5 *Additional information:* Partial drawings of the existing building are available for review at the office of the Owner. The Consultant/Owner does not represent or warranty that these drawings are complete or accurate and these drawings are made available for bidders' information only.

## 5. MANDATORY SITE MEETING

- 5.1 A mandatory site meeting for all pre-qualified general contractors and subcontractors has been scheduled for November 22 2018 at 10:00 a.m. at Place of Work. Attendees are requested to meet at the front entrance to Building 046. All bidders must attend and will be required to sign the "Site Meeting Log" to confirm their attendance.
- 5.2 Failure to attend shall result in disqualification of bidders and/or pre-qualified subcontractors for work of this Contract. Bids received from bidders who failed to attend the mandatory site meeting, as determined from the "Site Meeting Log", shall be returned unopened.
- 5.3 Representatives of the Consultant and/or the Owner will be in attendance and will conduct the bidders' briefing and tour.
- 5.4 Bidders and their sub-trades are required to be familiar with all matters discussed at this briefing and tour, and submission of bid shall be taken as warranty that the bidder and his trades are familiar with all site conditions and all matters discussed at the site briefing and tour.

## 6. PRE-QUALIFICATION

- 6.1 The following bidders have been pre-qualified:

- .1 Only pre-qualified general contracting firms named below may submit a bid as General Contractor for this Contract:

Address	Contact Name	Contact Email	Contact Phone No.
<b>Ira McDonald Construction Ltd.</b>			
67 Frid Street, Unit 16 Hamilton, ON L8P 4M3	Wynn McDonald	infor@iramacdona.com	(905) 297-4653
<b>Matheson Constructors Limited</b>			
205 Industrial Parkway N, Unit 5, Aurora, ON L4G 4C4	Allan Youmans	ayoumans@mathesonconstructors.com	(905) 669-7999
<b>Melloul-Blamey Construction Inc.</b>			
700 Rupert St, Unit A Waterloo, ON N2V 2B5	Michelle Voss	waterloo@melloul.com	(519) 886-8850 x226
<b>Harbridge &amp; Cross Limited</b>			
350 Creditstone Road, Suite 202, Concord, ON L4K 3Z2	Sam Kumar	mail@harbridgeandcross.com	(416) 213-7165
<b>Aquicon Construction Co. Ltd</b>			
131 Delta Park Blvd, Brampton, ON L6T 5M8	Joe Gizzarelli	purchasing@aquicon.com	(905) 458-1313
<b>MJ Dixon Construction Limited</b>			
2600 Edenhurst Drive, Suite 200 Mississauga, ON L5A 3Z8	Paul Chiang	estimating@mjdixon.ca	(905) 270-7770

- .2 Only pre-qualified firms named below may submit a bid to pre-qualified general contracting firms (named above) for mechanical work of this Contract.

Address	Contact Name	Contact Email	Contact Phone No.
<b>Brenner Mechanical Inc.</b>			
630 Superior Drive, Waterloo, ON N2V 2C6	Michael Brenner Paul Westman	pwestman@brenner.ca	(519) 746-0439
<b>JMR Electric Ltd.</b>			
301 Thames Rd East, Exeter, ON N0M 1S3	John Rasenberg	john.rasenberg@jmrelectric.ca	(519) 235-1516
<b>Mattina Mechanical Limited</b>			
211 Lanark Street, Hamilton, ON L8E 2Z9	Domenic Mattina	dmattina@mattina.ca	(905) 544-6380 x. 223
<b>LJ Barton Mechanical</b>			
1341 Osprey Dr, Ancaster, ON L9G 4V5	Jim Barton	jim@ljbarton.com	(905) 304-1976 x203
<b>Velocity Mechanical Inc.</b>			
176 Forfar Ave, Kitchener, ON N2B 3A1	Peter Linseman	peter@velocitymechanical.com	(519) 896-1119

- .3 Only pre-qualified firms named below may submit a bid to pre-qualified general contracting firms (named above) for electrical work of this Contract.

Address	Contact Name	Contact Email	Contact Phone No.
<b>P&amp;S Electric</b>			
6596 Gerrie Rd, Elora, ON N0B 1S0	Mark Parsons	pselectric@pselectricltd.com	(519) 265-6096
<b>JMR Electric Ltd.</b>			
301 Thames Rd E, Exeter, ON N0M 1S3	John Rasenberg	john.rasenberg@jmrelectric.ca	(519) 235-1516
<b>CEC Services Limited (Aurora)</b>			
16188 Bathurst St, King City, ON L7B 1K5	Kevin Beswick Dawna Van Loon	dvanloon@beswickgroup.com	(905) 713-3711

- 4 Only pre-qualified firms named below may submit a bid to pre-qualified general contracting firms (named above) for roofing work of this Contract.

Address	Contact Name	Contact Email	Contact Phone No.
<b>Aseal Roofing and Sheet Metal Limited</b>			
244 Brockport Drive, Unit 9 Etobicoke, ON M9W 6X9	Paul Oliveira	Info@asealroofing.com	(416) 213-0558
<b>Atlas Apex Roofing</b>			
65 Disco Road Etobicoke, ON M9W 1M2	Brett Beetles	bbeetles@atlas-apex.com	(416) 421-6244
<b>Conestoga Roofing &amp; Sheet Metal Limited</b>			
331 Sheldon Drive Cambridge, ON N1T 1B1	Mark Mollison	Info@conestogaroofing.com	(519) 623-7411
<b>Dean Thackeray Roofing Limited</b>			
199 Riverbend Drive Kitchener, ON N2B 2E8	Patrick Dean	Patrick.dtr@bellnet.ca	(519) 745-7386
<b>Flynn Canada Ltd</b>			
135 Fleming Drive Cambridge, ON N1T 2B8	Joseph Raposo Peter Novais	Joseph.Raposo@flynncompanies.com Peter.novais@flynncompanies.com	(519) 624-8797
<b>Nedlaw Roofing Ltd</b>			
232B Woolwich Street S Breslau, ON N0B 1M0	Randy Walden	Rwalden@nedlaw.ca	(519) 648-2218
<b>Nortex Roofing</b>			
66 Six Point Road Toronto, ON M8Z 2X2	Sandra Furtado	sandra@nortexroofing.com	(416) 236-6090
<b>Semple Gooder Roofing Corporation</b>			
1365 Martin Grove Road Toronto, ON M9W 4X7	Rosanne Capretta	rcapretta@semplegooder.com	(416) 743-5370
<b>Trio Roofing</b>			
5 West Drive Brampton, ON L6T 4T2	Paulo Vieira	paulo@trioroofing.ca	(905) 456-1688
<b>Wm. Green Roofing</b>			
45 Dawson Road Guelph, ON N1H 1B1	Scott Brookes	sbrookes@wmgreenroofing.ca	(519) 822-6414

- .5 Only pre-qualified firms named below may submit a bid to pre-qualified general contracting firms (named above) for telecommunications cable (telephone or data) work of this Contract.

Address	Contact Name	Contact Email	Contact Phone No.
<b>Demarcation Point</b>			
1025 Hargrieve Road, Unit 5 London, ON N6E 1P7	Veljko Vincic	Veljko.vincic@demarclondon.com	(519) 963-2225
<b>Roberts Onsite Inc.</b>			
209 Manitou Drive Kitchener, ON N2C 1L4	Debbie Magnus	dmagnus@robertsonsite.ca	(519) 578-2230 x239
<b>Vollmer Inc.</b>			
3822 Sandwich Street Windsor, ON N9C 1C1	David Ducharme	dducharme@vollmer.ca	(519) 966-6100 x222

- .6 Only pre-qualified firms named below may submit a bid to pre-qualified general contracting firms (named above) access control/security work of this Contract.

Address	Contact Name	Contact Email	Contact Phone No.
<b>Pinder's Security Products</b>			
25 Nihan Drive St. Catharines, Ontario, L2N 1L2	Brandon Pinder	brandon@pinders.com	(905) 934-6333
<b>Clockwork Systems</b>			
4605 Crysler Avenue, Units 1-2 Niagara Falls, Ontario L2E 3V6	Ryan Grealy / Kevin Grealy	N/A	(905) 650-0192
<b>Johnson Controls</b>			
40 Hempstead Drive, Unit 1, Hamilton, On L8W 2E7	Robert McLean	robert.2.mclean@jci.com	(905) 301-9890

- .7 Only pre-qualified firms named below may submit a bid to pre-qualified general contracting firms (named above) for fire alarm testing and verifications work of this Contract.

Address	Contact Name	Contact Email	Contact Phone No.
<b>Classic Fire Protection</b>			
645 Gayray Drive North York, ON M9L 1P9	Chris Berwick	chrisberwick@classicfire.com	(416) 740-3000
<b>Forest City Fire Protection Ltd.</b>			
160 Adelaide St. S London, ON N5Z 3L1	Chris Reynolds	Creynolds.fcfp.ca	(519) 668-0010
<b>Vipond Fire Protection</b>			
6380 Vipond Dr. Mississauga, ON L5T 1A1	Dennis Weber	Dennis.weber@vipond.ca	(905) 564-7060

- .8 Only pre-qualified firms named below may submit a bid to pre-qualified general contracting firms (named above) for fire suppression work of this Contract.

Address	Contact Name	Contact Email	Contact Phone No.
<b>Classic Fire Protection</b>			
645 Gayray Drive North York, ON M9L 1P9	Chris Berwick	chrisberwick@classicfire.com	(416) 740-3000
<b>Forest City Fire Protection Ltd.</b>			
160 Adelaide St. S London, ON N5Z 3L1	Chris Reynolds	Creynolds.fcfp.ca	(519) 668-0010
<b>Spira Fire Protections Ltd.</b>			
31 Hayes Ave Guelph, ON N1E 5V6	David Spira	david@spira.ca	(519) 823-1150 x222
<b>Vipond Fire Protection</b>			
6380 Vipond Dr. Mississauga, ON L5T 1A1	Dennis Weber	Dennis.weber@vipond.ca	(905) 564-7060

- 6.2 Bids received from bidders which have not been pre-qualified shall not be accepted and shall be returned unopened.
- 6.3 Bids received from bidders who fail to comply with 6.1.2, 6.1.3, 6.1.4, 6.1.5, and 6.2 shall be declared non-compliant.

## 7. BID AND PERFORMANCE SECURITY

- 7.1 Each bid shall be accompanied by bid security in the form of a bid bond in the amount of \$1,125,000.00 naming the Owner as obligee and issued by a surety licensed to conduct surety and insurance business in Ontario. The bid security is for the benefit of the Owner and stands as security that the bidder, if awarded the Contract, shall deliver the performance security and evidence of insurance and other documents required by these Instructions to Bidders or by the Contract. The bid security shall remain valid for sixty (60) days from the date of submission. No other form of bid security is acceptable.
- 7.2 The bid security of the bidder whose bid is acceptable shall be retained by the Owner to compensate the Owner for damages it shall suffer should the successful bidder fail to execute the Contract and/or fail to provide the specified performance security and/or evidence of insurance and other documents required by these Instructions to Bidders or by the Contract.
- 7.3 The bid security of the bidder whose bid is accepted shall be returned after the delivery of the specified performance security and evidence of insurance and other documents required by these Instructions to Bidders or by the Contract, and after the execution of the Contract. The bid security of all other bidders shall be returned after the execution of the Contract or after the expiry of this bid process without an award of Contract or after the rejection of all bids.
- 7.4 Each bid shall be accompanied by an agreement to bond issued by the same surety company that provides the bid bond, undertaking to provide a fifty percent (50%) performance bond and a fifty percent (50%) labour and material payment bond, both to be delivered to the Owner if the bidder is awarded the Contract.
- 7.5 Bids not accompanied by the required bid security and the required agreement to bond shall be declared non-compliant.
- 7.6 Include the cost of all bonds in the bid price.

## 8. AMENDMENTS TO BID DOCUMENTS

- 8.1 Direct questions arising during the bidding period to Theresa Ayre, OAA, Architect, J.L. Richards & Associates Limited: email: jlr\_uofgbuilding046@jlr-richards.ca, telephone: (519) 763-0713. The Bid Coordinator is the sole contact for bidding on this Project. A bid may be disqualified where contact is made with any person other than the Bid Coordinator.
- 8.2 Neither the Owner nor the Consultant will be responsible for instructions, clarifications or amendments communicated orally. Instructions, clarifications or amendments which affect the Bid Documents may only be made by addendum.
- 8.3 If bidders find discrepancies, omissions, errors, departures from building by-laws, codes or good practice, and points considered to be ambiguous or conflicting, they shall bring them to the attention of the Bid Coordinator in writing, and not less than ten (10) Working Days before the bid closing date, so that the Consultant may, if the Consultant deems it necessary, issue instructions, clarifications or amendments by addendum to all bidders to whom bid documents have been issued prior to the bid closing date.

The Consultant shall issue such addenda at least seven (7) calendar days prior to bid closing. Any and all addenda will be available through MERX.

8.4 Product/system options:

- .1 Where the Bid Documents stipulate a particular product, alternatives will be considered by the Consultant up to seven (7) working days prior to receipt of bids.
- .2 In submission of alternatives to products specified, bidders shall include in their bid any changes required in the work to accommodate such alternatives. A later claim by the Contractor for an addition to the Contract Price because of changes in work necessitated by use of alternatives shall not be considered.
- .3 Alternative products may be considered where indicated in the Contract Documents, if submitted for review during the tender period, , in accordance with the following:
  - .1 The submission shall provide sufficient information to enable the Consultant to determine acceptability of such products.
  - .2 Provide complete information on required revisions to other work to accommodate each alternative, the advantages and disadvantages of the proposed alternative, effect on schedule, and trades affected.
  - .3 Unless alternatives are submitted in this manner and subsequently accepted, provide products as specified.
- .4 The Owner will not necessarily accept alternatives proposed by the Bidder.
- .5 Accept full responsibility that a proposed alternative will not exceed dimensional requirements as indicated on the Drawings, that it is compatible in all ways with other specified work, that coordination and cost of installation is included in his price for the proposed alternative and that the Contractor will be responsible for additional engineering/design requirements.

8.5 Addenda issued during the bidding period shall become part of the Bid Documents and their receipt shall be acknowledged in the space provided on the Bid Form. Failure to acknowledge the addendum issued **will** result in the bid being declared as non-compliant. Addenda will be issued through MERX.

9. **TAXES**

- 9.1 Value Added Taxes shall not be included in the bid price. All other eligible taxes shall be included in the bid price. Any changes to taxes announced prior to the date of the issuance of these Bid Documents and scheduled to come into effect subsequent to it shall be taken into consideration in preparing the bid price.
- 9.2 All invoices or progress payments for work shall clearly show the amount of Value Added Tax applicable to the work completed.

10. **BID COMPLETION**

- 10.1 Fill in all blank spaces on the Bid Forms in ink, or typewritten, providing all information requested, and ensure that an authorized person or persons sign all forms where indicated. Failure to provide all requested information on the Bid Forms and failure to fill in all blank spaces may result in a bid being declared non-compliant.
- 10.2 Use only the Bid Forms issued as part of the Bid Documents for the Project. If any or all pages of the Bid Forms are amended by addendum, only the amended pages shall be used to submit a bid. Failure to comply with this paragraph may result in the bid being declared non-compliant.

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- 10.3 Information provided by bidders on the Bid Forms may be amended prior bid closing, in accordance with the rules provided by MERX. Other modifications, erasures, additions, conditions, qualifications or un-initialled pre-closing amendments may result in the bid being declared non-compliant.
- 10.4 Bids including any supplementary bid forms that are not originals, are unsigned, improperly signed, un-initialled, conditional, or illegible, may be declared non-compliant.
- 10.5 **Bid Price**
- .1 The Base Bid Form provides that the bid price shall be provided in numbers only.
  - .2 Where the Bid Forms require the Bidder to provide a breakdown of the bid price, the bid price shall govern in the case of conflict or ambiguity between the bid price and the sum of the breakdown of the bid price.
- 10.6 **Completion of the Work**
- .1 Where required, state the date of completion of the Work on the Bid Form.
  - .2 The work of this contract shall be completed as quickly as possible and consideration may be given to time of completion when reviewing the submitted bids.
- 10.7 **Listing of Sub-contractors and Cost Breakdown**
- .1 Where required by the Bid Documents, a Bidder shall submit a List of Sub-contractors and Cost Breakdown that the bidder proposes to perform an item of the "Work" called for by the Contract by completing and submitting the List of Sub-contractors and Cost Breakdown. Failure of the Bidder to list Sub-contractors and Cost Breakdown, where required, or the listing by a Bidder of more than one Sub-contractor and Cost Breakdown to perform or supply an item of work listed, may result in the bid being declared non-compliant.
  - .2 Should the bidder be awarded the Work, parties named, including bidder's own forces, shall be used to perform the work for which they are named and shall not be changed without the Owner's written consent.
  - .3 Where a bidder lists "own forces" in lieu of a Sub-contractor, the Bidder shall carry out such item of the "Work" with its own forces. Where "own forces" have been listed by a bidder, the Owner reserves the right to obtain information from the Bidder and from third parties respecting the qualifications and experience of the Bidder's "own forces" for such item of the "Work". If the Owner, acting reasonably, determines that the Bidder's "own forces" are not sufficiently qualified or sufficiently experienced to undertake such item of the "Work", it may declare the bid as non-compliant.
  - .4 Costs requested shall be for the specific trade or division of work. The cost should not include the bidder's general cost or mark-up. The cost information is for confidential information and use by the Owner.
- 10.8 **Itemized, Separate and Alternative Prices**
- .1 Where required by the Bid Documents, a Bidder shall submit Itemized, Separate and Alternative Prices.

- .2 **Itemized Prices** for work, if any, shall be included in the bid price. The itemized price shall be based on the materials, equipment and systems specified. The itemized price shall include all labour, materials, equipment, overhead and profit and all other charges except as otherwise stipulated. No additional mark-ups will be permitted. Except as instructed otherwise in writing, bidders shall verify and include all code and municipal/provincial requirements associated with proposed Itemized Prices.
- .3 **Separate Prices**, requested in the Tender Documents, shall not be included in the bid price. Consistent with their acceptance or rejection by the Owner, they will be carried in the Agreement as an amount separated from the Contract Amount or in a separate agreement. The separate price shall be based on the materials, equipment and systems specified. The separate price shall include all labour, materials, equipment, overhead and profit and all other charges except as otherwise stipulated. No additional mark-ups will be permitted. Except as instructed otherwise in writing, bidders shall verify and include all code and municipal/provincial requirements associated with proposed Separate Prices. Separate Prices shall be irrevocable for a period of sixty (60) days. The Owner reserves the right to accept or reject any or all separate prices submitted.
- .4 **Alternative Prices** for work, if any, shall adjust the bid price based upon acceptance or rejection of the alternative. The alternative price shall be based on the materials, equipment and systems specified. The alternative price shall include all labour, materials, equipment, overhead and profit and all other charges except as otherwise stipulated. No additional mark-ups will be permitted. Except as instructed otherwise in writing, bidders shall verify and include all code and municipal/provincial requirements associated with proposed Alternative Prices. Alternative Prices shall be irrevocable for a period of sixty (60) days. The Owner reserves the right to accept or reject any or all alternative prices submitted.

#### 10.9 Unit Prices

- .1 Where required by the Bid Document, a bidder shall submit Unit Prices. The unit price shall be based on the materials, equipment and systems specified.

#### 10.10 Bid Signing

- .1 The Bid Form and any supplementary bid forms shall be signed by the bidder.
- .2 Sole Proprietorship: Printed name and signature of sole proprietor. The signature include the name and signature of a witness to the proprietor's signature.
- .3 Partnership: Printed name and signature of one partner authorized to bind the partnership. Insert the word partner under signature. The signature shall include the name and signature of a witness to the partner's signature.
- .4 Limited Company: Printed name and signature of a signing officer authorized to bind the company in their normal signatures. Insert the officer's capacity in which the signing officer acts, under the signature. The signature shall include the name and signature of a witness to the signing officer's signature.

#### 10.11 Eligibility of Bids

- .1 Bids that are improperly signed or sealed, conditional, illegible, obscure, contain arithmetical errors, erasures, alterations, or irregularities of any kind may, at the sole discretion of the Owner, be declared non-compliant.
- .2 Bids that fail to include security deposit, bonding or insurance requirements **shall** be declared non-compliant.

- .3 Bids received after the time of bid close shall not be accepted and **shall** be declared non-compliant.
- .4 Bids received from bidders who failed to attend a mandatory pre-bid site visit will be declared non-compliant.
- .5 Unsigned bids **shall** be declared non-compliant.

## 11. BID SUBMISSION

- 11.1 Submit one (1) completed original version of the Bid Form and any required supplementary bid forms, accompanied by the bid bond and the agreement to bond, electronically to the University of Guelph through MERX EBS, the electronic tendering system used by the University.
- 11.2 Bids must be received before and not later than **3:00:00 P.M.** local time on **December 14, 2018**. The term "local time" shall mean the time as measured by MERX EBS system.
- 11.3 Bids will be date and time stamped electronically by MERX EBS.
- 11.4 ***Late bids will not be accepted by MERX.***
- 11.5 Bids which are submitted by any other means will **not** be considered.
- 11.6 Bidders are solely responsible for ensuring that their bids are downloaded and submitted (2 steps) to MERX EBS prior to the date and time specified above.
- 11.7 Failure to submit any of the required supplementary bid forms will result in the bid being declared non-compliant.
- 11.8 File size shall not exceed 100 MB. File names shall not exceed more than 100 characters.

## 12. BID EXPIRY PERIOD

- 12.1 Bids including any supplementary bid information shall be irrevocable for a period of sixty (60) days from the date of submission, after which period the bid expires.

## 13. BID OPENING

- 13.1 Bids will be received electronically from MERX and reviewed in private.

## 14. REQUESTS FOR CLARIFICATION

- 14.1 The Consultant/Owner may contact any one or more bidders to request clarification without any obligation to contact other bidders. Such additional clarification shall be provided promptly by the Bidder to the Consultant/Owner.
- 14.2 The Consultant/Owner may solicit additional information after close of bids from any or all bidders to support bid evaluation.

14.3 The Owner reserves the right to request supplementary information from one or more bidders after close of bids, without affecting the validity of the bids submitted, as may be required to facilitate the Owner's decision to award a contract, if any.

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

**15. PRESENTATION AND INTERVIEW**

15.1 The Owner may require one or more bidders to prepare and make a presentation to the Owner's Selection / Evaluation Committee in order to assist the Owner in evaluating any compliant bids. Selected bidders shall also be interviewed by the Owner's Selection / Evaluation Committee.

15.2 The selection of bidders for a presentation and an interview will be based on the best (lowest) two or three compliant bids received.

15.3 The following matrix illustrates the criteria for evaluation of the presentation and interview:

<b>Evaluation Score Sheet</b>				
<b>Criteria</b>	<b>Weight</b>	<b>Score 1/5/10</b>	<b>Points</b>	<b>Justification/Comments</b>
Overall Presentation	1			
Project Understanding	5			
Schedule	5			
Risk Management	5			
Quality Control	5			

15.4 The selected bidders shall be notified in advance of the proposed presentation and interview and shall have two (2) days to prepare for the presentation and interview. Participants in the presentation and interview must include the bidder's key personnel - Project Manager and Site Superintendent. The presentation must include a complete review of the project scope and complexity and should include any issue or risks to achieving the final completion date as specified. The information provided by a bidder at the presentation and the interview shall bind the bidder and the successful bidder shall be held to the responses given.

Selected bidders shall be responsible for all travel and related costs involved in attendance for the presentation and an interview.

15.5 The scores from the presentation and interview will be combined with a score for the bid price to determine the successful bidder.

**16. AWARD OF CONTRACT, EXECUTION OF THE CONTRACT, AND DOCUMENTS TO BE DELIVERED**

- 16.1 Bidders shall not issue or make any statement or news release concerning their bid, the bid process, the Owner's evaluation of the bids, or the Owner's award or cancellation of the bid process without the express written consent of the Owner.
- 16.2 If the Owner decides to award the Contract to a bidder, it will issue a "Letter of Intent" to award a contract.
- 16.3 Prior to commencing the "Work", the Contractor shall deliver to the Owner:
- .1 Certified true copies of the insurance policies required by the Bid Documents.
  - .2 A current Clearance Certificate issued by the Workplace Safety and Insurance Board.
  - .3 A signed AODA Supplier Compliance Form.
- 16.4 The Owner may not necessarily award the contract to the lowest bidder or to any bidder. The Owner reserves the right to waive any non-compliant bid and accept such a Bid, if, in the Owner's opinion, any such non-compliance does not give such Bidder an unfair advantage over the other bidders. The Owner reserves the right to accept or reject any or all bids, and to award the contract to the Bidder whose bid, in the Owner's sole and absolute discretion, is considered to be in the best interests of the Owner.
- 16.5 If the Owner does not receive any bid satisfactory to the Owner, in its sole and absolute discretion, the Owner reserves the right to re-bid the Work, or negotiate a contract for the whole or any part of the Work with any one or more persons, including one or more of the bidders.
- 16.6 The Owner takes no responsibility for the accuracy of the information supplied during the bid period unless provided in writing, and takes no responsibility for any bidder lacking information.
- 16.7 The award of a contract will be posted on MERX. No other notification of award to the unsuccessful bidders will be made.

**17. LIMIT OF LIABILITY**

- 17.1 The liability of the bidder to the Owner for loss and damage arising out of the Bidder's breach of the "bid contract" shall be limited to the lesser of the actual loss suffered by the Owner and the sum of **Twenty Thousand Dollars (\$ 20,000)**.
- 17.2 The liability of the Owner to any bidder for loss and damage arising in tort or for the breach by the Owner of the "bid contract" shall be limited to the lesser of the sum of **Twenty Thousand Dollars (\$ 20,000)** and the reasonable cost to the Bidder of preparing its bid.

**18. CONFLICT OF INTEREST**

- 18.1 The Bidder agrees to be bound by the following requirements:
1. That no person either natural or body corporate, other than the Bidder, has or will have any interest or share in this bid or in the proposed Agreement.
  2. That there is no collusion or arrangement between the Bidder and any other bidder (s) in connection with this Project.
  3. That the Bidder has no knowledge of the contents of other bids and has made no comparison of figures, agreements, arrangements, expressed or implied, with any other party in connection with the making of the bid.

4. Neither the Bidder nor members of his/her immediate family or any employee of the Bidder shall have any direct or indirect interest in any other entity that provides goods or services to the Project. Bidder shall immediately disclose any potential conflict of interest should it arise before, during or after this bid and/or any award of contract.
5. Neither the Bidder nor members of his/her immediate family or any employee of the Bidder shall offer or receive any reimbursement from or to any employee of The University, from or to any vendor, consultant or contractor employed by The University except as token gifts in accordance with University policy governing this matter.

## 19. **DISPUTES**

- 19.1 In the event of a dispute arising in connection with this bid process including, without limitation, a dispute concerning the existence of the "bid contract" or a breach of the "bid contract", or a dispute as to whether the bid of any bidder was submitted on time or whether a bid is compliant, the Owner may refer the dispute to a confidential binding arbitration pursuant to the *Arbitration Act, 1991*, as amended, before a single arbitrator with knowledge of procurement/bidding law. In the event that the Owner refers the dispute to arbitration, the bidder agrees that it is bound to arbitrate such dispute with the Owner. Unless the Owner shall refer such dispute to binding arbitration, there shall be no arbitration of such dispute.
- 19.2 In the event the Owner refers a dispute to binding arbitration, the Owner may give notice of the dispute to one or more of the other bidders who submitted bids, whether or not they may be compliant, each of whom shall be a party to and shall be entitled to participate in the binding arbitration, and each of whom shall be bound by the arbitrator's award, whether or not they participated in the binding arbitration.
- 19.3 In the event the Owner refers a dispute to binding arbitration, the parties to the arbitration shall exchange brief statements of their respective positions on the dispute, together with the relevant documents, and submit to a binding arbitration hearing which shall last no longer than two days, subject to the discretion of the arbitrator to increase such time. The parties further agree that there shall be no appeal from the arbitrator's award.
- 19.4 This Article is not intended to form part of any "bid contract" that may come into being between a bidder and any prospective Subcontractor or Supplier of that bidder.

## 20. **DEBRIEFING**

- 20.1 Each Bidder who submits a bid in response to this request for bids is entitled to a debriefing process.
- 20.2 In the event a Bidder wishes to obtain information on their bid relative to this call for bids, the Bidder must make such a request, in writing, to the Owner within sixty (60) days after award is made.
- 20.3 The debriefing process will occur only after the award of a contract for the work.
- 20.4 The debriefing process with a bidder will not address any issues, questions or concerns regarding the bid of any other bidder, including the bid of the successful Bidder.

## 21. **ACCESSIBILITY FOR ONTARIANS WITH DISABILITIES ACT (AODA)**

- 21.1 The University is committed to fostering, creating and maintaining an accessible environment for all individuals under the Accessibility for Ontarians with Disabilities Act (AODA).

- 21.2 Each Proponent agrees to:
- (a) Comply with the accessibility standards established under the AODA by the Ontario Government and adhere to the University's policies and procedures in regards to accessibility as well as to ensure all of its subcontractors similarly do the same.
  - (b) Ensure that training on the requirements of the accessibility standards are provided to those of its employees who will be working with the public (students, staff, faculty, visitors or other third parties) at, or on behalf of, the University and who participate in developing the proponent's policies, practices or procedures.
  - (c) Keep records of such training.
  - (d) Provide such records when required by the University.
- 21.3 For proponent(s) who will be working with the public (students, staff, faculty, visitors or other third parties) at, or on behalf of, the University, the University will require the successful proponent(s), upon Notice of Award, to provide to the University with a signed AODA Supplier Compliance Form prior to commencing any work for the University.

The AODA Supplier Compliance Form is available at:

<https://www.uoguelph.ca/finance/sites/uoguelph.ca.finance/files/FF020.0503%20AODA%20Supplier%20Compliance%20Form.pdf>

## 22. HUMAN RIGHTS AND SEXUAL AND GENDER HARASSMENT POLICIES

- 22.1 Proponents agree to be governed by the provisions of the Ontario Human Rights Code. In furtherance of the commitment, the Proponents agree to comply with the provisions of the University's Human Rights Policy and Procedures. The Proponents also agree to comply with any successor policies and procedures to the document that the Owner's Board of Governors may approve. Proponents shall refer to [www.uoguelph.ca/hre/hr.shtml](http://www.uoguelph.ca/hre/hr.shtml) for more information.

**END OF DOCUMENT**

**PART ONE - GENERAL****1.1 Reports**

- .1 The following material *bound herein (or in a separate volume of the Contract Documents) is included for information or is available from the Owner/Consultant:*
  - .1 Designated Substances Survey and Perchlorate Detection in Fume Hoods, OVC – Former VMI Building, prepared by LEX Scientific Inc., June 2018 (LEX Project No. 01180066).
  - .2 Letter Report: Spray-Applied Beam Insulation Inspection – Former VMI Building – Ontario Veterinary College, prepared by Lex Scientific Inc., August 30, 2018.
  - .3 Footing and Subgrade Inspection and Recommendations, prepared by Chung & Vander Doelen Engineering Ltd., July 7, 2018.
  - .4 University of Guelph Standard Operating Procedures (SOP):
    - .1 IU.324 – Procedures for Getting Supplies In and Out of the Facility
    - .2 IU.326 – Donning and Doffing of Personal Protective Equipment (PPE)
    - .3 IU.329 – Personal Items in the Containment Zone
  - .5 EACO Mould Abatement Guidelines Edition 3 (2015).
- .2 The above material cannot, by its nature, reveal all conditions that may exist at the Place of the Work. Should conditions be found to vary substantially from the above, advise the Consultant accordingly and request direction.

**END OF DOCUMENT**



Physical Resources  
Design, Engineering & Construction  
Tel (519) 824-4120  
Fax (519) 837-0581

J.C. Hersey Building  
University of Guelph  
Guelph, Ont. N1G 2W1

### BID FORM

Project No.: 504034

Project (Work): Building #046 Renovations

Page 1 of 3

Bid Issue Authorized By John Wanos Manager, Design, Engineering & Construction

Bid Closing: Date: **December 14, 2018** Time: before and not later than 3:00 PM (as determined by MERX)

A mandatory site briefing at which all pre-qualified General Contract and pre-qualified subcontract bidders who wish to submit bids are required to attend is scheduled for: November 22, 2018, convening at 10:00 a.m. at Building #046, 50 College Avenue West, Guelph, ON, N1G 4T6.

Name of Bidder \_\_\_\_\_

Address \_\_\_\_\_

Telephone \_\_\_\_\_ Fax \_\_\_\_\_

### BID PRICE

I / We, the undersigned, having examined the Bid Documents (drawings and specifications) identified in Specification Section 00 01 15 List of Drawings for the above project, and having received, carefully examined and incorporated Addenda up to and including number \_\_\_\_\_, all as prepared by J.L. Richards & Associates Limited hereinafter referred to as the *Consultant* and having visited and examined the *Place of the Work*, and having examined all conditions, circumstances and limitations affecting the Work, offer to enter into a Contract with the Owner to perform the Work required by these Documents for the above project for the stipulated sum *Bid Price* of:

\$ \_\_\_\_\_ [Note: insert amount in numbers only]

**Bid Price is not to include Value Added Tax.**

H.S.T./G.S.T. Registration # \_\_\_\_\_

### BID SECURITY

Attached to this bid is a bid bond issued by \_\_\_\_\_ in the amount of

\$ \_\_\_\_\_ [Note: insert amount in numbers only]

### AGREEMENT TO BOND

Attached to this bid is a separate agreement to bond issued by \_\_\_\_\_

undertaking to provide the bonds as required by the Bid Documents.

## DECLARATIONS

I / We, the undersigned declare that:

- .1 *Work will be commenced immediately upon award of Contract and shall achieve Substantial Performance by **April 30, 2020***
- .2 There is no conflict of interest in submitting this Bid and that no person either natural or body corporate, other than the bidder, has or will have any interest or share in this bid or in the proposed Agreement;
- .3 There is no collusion or arrangement between the bidder and any other bidder (s) in connection with this Project;
- .4 The bidder has no knowledge of the contents of other bids and has made no comparison of figures, agreements, arrangements, expressed or implied, with any other party in connection with the making of the bid;
- .5 This Bid is open to acceptance and irrevocable for a period of sixty (60) days.
- .6 This agreement supersedes all prior negotiations, representations, or agreements, either written or oral, relating in any manner to the *Work*.
- .7 The *Contract Documents* consist of this Bid Form; Specification Sections, dated **November 15, 2018**, and Drawings, all as listed in attached specification *Section 00 01 15 List of Drawings* and including the Definitions and General Conditions of CCDC 2-2008 Stipulated Price Contract, and Addenda issued. For the purposes of the Definitions and General Conditions of CCDC 2-2008, the *Owner* is the University of Guelph and the *Consultant* is *J.L. Richards & Associates Limited*.
- .8 The bidder will comply with the Owner's policies related to Human rights and Sexual and Gender Harassment and Accessibility for Ontarians with Disabilities.
- .9 The following Forms are attached to the Bid:  
Bid Bond  
Agreement to Bond  
Section 00 43 01 – List of Sub-contractors and Cost Breakdown  
Section 00 43 03 – Unit Prices  
Section 00 43 05 – Itemized, Separate and Alternative Prices

**SIGNATURES:**

**Signed and submitted by:**

\_\_\_\_\_  
Company Name

**Note: Affix Corporate seal as required**

Seal:

\_\_\_\_\_  
Printed Name and Title of Authorized Signing Officer

\_\_\_\_\_  
Signature of Authorized Signing Officer

\_\_\_\_\_  
Printed Name and Title of Witness

\_\_\_\_\_  
Signature of Witness

Dated this \_\_\_\_\_ day of \_\_\_\_\_, 2018.

Email Address \_\_\_\_\_ Telephone \_\_\_\_\_

END OF DOCUMENT

**Project No.: 504034**

**Project Name: Building #046 Renovations**

**NAME OF BIDDER:** \_\_\_\_\_

I/We, the undersigned, propose to employ the following Sub-contractors and/or Suppliers to perform an item of the Work called for by the Contract. I/We confirm that all have been investigated to confirm their reliability and competency to carry out such work in accordance with the Contract Documents.

I/We acknowledge that the Instructions to Bidders require that we list only one Sub-contractor and/or Supplier for each item of the Work described in this List of Subcontractors. I/We further acknowledge that where we have entered "own forces" to perform an item of the Work, we are experienced in the work to be performed and it is our intention to use "own forces" for that purpose.

After bid submission, no substitution for a Sub-contractor, Supplier or "own forces" will be permitted except as provided in the Contract.

I/We the undersigned understand that if this Supplementary Bid Form is not completed, our Bid may be declared as "non-compliant".

ITEM OF WORK	SUBCONTRACTOR	COST
Mechanical		\$
Electrical		\$
Roofing		\$
Telecommunications		\$
Electronic Access/Security		\$
Fire Alarm Testing		\$
Fire Suppression		\$

This List of Sub-contractors and Cost Breakdown is an integral part of these Bid Documents.

**DATE:** \_\_\_\_\_

**SIGNATURE:** \_\_\_\_\_

**NAME AND TITLE:** \_\_\_\_\_

**END OF DOCUMENT**

**Project No.: 504034**

**Project Name: Building #046 Renovations**

**NAME OF BIDDER** \_\_\_\_\_

I/We the undersigned offer the following unit prices for the work or for additional work listed here. All unit prices, unless specifically indicated, are for complete work, in place, supplied and installed in accordance with applicable Contract requirements and include all overhead and profit mark-up.

I/We the undersigned agree that the credits for deleted work shall be no less than eighty percent (80%) of the unit prices listed hereunder.

I/We the undersigned agree that the Owner shall have the right to negotiate the cost of additional work instead of using the unit prices listed hereunder.

I/We the undersigned understand that if this Supplementary Bid Form is not completed, our Bid may be declared as “non-compliant”.

Prices listed hereunder do not include any Value Added Taxes but include all other eligible taxes.

<b><u>ITEM OF WORK UNIT</u></b>	<b><u>COST/UNIT</u></b>
• <u>Construction Manager</u>	<u>/hour</u>
• <u>Project Coordinator</u>	<u>/hour</u>
• <u>Project Superintendent</u>	<u>/hour</u>
• <u>Site Labour (General Contractor’s Own Forces)</u>	<u>/hour</u>
• <u>Site Labour (Mechanical Sub-contractor)</u>	<u>/hour</u>
• <u>Site Labour (Electrical Sub-contractor)</u>	<u>/hour</u>
• <u>Construction Manager (After-hours)</u>	<u>/hour</u>
• <u>Project Coordinator (After-hours)</u>	<u>/hour</u>
• <u>Project Superintendent (After-hours)</u>	<u>/hour</u>
• <u>Site Labour (General Contractor’s Own Forces) (After-hours)</u>	<u>/hour</u>
• <u>Site Labour (Mechanical Sub-contractor) (After-hours)</u>	<u>/hour</u>
• <u>Site Labour (Electrical Sub-contractor) (After-hours)</u>	<u>/hour</u>
• <u>Removal and disposal of asbestos containing floor tile and mastic</u>	<u>/sq.m.</u>
• <u>Removal and disposal of an additional asbestos containing parged pipe fitting</u>	<u>/fitting</u>

- 
- Removal and disposal of an additional PCB ballast /ballast
  - Removal and disposal of an additional mercury containing light tube /tube
  - Removal and disposal of asbestos containing sprayed applied fireproofing /sq.m.
  - Repair and/ repoint existing brick /sq.m.

This list of Unit Prices is an integral part of these Bid Documents.

**DATE:**

---

**SIGNATURE:**

---

**NAME AND TITLE:**

---

**END OF DOCUMENT**

Project No.: 504034

Project Name: Building #046 Renovations

NAME OF BIDDER \_\_\_\_\_

I/We the undersigned offer the Itemized Prices, Separate Prices and Alternative Prices described below.

I/We the undersigned understand that if this Supplementary Bid Form is not completed, our Bid may be declared as “non-compliant”.

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. **"Itemized Prices"** are for work included in the bid price and are provided for information purposes only. They will not be used to adjust the scope of the work or the bid price.
3. **"Alternative Prices"** are amounts stipulated by bidders for solicited alternatives which can be stated as additions, deductions or no change to the bid price.
4. Without limiting its rights under the Instructions to Bidders, the Owner reserves the right to accept or reject any of the Alternative Prices. Acceptance of Alternative Prices is subject to the earlier acceptance of the bid or the bid expiry date.
5. **"Separate Prices"** are amounts stipulated by the Bidders for solicited additional work. Separate prices shall not be included in the Stipulated Price. Consistent with their acceptance or rejection by the Owner, they will be carried in the Agreement as an amount separated from the Contract Amount or in a separate agreement.
6. Prices listed hereunder do not include Value Added Tax but include all other eligible taxes.
7. These amounts shall be irrevocable for the Bid Expiry Period provided in the Instructions to Bidders.

#### ITEMIZED PRICES

1. *Not applicable*

#### SEPARATE PRICES

1. Separate price for the testing, abatement, demolition and removal of all piping and equipment associated with the receiving/holding tanks in the Sewage Room. \$ \_\_\_\_\_
2. Separate price for supply and install of millwork MW123b. \$ \_\_\_\_\_
3. Separate price for the replacement of existing panels LP-U, LP-R, LP-T, LP-P as indicated on electrical drawings. \$ \_\_\_\_\_

#### ALTERNATIVE PRICES

1. *(Not Applicable.)* \$ \_\_\_\_\_

This List of Itemized, Separate and Alternative Prices is an integral part of the Bid Documents.

**DATE:** \_\_\_\_\_

**SIGNATURE:** \_\_\_\_\_

**NAME AND TITLE:** \_\_\_\_\_

**END OF DOCUMENT**

1.0 Performance Bond, Labour  
and Materials Payment Bond

.1 Provide to the Owner a Performance Bond in the value of 50% of the original Contract Price plus Value Added Tax, and a Labour and Materials Payment Bond in the value of 50% of the original Contract Price plus Value Added Tax.

\*\*\*\*\*END\*\*\*\*\*

**1. GENERAL**

- 1.1 The Standard Construction Document for Stipulated Price Contract, CCDC 2 – 2008, English version, consisting of the Agreement Between *Owner* and *Contractor*, Definitions, and General Conditions of the Stipulated Price Contract, Parts 1 to 12 inclusive, governing same is hereby made part of these *Contract Documents*, as amended by Section 00 73 01 Supplementary Conditions and with the following amendments, additions and modifications:

**2. SUPPLEMENTARY CONDITIONS**

Refer to Section 00 73 01 Supplementary Conditions for amendments to the General Conditions of CCDC 2 - 2008.

**3. REVISIONS TO ARTICLES OF CCDC 2 - 2008****3.1 ARTICLE A-5 PAYMENT**

- 3.1.1 Into the blanks in Article 5.1, insert the following words, in their respective locations:

“ten” and “10”.

- 3.1.2 Delete paragraph 5.1.2 in its entirety and substitute the following:

“5.1.2 Upon Substantial Performance of the Work as certified by the Consultant, and after all Lien Rights regarding the work performed before the date certified to be the date of Substantial Performance have expired, pay to the Contractor the unpaid balance of Holdback monies then due, together with such Value Added Taxes as may be applicable to such payment, and”.

- 3.1.3 Delete paragraph 5.1.3 in its entirety and substitute the following:

“5.1.3 Upon receipt of the Consultant’s final certificate for payment, and after all Lien Rights for finishing work have expired, pay to the Contractor the unpaid balance of the Contract Price then due together with such Value Added Taxes as may be applicable to such payment.”

- 3.1.4 Delete sentences (1) and (2) found in Article 5.3, paragraph .1 and replace with the following:

- (1) 1% per annum above the prime rate for the first 90 days.
- (2) 2% per annum above the prime rate after the first 90 days.

- 3.1.5 Into the blank in Article 5.3, paragraph .1, insert the following words”:

“Royal Bank of Canada”.

## 3.2 ARTICLE A-6 RECEIPT AND ADDRESSES FOR NOTICES IN WRITING

3.2.1 Delete Article A-6.1 and substitute new article 6.1 as follows:

- 6.1 Notices in Writing between the parties or between them and the Consultant shall be considered to have been received by the addressee on the date of receipt if delivered by hand or by commercial courier or if sent during normal business hours by fax and addressed as set out below. Such Notices in Writing will be deemed to be received by the addressee on the next business day if sent by fax after normal business hours or if sent by overnight commercial courier. Such Notices in Writing will be deemed to be received by the addressee on the fifth Working Day following the date of mailing, if sent by pre-paid registered post, when addressed as set out below. An address for a party may be changed by Notice in Writing to the other party setting out the new address in accordance with this Article.

## 3.3 DEFINITIONS

3.3.1 Add the following new definitions:

27. Make Good  
“Make Good” means to restore new or existing work after being damaged, cut or patched or rejected by the *Consultant*. Use materials identical to the original materials, with new visible surfaces matching the appearance and the expected performance of the original surfaces in all details, with no apparent junctions between the new and existing surfaces.
28. Mark-up  
Markup means the *Contractor's* or the *Subcontractor's* (in the case of work being done by the *Subcontractor*) add for profit and overhead costs as related to the General Conditions and the Sections of Divisions 0 and 1 of the *Specifications* including costs of extension of contract time, office overhead, field supervision, layouts, co-ordination, travelling expenses and any other direct or indirect costs.
29. Submittals  
Submittals are documents or items required by the *Contract Documents* to be provided by the *Contractor*, such as:
- *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
  - Record drawings and manuals to provide instructions to the operation and maintenance of the *Work*.
30. Toxic and Hazardous Substances  
Toxic and Hazardous Substances shall mean designated substances as defined by applicable statutory and regulatory requirements.

**END OF SECTION**

**1. GENERAL**

- 1.1 The Standard Construction Document for Stipulated Price Contract, CCDC 2 – 2008, English version, consisting of the Agreement Between *Owner* and *Contractor*, Definitions, and General Conditions of the Stipulated Price Contract, Parts 1 to 12 inclusive, governing same is hereby made part of these *Contract Documents*, as amended by the amendments, additions and modifications which follow.
- 1.2 These Supplementary Conditions shall be read together with and will govern over the General Conditions of CCDC 2 – 2008.
- 1.3 Where a General Condition or paragraph of the General Conditions of the Stipulated Price Contract is deleted by these Supplementary Conditions, the numbering of the remaining General Conditions or paragraphs shall remain unchanged, and the numbering of the deleted item will be retained, unused.

**2. GC 1.1 CONTRACT DOCUMENTS**

- 2.1 Add to the end of subparagraph 1.1.2.2:

“except where the *Consultant* shall be indemnified as a third party beneficiary as provided in subparagraphs 9.2.7.4, 9.5.3.4 and in 12.1.3.”

- 2.2.1 Add new sentence to the end of paragraph 1.1.6 as follows:

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 *Consultant* to settle disputes among the *Subcontractors* and *Suppliers* in respect to such divisions. The *Contractor* is solely responsible for the coordination of *Subcontractors*. The *Contractor* is solely responsible for the division and definition of work between *Contractor* and *Subcontractors* and for any jurisdictional matters arising therefrom.

- 2.3 Add new subparagraph 1.1.7.5 as follows:

1.1.7.5 in case of discrepancies, noted materials and annotations shall take precedence over graphic indications in the *Contract Documents*.

- 2.4 Delete paragraph 1. 1.8 in its entirety and substitute new paragraph 1. 1.8 as follows:

1.1.8 “The *Owner* shall provide the *Contractor*, without charge, one (1) electronic copy on compact disc of the *Contract Documents*, exclusive of those required by jurisdictional authorities and the executed *Contract Documents*. Reproduction of the CD or printing from the CD will be at the *Contractor*’s expense.”

- 2.5 Add new paragraph 1.1.11 as follows:

1.1.11 Wherever the words “approved”, “as directed”, “submit”, “make good”, “reviewed”, or similar wording or phrases appear throughout the *Contract Documents*, they shall be understood unless otherwise provided, to mean materials or items referred to shall be “as approved by the *Consultant*”, “as directed by the *Consultant*”, “make good to the *Consultant*’s satisfaction”, “submit to the *Consultant*”, or “reviewed by the *Consultant*”.

**3. GC 2.2 ROLE OF THE CONSULTANT**

3.1 Add new sentence to the end of paragraph 2.2.2 as follows:

“Such reviews, or lack thereof, shall not give rise to any claims by the *Contractor* in connection with construction safety at the *Place of the Work*, responsibility for which belongs exclusively to the *Contractor*.”

3.2 Revise in paragraph 2.2.14 as follows:

Delete the comma after the word “submittals” and add the words “which are provided” before the words “in accordance”.

**4. GC 2.4 DEFECTIVE WORK**

4.1 Add new subparagraphs 2.4.1.1 and 2.4.1.2 as follows:

2.4.1.1 The *Contractor* shall rectify, in a manner acceptable to the *Owner* and the *Consultant*, all defective work and deficiencies throughout the *Work*, whether or not they are specifically identified by the *Consultant*.

2.4.1.2 The *Contractor* shall prioritize the correction of any defective work which, in the sole discretion of the *Owner*, adversely affects the day to day operation of the *Owner*.

4.2 Add the new words to the beginning of paragraph 2.4.3 as follows:

“Except for defective work or work not performed that may lead to dangerous circumstances and subject the workers to potential or actual health and safety hazards, if in the opinion .....”

4.3 Add new paragraph 2.4.4 as follows:

2.4.4 Defective work or work not performed that may lead to dangerous circumstances and subject workers to potential and actual health and safety hazards shall be immediately corrected, completed and otherwise made safe.

**5. GC 3.1 CONTROL OF THE WORK**

5.1 Add new paragraph 3.1.3 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 obtain written instructions notify the *Consultant* in writing and obtain written instructions from the *Consultant* before proceeding with any part of the affected work.

**6. GC 3.2 CONSTRUCTION BY OWNER OR OTHER CONTRACTORS**

6.1 Delete subparagraph 3.2.2.1 in its entirety.

6.2 Delete subparagraph 3.2.2.2 in its entirety.

6.3 Add new subparagraph 3.2.3.4 as follows:

3.2.3.4 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 the *Place of the Work*, including all of the responsibilities of the constructor under the Occupational Health and Safety Act.

**7. GC 3.4 DOCUMENT REVIEW**

7.1 Delete paragraph 3.4.1 in its entirety and substitute new paragraph 3.4. 1 as follows:

3.4.1 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 comply with the standard of care described in paragraph 3.14.1 of the *Contract*. 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*. 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. If the *Contractor* does discover any error, inconsistency or omission in the *Contract Documents*, the *Contractor* shall not proceed with the work affected until the *Contractor* has received corrected or missing information from the *Consultant*.

7.2 Add new paragraph 3.4.2 as follows:

3.4.2 If the *Contractor* finds discrepancies in and/or omissions from the *Contract Documents* or has any doubt as to the meaning or intent of any part thereof, the *Contractor* must immediately notify the *Consultant*, who will provide written instructions or explanations. Neither the *Owner* nor the *Consultant* will be responsible for oral instructions.

**8. GC 3.5 CONSTRUCTION SCHEDULE**

8.1 Delete paragraph 3.5.1 in its entirety and substitute new paragraph 3.5.1 as follows:

3.5.1 The *Contractor* shall,

3.5.1.1 Subject to building permit availability, commence *Work* immediately upon award of *Contract* and provide sufficient expertise and resources to ensure the steady progress of the *Work* including overtime work, if required, to perform the *Work* within the *Contract Time* and in accordance with the approved construction schedule.

3.5.1.2 Prior to submitting the first application for payment, submit to the *Owner* and the *Consultant* for their review and acceptance a construction schedule indicating the critical path for the *Project* demonstrating that the *Work* will be performed in conformity with the *Contract Time* and in accordance with the *Contract Documents*. The *Contractor* shall provide the schedule information required by this paragraph in both electronic 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.

- 3.5.1.3 Provide the expertise and resources, such resources including manpower and equipment, as are necessary to maintain progress under the accepted baseline construction schedule referred to in paragraph 3.5.1.2 or any successor or revised schedule accepted by the *Owner* pursuant to GC3.5;
- 3.5.1.4 Monitor the progress of the *Work* on a weekly basis relative to the construction schedule reviewed and accepted pursuant to paragraph 3.5.1.2, or any successor or revised schedule accepted by the *Owner* pursuant to GC 3.5, update the schedule on a monthly basis, submit the updated schedule with each application for a progress payment and advise the *Consultant* and the *Owner* in writing of any variation from the baseline or slippage in the schedule; and
- 3.5.1.5 If, after applying the expertise and resources required under paragraph 3.5.1.3, the *Contractor* forms the opinion that the slippage in schedule reported in paragraph 3.5.1.4 cannot be recovered by the *Contractor*, it shall, in the same notice provided under paragraph 3.5.1.4, indicate to the *Consultant* and the *Owner* if the *Contractor* intends to apply for an extension of *Contract Time* as provided in PART 6 - CHANGES IN THE WORK.

8.2 Add new paragraph 3.5.2 as follows:

- 3.5.2 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, based on critical path methodology, or if the *Contractor* has given notice of such to the *Owner* or the *Consultant* pursuant to 3.5.1.3, the *Contractor* shall take appropriate steps to cause the actual progress of the *Work* to conform to the schedule and shall produce and present to the *Owner* and the *Consultant* a recovery plan demonstrating how the *Contractor* will achieve the recovery of the schedule. If the *Contractor* intends to apply for a change in the *Contract Price* in relation to a schedule recovery plan, the *Contractor* shall proceed with PART 6 – CHANGES IN THE WORK.

## 9. GC 3.6 SUPERVISION

9.1 Delete paragraph 3.6.1 in its entirety and substitute new paragraph 3.6.1 as follows:

- 3.6.1 The *Contractor* shall provide all necessary supervision and appoint competent representatives who shall be in attendance at the *Place of the Work* while work is being performed. Should the *Contractor's* Supervisor or Project Manager prove for valid reasons to be unacceptable to the *Owner*, the *Owner* shall give written notice to the *Contractor* who shall within 7 days of receipt of same provide a suitable replacement acceptable to the *Owner*. The appointed representatives shall not be changed except for valid reasons, and upon the *Contractor* obtaining the *Owner's* written consent, which consent will not be unreasonably withheld.

9.2 Add new paragraph 3.6.3 as follows:

- 3.6.3 The *Owner* may, at any time during the course of the *Work*, request the replacement of the appointed representative(s), where the grounds for the request involve conduct which jeopardizes the safety of the *Owner's* operations. Immediately upon receipt of the request, the *Contractor* shall make arrangements to appoint an acceptable replacement.

**10. GC 3.7 SUBCONTRACTORS AND SUPPLIERS**

10.1 Delete paragraph 3.7.2 in its entirety and substitute new paragraph 3.7.2 as follows:

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

10.2 Add new paragraph as follows:

3.7.7 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-bid or pre-negotiated by the *Owner*.

**11. GC 3.8 LABOUR AND PRODUCTS**

11.1 Add new sentence to the end of paragraph 3.8.2 as follows:

“The *Contractor* represents and warrants that the *Products* provided for in accordance with the *Contract* are not subject to any conditional sales contract and are not subject to any security rights obtained by any third party which may subject any of the *Products* to seizure and/or removal from the *Place of the Work*.”

11.2 Add new sentence to the end of paragraph 3.8.3 as follows:

“The foreperson of each trade engaged on the *Work* must be able to speak and understand the English language sufficiently well to comprehend and carry out all instructions issued and to work in complete coordination with other trades.”

11.3 Add new paragraph 3.8.4 as follows:

3.8.4 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 the *Owner*.

**12. GC 3.9 DOCUMENTS AT THE SITE**

12.1 Delete paragraph 3.9.1 in its entirety and substitute new paragraph 3.9.1 as follows:

3.9.1 The *Contractor* shall keep one copy of the current *Contract Documents*, *Supplemental Instructions*, *Contemplated Change Orders*, *Change Orders*, *Change Directives*, reviewed *Shop Drawings*, *Submittals*, approved construction schedule, as-built drawings, reports and records of meetings at the *Place of the Work*, in good order and available to the *Owner* and *Consultant*.

**13. GC 3.10 SHOP DRAWINGS**

13.1.1 Add the words "AND OTHER SUBMITTALS " to the Title after SHOP DRAWINGS.

13.2 Add "and *Submittals*" after the words "*Shop Drawings*" in clauses 3.10.2, 3.10.4, 3.10.5, 3.10.7, 3.10.8, 3.10.8.2, 3.10.9, 3.10.10, and 3.10.11.

13.3 Delete paragraph 3.10.3 in its entirety and substitute new paragraph 3.10.3 as follows:

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

13.4 Add new sentence to the end of paragraph 3.10.6 as follows:

“Where the *Consultant's* shop drawing review stamp is affixed to any one page, drawing or sheet in a submission for a *Product* or process, it shall be deemed to apply to all pages, drawings or sheets in the submission for the *Product* or process.”

13.5 Delete subparagraph 3.10.8.1 in its entirety and substitute new subparagraph 3.10.8.1 as follows:

3.10.8.1 The *Contractor* has determined and correlated all of the required field measurements with the *Shop Drawings* and any *Submittals* and field construction conditions, *Product* requirements, catalogue numbers and similar data, or will do so if not possible at the time of the review, and

13.6 Delete paragraph 3.10.12 in its entirety and substitute new paragraph 3.10.12 as follows:

3.10.12 The *Consultant* will review and return *Shop Drawings* and *Submittals* in accordance with the schedule agreed upon in 3.10.3, or, in the absence of such schedule, with reasonable promptness. If, for any reason, the *Consultant* cannot process them within the agreed-upon schedule or with reasonable promptness, the *Consultant* shall notify the *Contractor* and they shall meet to review and arrive at an acceptable revised schedule for processing. The *Contractor* shall update the *Shop Drawings* and *Submittals* Schedule to correspond to changes in the construction schedule. Changes in the *Contract Price* or *Contract Time* may be made only as otherwise provided in the *Contract*.

13.7 Add new paragraphs 3.10.13, 3.10.14, 3.10.15, 3.10.16, 3.10.17 and 3.10.18 as follows:

3.10.13 *Contractor* shall secure, from all his Subcontractors and material suppliers, uniform size *Shop Drawings* of all items, as listed in their respective trade specifications, showing construction materials, etc., or as required, and upon which representative trade bids have been based.

3.10.14 *Shop Drawings* shall define divisions of responsibility between Trades, and all items shown on *Shop Drawings* shall be supplied as part of the *Contract* unless it is specifically approved that certain items are not part of the *Contract*.

3.10.15 *Shop Drawings* shall be laid out with same orientation as *Contract Documents*.

3.10.16 Submit digital copy of Shop Drawings. Provide a 75 x 180 mm blank space for the Consultant's use. Upon receipt of these copies, the Consultant will review, mark corrections or changes, and digitally return to the Contractor. Shop drawings shall be corrected and resubmitted for the Consultant's further review and further revision if necessary. Shop drawings will be digitally returned to Contractor for reproduction. For Divisions, 3, 5, 10, 15 and 16, submit two additional copies. All fixture cuts, equipment brochures and printed descriptive literature shall be digitally submitted on letter size paper. Provide eight copies of all such material.

3.10.17 Upon completion of review by *Consultant*, *Shop Drawings* and other *Submittals* will be returned to the *Contractor* for reproduction and issuance to all concerned. Retain one complete set of all reviewed *Shop Drawings* and other *Submittals* for *Owner* which shall, on completion of the work, be issued to the *Owner* in an approved form.

3.10.18 Any fabrication work done before receiving final reviewed *Shop Drawings* and other *Submittals* shall be at the *Contractor's* and his Subcontractor's and/or supplier's risk."

#### 14. GC 3.11 USE OF THE WORK

14.1 Add new sentence to the end of paragraph 3.11.2 as follows:

The Contractor shall undertake the implementation of procedures and practices to review, at least on a weekly basis, the proposed loading of any part of the *Work* to ensure that the proposed weight or force of the load will not endanger the safety of the *Work* or the Workers.

14.2 Add new paragraph 3.11.3 as follows:

3.11.3 The *Owner* shall have the right to use and occupy the *Place of the Work*, including but not limited to the building and site in accordance with other provisions of the *Contract Documents*. Such use and occupation shall not be considered acceptance of the *Work*, nor shall such use and occupation in any way relieve the *Contractor* from his responsibility to complete the *Contract*. Such use shall not be considered an act or omission by the *Owner* causing delay in GC 6.5 Delays, and the *Contractor* is responsible for coordinating the *Work* to suit such use and occupancy, as may be further required in the *Contract Documents*."

#### 15. GC 3.12 CUTTING AND REMEDIAL WORK

15.1 Add new sentence to the end of paragraph 3.12.4 as follows:

The *Contractor* and the specialist shall review all proposed procedures for cutting and remedial work with the *Consultant* prior to undertaking the cutting.

#### 16. GC 3.13 CLEANUP

16.1 Add new paragraph 3.13.4 as follows:

3.13.4 The *Contractor* shall undertake the implementation of a schedule of procedures and practices to ensure that the *Place of the Work* is kept in a safe, tidy and clean condition.

#### 17. GC 3.14 PERFORMANCE BY CONTRACTOR

Add new General Condition 3.14 as follows:

3.14.1 In performing its services and obligations under the *Contract*, the *Contractor* shall exercise a 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 *Contractor's* obligations, duties and responsibilities shall be interpreted in accordance with this standard. The *Contractor* shall exercise the same standard of due care and diligence in respect of any *Products*, personnel, or procedures which it may recommend to the *Owner*.

3.14.2 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 its designated supervisor and project manager, subject to the *Owner's* approval, in the event of death, incapacity, removal or resignation.
- .3 There are no pending, threatened or anticipated claims that would have a material effect on the financial ability of the *Contractor* to perform its work under the *Contract*.

## 18. GC 3.15 RIGHT OF ENTRY

Add new General Condition 3.15 as follows:

3.15.1 The *Owner* shall have the right to enter or occupy the *Work* in whole or in part for the purpose of placing fittings and equipment or for other uses before *Substantial Performance of the Work*, if, in the opinion of the *Consultant* and *Contractor*, such entry or occupation does not prevent or substantially interfere with the *Contractor* in completion of the *Contract* within the *Contract Time*. Such entry or occupation shall not be considered as acceptance of the *Work* or in any way relieve the *Contractor* from responsibility to complete the *Contract*."

## 19. GC 4.1 CASH ALLOWANCES

19.1 Delete the last sentence in paragraph 4.1.4 in its entirety and substitute a new sentence as follows:

Where costs under a cash allowance exceed the amount of the allowance, unexpended amounts from other cash allowances shall be reallocated at the *Consultant's* direction to cover the shortfall.

19.2 Delete paragraph 4.1.5 in its entirety and substitute new paragraph 4.1.5 as follows:

4.1.5 The unexpended total cash allowance amount shall be deducted from the *Contract Price* by *Change Order*.

19.3 Delete paragraph 4.1.7 in its entirety and substitute new paragraph 4.1.7:

4.1.7 At the commencement of the work, the *Contractor* shall prepare for the review and acceptance of the *Owner* and the *Consultant*, a schedule indicating the times, within the construction schedule referred to in GC 3.5, that items called for under cash allowances and items that are specified to be *Owner* purchased and *Contractor* installed or hooked up are required at the site to avoid delaying the progress of the *Work*.

19.4 Add new paragraph 4.1.8 as follows:

4.1.8 The *Owner* or the *Contractor* shall call for competitive bids for portions of the *Work*, to be paid for from cash allowances.

## 20. GC 5.1 FINANCING INFORMATION REQUIRED OF THE OWNER

20.1 Revise the heading, "GC 5.1 FINANCING INFORMATION REQUIRED OF THE OWNER" to read, "GC 5.1 FINANCING INFORMATION REQUIRED".

20.2 Delete paragraph 5. 1.1 in its entirety and substitute new paragraph 5.1.1 as follows:

5.1.1 The *Owner* and *Contractor* shall provide each other with timely *Notice in Writing* of any material change in their financial ability to fulfill their respective obligations under the *Contract*.

20.3 Delete paragraph 5.1.2 in its entirety.

## 21. GC 5.2 APPLICATIONS FOR PROGRESS PAYMENT

21.1 Add to the end of paragraph 5.2.1 the following new sentence:

“subject to such limitations and conditions as may be otherwise indicated.”

21.2 Add to the end of paragraph 5.2.7 the following new sentence:

"Any *Products* delivered to the *Place of the Work* but not yet incorporated into the *Work* shall remain at the risk of the *Contractor* notwithstanding that title has passed to the *Owner* pursuant to GC 13.1 OWNERSHIP OF MATERIALS."

21.3 Add new paragraphs 5.2.8, 5.2.9, 5.2.10 and 5.2.11 as follow:

5.2.8 The *Contractor* shall submit, with each application for progress payment after the first, a Statutory Declaration, on an original form of CCDC Document 9A-2001, stating that payments in connection with the *Work*, as noted in the Statutory Declaration, have been made to the end of the period immediately preceding that covered by the current application.

5.2.9 The *Contractor* shall submit Workplace Safety & Insurance Board Clearance Certificate, with each application for progress payment.

5.2.10 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* reserves the right to retain a reasonable amount for the value of the as-built *Drawings* not presented for review.

5.2.11 AS required by paragraph 3.5.1.4, the *Contractor* shall prepare and submit, with each application for progress payment, an updated construction schedule.

## 22. GC 5.3 PROGRESS PAYMENT

22.1 Delete from the first line of subparagraph 5.3.1.2, the words, "calendar days" and substitute the following words:

"*Working Days*".

22.2 Delete subparagraph 5.3.1.3 in its entirety and substitute new subparagraph 5.3.1.3 as follows:

5.3.1.3 The *Owner* shall make payment to the *Contractor* on account as provided in Article A-5 of the Agreement – PAYMENT no later than 15 *Working Days* after the date of a certificate of payment issued by the *Consultant*, or where no Certificate for Payment is issued not later than 14 *Working Days* after the *Owner* deems the invoice acceptable.

22.3 Add new paragraph 5.3.2 as follows:

Notwithstanding any provisions in the *Contract Documents* to the contrary, the *Owner* shall be entitled to deduct from any payment to the *Contractor* an amount equal to the value, as determined by the *Consultant* in the first instance, of any claim, deficiency in the *Work*, or other significant risk that the *Owner* faces due to the failure of the *Contractor* to perform any material obligations under the *Contract*.”

### 23. GC 5.4 SUBSTANTIAL PERFORMANCE OF THE WORK

23.1 Delete paragraph 5.4.3 in its entirety and substitute new paragraph 5.4.3 as follow:

5.4.3 Immediately following the issuance of the certificate of *Substantial Performance of the Work*, the *Contractor*, in consultation with the *Consultant*, shall establish reasonable dates for finishing the *Work* and correcting deficient work.

23.2 Add new paragraph 5.4.4, 5.4.5, 5.4.6 and 5.4.7 as follows:

5.4.4 The *Contractor* shall publish, in a construction trade newspaper in the area of the location of the *Work*, a copy of the Certificate of *Substantial Performance of the Work* within seven (7) 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 *Owner*. If the *Contractor* fails to publish such notice, the *Owner* shall be at liberty to publish and back charge the *Contractor* its reasonable costs for doing so.

5.4.5 Prior to submitting its application for *Substantial Performance of the Work*, the *Contractor* shall submit to the *Consultant* all:

- .1 Guarantees
- .2 Warranties
- .3 Certificates
- .4 Testing and balancing reports
- .5 Distribution system diagrams
- .6 Spare parts
- .7 Maintenance manuals

and other materials or documentation required to be submitted under the *Contract*, together with written proof acceptable to the *Owner* and the *Consultant* that the *Work* has been performed in conformance with the requirements of municipal, government and utilities authorities having jurisdiction.

5.4.6 Where the *Contractor* is unable to deliver the documents and materials described in paragraph 5.4.5, then, provided that none of the missing documents and materials interferes, in a material way, with the use and occupancy of the *Work*, failure to deliver shall not be grounds for the *Consultant* to refuse to certify *Substantial Performance of the Work*. Any documents or materials not delivered in accordance with paragraph 5.4.5 shall be delivered as provided in GC 5.7, paragraph 5.7.1.

- 5.4.7 Notwithstanding paragraph 5.4.1, and with the prior consent of the *Owner*, and as may be described in the *Contract Documents*, the *Contractor* may elect to waive application for a Certificate of Substantial Performance and proceed to Completion of Contract as defined in applicable lien legislation.

**24. GC 5.5 PAYMENT OF HOLDBACK UPON SUBSTANTIAL PERFORMANCE OF THE WORK**

- 24.1 Add new subparagraphs 5.5.1.3, 5.5.1.4 and 5.5.1.5 as follow:

5.5.1.3 submit a declaration that no written notices of lien have been received by it.

5.5.1.4 submit a Statutory Declaration CCDC 9A-2001.

5.5.1.5 submit Workplace Safety & Insurance Board Clearance Certificate.

- 24.2 Delete from line 1 of paragraph 5.5.2, the words, "the statement" and substitute the following words:

"the documents".

- 24.3 Delete paragraph 5.5.3 in its entirety.

**25. GC 5.6 PROGRESSIVE RELEASE OF HOLDBACK**

- 25.1 Delete Article GC 5.6 in its entirety.

**26. GC 5.7 FINAL PAYMENT**

- 26.1 Delete paragraph 5.7.1 in its entirety and substitute new paragraph 5.7. 1 as follows:

5.7.1 When the *Contractor* considers that the *Work* is completed, the *Contractor* shall submit an application for final payment within 60 days of the Completion of the Contract within the meaning of the Construction Lien Act (Ontario). Failure to submit the invoice within the specified time frame voids *Owner's* obligation to pay invoice The *Contractor's* application for final payment shall be accompanied by any documents or materials not yet delivered pursuant to paragraph 5.4.5 together with complete as-built *Drawings*. Should the *Contractor* fail to deliver any of the foregoing documents, the *Owner* shall be at liberty to withhold from amounts otherwise payable to the *Contractor*, the sum of \$ **Fifty-Thousand** Dollars (\$50,000.00) as security for the obligation of the *Contractor* to deliver the undelivered documents.

- 26.2 Delete from the first line of paragraph 5.7.2 the words, "calendar days" and substitute the following words:

"*Working Days*".

- 26.3 Delete from the second line of paragraph 5.7.4 the words, "calendar days" and substitute the following words:

"*Working Days*".

26.4 Add new paragraph 5.7.5 as follows:

5.7.5 As additional requirements for release of finishing construction lien holdback, the *Contractor* shall submit the following documentation:

- .1 *Contractor's* written request for release of holdback, including a declaration that no written notices of lien have been received by it.
- .2 *Contractor's* Statutory Declaration CCDC 9A-2001.
- .3 *Contractor's* Workplace Safety & Insurance Board Clearance Certificate.

5.7.6 The release of the remaining Holdback monies shall become due and payable on the day following the expiration of the statutory limitation period stipulated in the lien legislation applicable to the *Place of the Work* providing that the *Owner* may retain out of such Holdback monies any sums required by law to satisfy any liens against the *Work* or monetary claims against the *Contractor* and enforceable against the *Owner*, and providing that the *Contractor* has submitted to the *Owner* a sworn statement that all accounts for labour, subcontracts, products, construction machinery and equipment and other indebtedness which may have been incurred by the *Contractor* in the performance of the *Work*, and for which the *Owner* might in any way be held responsible, have been paid in full, except Holdback monies properly retained.

## 27. GC 5.8 WITHHOLDING OF PAYMENT

27.1 Add new paragraphs 5.8.2, 5.8.3 and 5.8.4 as follows:

5.8.2 The *Owner* may retain from any amounts otherwise payable to the *Contractor* under this *Contract* an amount sufficient to satisfy any claims made by third parties arising out of the *Contractor's* performance of the *Work*, or of the performance of others for whom the *Contractor* is responsible in law, including, without limiting the foregoing, amounts sufficient to satisfy court judgments or arbitration awards.

5.8.3 The *Owner* may retain from any amounts otherwise payable to the *Contractor* under this *Contract* an amount sufficient to satisfy bona fide claims of the *Owner*, including, without limiting the foregoing, the amount of any additional costs incurred by the *Owner* arising from the *Contractor's* failure to perform its contractual obligations under the *Contract*.

5.8.4 The withholding or retention of funds by the *Owner* under this GC 5.8 - WITHHOLDING OF PAYMENT shall not constitute grounds under GC 7.2 - CONTRACTOR'S RIGHT TO THE STOP WORK OR TERMINATE THE CONTRACT for declaring the *Owner* in default, but shall be subject to the provisions of the lien legislation applicable to the *Place of the Work*."

## 28. GC 5.10 CONSTRUCTION LIENS

28.1 Add new General Condition 5.10 as follows:

5.10.1 Provided the *Owner* is not in default of its payment obligations under the *Contract* and notwithstanding anything else in this PART 5 PAYMENT, in the event a claim for lien is registered against the *Project* lands, or the *Owner* receives any written notice of lien, the *Owner* shall be entitled to withhold any payment otherwise due to the *Contractor* until such time as such claims have been dealt with as provided below.

- 5.10.2 In the event that a written notice of a lien from the performance of the Work is received by the Owner, the Contractor shall, within 10 calendar days, at its sole expense, arrange for the withdrawal or other disposal of the written notice of a lien pursuant to the Construction Act (Ontario).
- 5.10.3 If a construction lien arising from the performance of the *Work* is registered against the *Project* lands, the *Contractor* shall, within 10 calendar days, at its expense, vacate or discharge the lien from title to the *Project* lands. If the lien is merely vacated, the *Contractor* shall, if requested, undertake the *Owner's* defense of any subsequent action commenced in respect of the lien at the *Contractor's* expense.
- 5.10.4 If the *Contractor* fails or refuses to vacate or discharge a construction lien or written notice of lien within the time prescribed above, the *Owner* shall, at its option, be entitled to take all steps necessary to vacate and/or discharge the lien, and all costs incurred by the *Owner* in doing so (including, without limitation, legal fees on a solicitor and his own client basis and any payment which may ultimately be made out of or pursuant to security posted to vacate the lien) shall be for the account of the *Contractor*, and the *Owner* may deduct such amounts from the amounts otherwise due or owing to the *Contractor*.
- 5.10.5 Without limiting any of the foregoing, the *Contractor* shall satisfy all judgments and pay all costs resulting from any construction liens or any actions brought in connection with any liens, or in connection with any other claim or lawsuit brought against the *Owner* by any person that provided services or materials to the *Project* lands which constituted part of the *Work*, and the *Contractor* shall indemnify the *Owner* for any and all costs (including, without limitation, legal fees on a solicitor and client basis) the *Owner* may incur in connection with such claims or actions.
- 5.10.6 This GC 5.10 – CONSTRUCTION LIENS does not apply to construction liens claimed by the *Contractor*.”

**29. GC 6.1 OWNER'S RIGHT TO MAKE CHANGES**

29.1 Add the following sentences to the end of paragraph 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 course of conduct or dealing between the parties, no express or 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* or a claim for any extension of the *Contract Time*.

29.2 Add new paragraph 6.1.3 as follows:

- 6.1.3 The *Contractor* shall perform the work for any and all changes to the standards prescribed in the *Contract* including quality of workmanship in a safe manner.

**30. GC 6.3 CHANGE DIRECTIVE**

30.1 Delete 6.3.7.1(1) and replace it with the following:

- (1) carrying out the work, including necessary supervisory services;

30.2 Delete paragraph 6.3.7.1(2) and replace it with the following:

- (2) intentionally left blank.

30.3 Amend paragraph 6.3.7.1(3) so that, as amended, it reads:

- (3) engaged in the preparation of *Shop Drawings*, fabrication drawings, coordination drawings and project record drawings: or...

30.4 Amend paragraph 6.3.7.1(4) so that, as amended, it reads:

- (4) including all professional and clerical staff engaged in processing changes in the Work.

30.5 Add the following sentences to the end of paragraph 6.3.7:

6.3.7.18 other factors as may be specified;

6.3.7.19 The procedures of evaluation including applicable overhead and profit mark-up provisions shall be as described under 6.2 CHANGE ORDER and the specifications.”

**31. GC 6.4 CONCEALED OR UNKNOWN CONDITIONS**

31.1 Add new subparagraph 6.4.5 as follows:

6.4.5 The *Contractor* confirms that, prior to bidding the *Project*, it carefully investigated the *Place of the Work* and applied to that investigation the degree of care and skill described in paragraph 3.14.1, given the amount of time provided between the issue of the bid documents and the actual closing of bids, the degree of access provided to the *Contractor* prior to submission of bid, and the sufficiency and completeness of the information provided by the *Owner*. The *Contractor* is not entitled to compensation or to an extension of the *Contract Time* for conditions which could reasonably have been ascertained by the *Contractor* by such careful investigation undertaken prior to the submission of the bid.

**32. GC 6.5 DELAYS**

32.1 Delete the period at the end of paragraph 6.5.1, and substitute the following words:

, but excluding any consequential, indirect or special damages.

32.2 Delete the period at the end of paragraph 6.5.2, and substitute the following words:

, but excluding any consequential, indirect or special damages.

32.3 Add new paragraphs 6.5.6. and 6.5.7 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 employed or engaged by the *Contractor* directly or indirectly, or by any cause within the *Contractor's* control, then the *Contract Time* may be extended for such reasonable time as the *Consultant* may decide in consultation with the *Owner*. As a condition to the *Owner's* agreement to extend the contract time, the *Owner* shall be reimbursed by the *Contractor* for all reasonable costs incurred by the *Owner* as the result of such delay, including all services required by the *Owner* from the *Consultant* as a result of such delay by the *Contractor* and, in particular, the cost 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 provisions of these General Conditions and any later, actual date of *Substantial Performance of the Work* achieved by the *Contractor*.

6.5.7. The *Contractor* shall be responsible for the care, maintenance and protection of the *Work*, in the event of a suspension or delay in the performance of the *Work*, regardless of the reason for such suspension or delay. In the event the delay or suspension was not the fault of the *Contractor*, the *Contractor* shall be reimbursed by the *Owner* for reasonable costs incurred by the *Contractor* as the result of such care, maintenance and protection of the *Work*.

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

33.1 Add to the end of paragraph 7.1.1, the following new words:

without affecting in any respect the liability of the *Contractor* in respect of earlier defaults.

33.2 Add to paragraph 7.1.2, after the word "properly", the following new words:

or fails or neglects to maintain the latest approved schedule provided pursuant to GC3.5

33.3 Delete the words "to a substantial degree" from paragraph 7.1.2.

33.4 Add to paragraph 7.1.3.1 after the word "commences" the words :

and is diligently proceeding with.

33.5 Delete in paragraph 7.1.3.2 the words "provides the *Owner* with an acceptable schedule for such correction, and" and insert the words "provides a schedule acceptable to the *Owner* for such correction, and".

**34. GC 7.2 CONTRACTOR'S RIGHT TO SUSPEND THE WORK OR TERMINATE THE CONTRACT**

34.1 Delete subparagraph 7.2.3.1 in its entirety.

34.2 Delete subparagraph 7.2.3.3 in its entirety and substitute new subparagraph 7.2.3.3 as follows:

7.2.3.3 the *Owner* fails to pay the *Contractor* when due the amount certified by the *Consultant* or awarded by arbitration or a Court, except where the *Owner* has a bona fide claim for set off, or

34.3 Delete from line 2 of subparagraph 7.2.3.4, the words, "OF THE OWNER".

34.4 Add new subparagraph 7.2.3.5 as follows:

The foregoing default shall not apply to the proper withholding of payment as provided for under the *Contract*, including the *Contractor's* failure to promptly pay previously valid claims or because of registration or notice of liens against the *Owner's* property, until such claims and liens are discharged. The foregoing default shall not apply to the withholding of funds for setoff under GC 5.8.2.

34.5 Delete from the second line of paragraph 7.2.4 the words, "5 *Working Days*" and substitute the following words:

"15 *Working Days*".

34.6 Add new paragraph 7.2.6 as follows:

7.2.6 If the *Contractor* terminates the *Contract* under the conditions described in this GC 7.2, the *Contractor* shall be entitled to be paid for all work performed to the date of termination. The *Contractor* shall also be entitled to recover the direct costs associated with termination, including the costs of demobilization, losses sustained on *Products* and construction machinery and equipment but in no event shall the *Contractor* be entitled to receive nor shall the *Owner* be required to pay, indirect, special or consequential damages including, without limitation, loss of overhead and profit, as a result of the termination.

## 35. GC 8.1 AUTHORITY OF THE CONSULTANT

35.1 Add in the first line of paragraph 8.1.3, the word "written" before the word "instructions".

35.2 Delete last sentence of 8.1.3 and substitute the following sentence:

If it is subsequently determined that such instructions were at variance with the *Contract Documents*, the *Owner* shall pay the *Contractor* costs incurred by the *Contractor* in carrying out such instructions which the *Contractor* was required to do beyond the requirements of the *Contract Documents*, including costs resulting from interruption of the *Work*.

## 36. GC 8.2 NEGOTIATION, MEDIATION AND ARBITRATION

36.1 Delete from the sixth line of paragraph 8.2.2 the words, "10 *Working Days*" and substitute the following words:

"15 *Working Days*".

36.2 Delete from the first line of paragraph 8.2.4 the words, "10 *Working Days*" and substitute the following words:

"15 *Working Days*".

36.3 Add new paragraphs 8.2.9, 8.2.10, 8.2.11, 8.2.12, 8.2.13, 8.2.14, 8.2.15 and 8.2.16 as follow:

- 8.2.9 Within 5 *Working Days* of receipt of the notice of arbitration by the responding party under paragraph 8.2.6, 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 8.2.9 to 8.2.16 of the *Contract*.
  - .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.
- 8.2.10 The *Owner* and the *Contractor* agree that the *Consultant* may elect, within ten *Working Days* of receipt of the notice under paragraph 8.2.9, to become a full party to the arbitration under paragraph 8.2.6 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 8.2.6.
  - .4 Agrees to be bound by the arbitrate award made in the arbitration.
- 8.2.11 If the *Consultant* is not given the written notice required under paragraph 8.2.10, both the *Owner* and the *Contractor* are estopped from pursuing an action, counter claim or other proceeding or making an application against the *Consultant* arising out of the issues in dispute in the arbitration between the *Owner* and the *Contractor* under paragraph 8.2.6.”
- 8.2.12 If an election is made under paragraph 8.2.10, the *Consultant* may participate in the appointment of the arbitrator and notwithstanding the rules referred to in paragraph 8.2.6, the time period for reaching agreement on the appointment of the arbitrator shall begin to run from the date the *Owner* receives a copy of the notice of arbitration.
- 8.2.13 The arbitrator in the arbitration in which the *Consultant* has elected under paragraph 8.2. 10 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 8.2.10.
  - .2 Make any procedural order considered necessary to facilitate the addition of the *Consultant* as a party to the arbitration.
- 8.2.14 The provisions of paragraph 8.2.9 shall apply mutatis mutandis to written notice to be given by the *Consultant* to any sub-consultant.
- 8.2.15 In the event of notice of arbitration given by a *Consultant* to a sub-consultant, the sub-consultant is not entitled to any election with respect to the proceeding as outlined in 8.2.10, and is deemed to be bound by the arbitration proceeding.
- 8.2.16 The cost of arbitration shall be apportioned against the parties hereto or against any one of them as the arbitrator may decide, as outlined in the latest edition of the Rules for Mediation of CCDC 2 Construction Disputes, except that those costs shall not include counsel fees for any of the parties to the arbitration. Counsel fees shall be paid by each party.

**37. GC 8.3 RETENTION OF RIGHTS**

37.1 Add new paragraph 8.3.3 as follows:

8.3.3 If the *Owner* gives the notice in writing described in paragraph 8.2.6 to have a dispute resolved by arbitration, the *Contractor* agrees that this paragraph 8.3.3 shall be construed as a formal consent to the stay of any lien proceedings until an award is rendered in the arbitration or such dispute is otherwise resolved between the parties. In no event shall the *Contractor* be deprived of its right to enforce its lien against the *Project* should the *Owner* fail to satisfy any arbitral award against it in full on the dispute in respect of which the lien proceedings were commenced. Nothing in this paragraph 8.3.3 shall prevent the *Contractor* from taking the steps required by the *Construction Lien Act* to preserve and/or perfect a lien to which it may be entitled.

**38. GC 9.1 PROTECTION OF WORK AND PROPERTY**

38.1 Delete subparagraph 9.1.1.1 in its entirety and substitute new subparagraph as follows:

9.1.1.1 errors in the *Contract Documents* which the *Contractor* could not have discovered applying the standard of care described in paragraph 3.14.1;

38.2 Delete paragraph 9.1.2 in its entirety and substitute the following new paragraph 9.1.2 as follows:

9.1.2 Before commencing any work, the *Contractor* shall determine the locations of all underground utilities and structures indicated in the *Contract Documents* or that are discoverable by applying to inspection of the *Place of the Work* the degree of care and skill described in paragraph 3.14.1.

38.3 Add new paragraph 9.1.5 as follows:

9.1.5 The *Contractor* shall neither undertake to repair and/or replace any damage whatsoever to the work of other contractors, or to adjoining property, nor acknowledge 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*. However, where there is danger to life or public safety, the *Contractor* shall take such emergency action as it deems necessary to remove the danger.

**39. GC 9.2 TOXIC AND HAZARDOUS SUBSTANCES**

39.1 Add to paragraph 9.2.6 after the word "responsible", the following new words:

or whether any toxic or hazardous substances or materials already at the *Place of the Work* (and which were then harmless or stored, contained or otherwise dealt with in accordance with legal and regulatory requirements) were dealt with by the *Contractor* or anyone for whom the *Contractor* is responsible in a manner which does not comply with legal and regulatory requirements, or which threatens human health and safety or the environment, or material damage to the property of the Owner or others,

39.2 Add "and the Consultant" after "Contractor" in subparagraph 9.2.7.4.

39.3 Add to paragraph 9.2.8 after the word "responsible", the following new words:

or that any toxic or hazardous substances or materials already at the *Place of the Work* (and which were then harmless or stored, contained or otherwise dealt with in accordance with legal and regulatory requirements) were dealt with by the *Contractor* or anyone for whom the *Contractor* is responsible in a manner which does not comply with legal and regulatory requirements, or which threatens human health and safety or the environment, or material damage to the property of the Owner or others,

#### 40. GC 9.4 CONSTRUCTION SAFETY

40.1 Delete paragraph 9.4.1 in its entirety and substitute new paragraph 9.4.1 as follows:

9.4.1 The *Contractor* shall be the "constructor" within the meaning of OHSA and 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 applicable construction health and safety legislation and shall be responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the performance of the *Work*.

40.2 Add new paragraphs 9.4.2, 9.4.3 and 9.4.4 as follow:

9.4.2 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 of the *Contractor's* in-house safety-related programs; and
- .4 a copy of the Notice of Project filed with the Ministry of Labour naming itself as "constructor" under OHSA.

9.4.3 The *Contractor* shall indemnify and save harmless the *Owner*, its agents, officers, directors, employees, consultants, successors and assigns from and against the consequences of any and all safety infractions committed by the *Contractor* under OHSA, including the payment of legal fees and disbursements on a full indemnity basis. Such indemnity shall apply to the extent to which the *Owner* is not covered by insurance, provided that the indemnity contained in this paragraph shall be limited to costs and damages resulting directly from such infractions and shall not extend to any consequential, indirect or special damages.

9.4.4 The *Owner* undertakes to include in its contracts with other contractors and/or in its instructions to its own forces the requirement that the other contractor or own forces, as the case may be, will comply with directions and instructions from the *Contractor* with respect to occupational health and safety and related matters. The text of such instruction is attached to these Supplementary Conditions.

**41. GC 9.5 MOULD**

41.1 Delete paragraph 9.5.3.3 in its entirety and substitute new paragraph 9.5.3.3 as follows:

9.5.3.3 extend the *Contract Time* for such reasonable time as the *Consultant* may recommend in consultation with the *Contractor*. in the opinion of the *Consultant*, the *Contractor* has been delayed in performing the *Work* and / or has incurred additional costs under paragraph 9.5.1.2, the *Owner* shall reimburse the *Contractor* for reasonable costs incurred as a result of the delay and as a result of taking those steps, and

41.2 Add “and the Consultant” after “Contractor” in subparagraph 9.5.3.4.

**42. GC 10.1 TAXES AND DUTIES**

42.1 Add to the end of paragraph 10.1.2 the following words:

“, except for changes announced prior to the time of the bid closing that are to take effect at some time thereafter, shall be deemed to have been taken into account in the *Contract Price*. The *Contractor* shall furnish to the *Owner* such information concerning its acquisition of equipment, inventory and other materials to enable the *Owner* to accurately access effect upon the *Contractor* of such change in tax or duty.

42.2 Add new paragraphs 10.1.3 and 10.1.4 as follows:

10.1.3 The *Contractor* is not entitled to any mark-up for profit, overhead or otherwise, due to an increase in taxes or duties. The *Contractor* shall be entitled to claim for the increase in cost equal to the amount of the tax and/or duty on the uncompleted cost of the work. The *Owner* will be entitled to withhold payment to the *Contractor* a sum equal to the amount of tax and/or duty reduction on the uncompleted portion of the work.

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

**43. GC 10.2 LAWS, NOTICES, PERMITS, AND FEES**

43.1 Add to the end of paragraph 10.2.4, the following words:

"The *Contractor* shall notify the Chief Building Official or the registered code agency where applicable, of the readiness, substantial completion, and completion of the stages of construction set out in the Ontario Building Code. The *Contractor* shall be present at each site inspection by an inspector or registered code agency as applicable under the Ontario Building Code."

43.2 Delete from the first line of paragraph 10.2.5 the word, "The" and substitute the following words:

"Subject to paragraph 3.4.1, the".

**44. GC 11.1 INSURANCE**

44.1 Delete paragraph 11.1.1 in its entirety and substitute the following:

“11.1.1 The Owner will provide Wrap-up Liability. General Liability insurance shall be in the joint names of the Contractor, the Owner, the Consultant, and any and all subcontractors and sub-consultants involved in the Work, with limits of not less than \$5,000,000 per occurrence and with a property damage deductible not exceeding \$10,000.

The insurance coverage shall include at least the following extensions: Premises, Property and Operations; Occurrence basis, Owners/Contractors protective, Products and Completed Operations; Blanket Contractual; Employees as Additional Insureds; Broad Form Property Damage; Broad Form Loss of Use; Personal Injury; Incidental Malpractice; Contingent Employers Liability; Cross Liability/ Severability of Interests; Non-Owned Automobile Liability including Endorsement Form 96; Intentional Injury to protect persons or property, Xplate/unlicensed/specially licensed vehicles; Attached Machinery; Hostile fire exception to any pollution exclusion; Voluntary Medical Payments. To achieve the desired limit, umbrella or excess liability insurance may be used. All liability coverage shall be maintained for the completed operations hazard from the date of Substantial Performance of the Work, for 24 months following. The Policy shall be endorsed to provide the Contractor with not less than 30 days notice in writing in advance of any cancellation or change or amendment restricting coverage.

44.2 Add new subparagraphs 11.1.1.1 as follows:

“11.1.1.1 The *Owner* will obtain and maintain “Builders’ Risk” or “all risks” or “course of construction” property insurance shall be in the joint names of the *Owner*, the *Contractor*, and the *Consultant*, insuring not less than the full replacement cost of the building and associated equipment. The policy shall carry a deductible of not more than \$10,000 for general claims and \$25,000 for water related claims and shall be maintained continuously from commencement of work until 10 days after substantial completion.

- (1) 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 *Owner* shall act on behalf of the *Contractor* for the purpose of adjusting the amount of such loss or damage payment with 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 *Contract Time* relative to the extent of the loss or damage as the *Consultant* may recommend in consultation with the *Contractor*.
- (2) 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 in accordance with progress payment provisions. 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*.

- (3) In the case of loss or damage to the Work arising from the work of another contractor, or Owner's own forces, the Owner shall, in accordance with the Owner's obligations under the provisions relating to the construction by the Owner or other contractors, pay the Contractor the cost of restoring the Work as the restoration of the Work proceeds and in accordance with the progress payment provisions.

44.4 Delete paragraphs 11.1.6 and 11.1.7 in their entirety.

44.5 Delete paragraph 11.1.8 and substitute the following:

"A *Change Directive* shall not be used to direct a change in the insurance requirements to be provided by the *Contractor*."

#### 45. GC 11.2 CONTRACT SECURITY

45.1 Add to the end of paragraph 11.2.1, the following words:

"guarantee the faithful performance of the *Contract* in accordance with the *Contract Documents*. The performance bond shall cover all extended warranty periods specified in GC 12.3. The Labour and Material Payment Bond shall ensure payment of wages and products to Subcontractors and suppliers, and discharge of liens and debts, including commitments in law, such as Employment Insurance, Income Tax Deductions, Workplace Safety and Insurance Board premiums and Vacation Pay."

45.2 Add new paragraphs 11.2.3, 11.2.4, 11.2.5, and 11.2.6 as follows:

11.2.3 The *Contractor* and not the *Owner* shall be responsible for notifying the surety company of any changes made to the *Contract* during the course of construction.

11.2.4 Obligations incurred in the event of the *Contractor's* default shall include, but not necessarily be limited to the following:

11.2.4.1 The payment of all legal, accounting, architectural, engineering and consulting fees incurred by the *Owner* in determining the extent of the *Work* executed and any additional work required as a result of the interruption of the *Work*, and

11.2.4.2 The payment of additional expenses by the *Owner* in the form of security, light, heat, power, etc. during the period between the default of the *Contractor* and the commencement of the work.

11.2.5 Without limiting the foregoing in any way, the Performance Bond shall indemnify and hold harmless the *Owner* for and against any and all costs and expenses (including all legal and professional fees and court costs) arising out of or as a result of or as a consequence of any default of the *Contractor* under the *Contract*."

11.2.6 The Performance Bond shall remain in effect for the duration of the warranty period as specified in GC 12.3, or as may be amended by these Supplementary Conditions.

**46. GC 12.1 INDEMNIFICATION**

46.1 Add new paragraph 12.1.7 as follows:

12.1.7 The Contractor shall indemnify and hold harmless the Consultant, its agents and employees from and against claims, demands, losses, costs, damages, actions, suits, or proceedings by third parties that arise out of, or are attributable to, the Contractor's performance of the Contract, provided such claims are attributable to bodily injury, sickness, disease, or death, or to injury to or destruction of tangible property, and caused by negligent acts or omissions of the Contractor or anyone for whose acts the Contractor may be liable, and made in writing within a period of 6 years from the date of Substantial Performance of the Work as set out in the certificate of Substantial Performance of the Work, or within such shorter such period as may be prescribed by any limitation statute or the province or territory of the Place of Work".

**47. GC 12.2 WAIVER OF CLAIMS**

47.1 Delete the last sentence of subparagraph 12.2.3.4 and substitute the following:

For purposes of this subparagraph 12.2.3.4, "substantial defects or deficiencies" means those defects or deficiencies in the *Work* where the reasonable cost of repair of such defects or deficiencies exceeds:

- .1 if the *Contract Price* is \$2 million or less, the sum of \$50,000, before Value Added Tax;
- .2 if the *Contract Price* exceeds \$2 million, the sum of \$100,000, before Value Added Tax.

In any event, "substantial defects or deficiencies" shall include defects or deficiencies in the *Work* which affect the *Work* to such an extent or in such a manner that a significant part or the whole of the *Work* is unfit for the purpose intended by the *Contract Documents*.

**48. GC 12.3 WARRANTY**

48.1 Delete from the first line of paragraph 12.3.2 the word, "The" and substitute the following words:

"Subject to paragraph 3.4.1, the...

**49. PART 13 OTHER PROVISIONS**

Add new **PART 13** as follows:

**GC 13.1 OWNERSHIP OF MATERIALS**

13.1.1 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*.

**GC 13.2 CONTRACTOR DISCHARGE OF LIABILITIES**

- 13.2.1 In addition to the obligations assumed by the *Contractor* pursuant to GC 3.7, the *Contractor* agrees to discharge all liabilities incurred by it for labour, materials, services, *Subcontractors* and *Products*, used or reasonably required for use in the performance of the *Work*, except for amounts withheld by reason of legitimate dispute which have been identified to the party or parties, from whom payment has been withheld.

**GC 13.3 RECORD DRAWINGS**

- 13.3.1 As provided in the *Contract Documents*, the *Contractor* shall prepare record *Drawings* and specifications and provide them to the *Consultant* for review.

**GC 13.4 DAILY REPORTS/DAILY LOGS**

- 13.4.1 The *Contractor* shall cause its supervisor, or such competent person as it may delegate, to prepare a daily log or diary reporting on weather conditions, work force of the *Contractor*, *Subcontractors*, *Suppliers* and any other forces on site and also record the general nature of *Project* activities. Such log or diary shall also include any extraordinary or emergency events which may occur and also the identities of any persons who visit the site who are not part of the day-to-day work force.
- 13.4.2 The *Contractor* shall also maintain records, either at its head office or at the job site, recording manpower and material resourcing on the *Project*, including records which document the activities of the *Contractor* in connection with GC 3.5, and comparing that resourcing to the resourcing anticipated when the most recent version of the schedule was prepared pursuant to GC 3.5.

**GC 13.5 NEUTRAL APPOINTING AUTHORITY**

- 13.5.1 For purposes of the Rules for Mediation and Arbitration of Construction Disputes CCDC 40, the term "neutral appointing authority", as used in both the Rules for Mediation of CCDC 2 Construction Disputes and the Rules for Arbitration of CCDC 2 Construction Disputes shall mean the head of the construction section of the ADR Institute of Ontario, Inc. presiding at the time notice of the dispute is given pursuant to the *Contract*.

**GC 13.6 HUMAN RIGHTS AND SEXUAL AND GENDER HARASSMENT POLICIES**

- 13.6.1 The parties agree to be governed by the provisions of the Ontario Human Rights Code. Furthermore, the parties agree to comply with the provisions of the Client's Human Rights Policy and any subsequent related policy or procedures that the Client may approve. The architect shall refer to [www.uoguelph.ca/hre/hr.shtml](http://www.uoguelph.ca/hre/hr.shtml) for more information.

**GC13.7 ACCESSIBILITY FOR ONTARIANS WITH DISABILITIES ACT (AODA)**

13.7.1 The parties agree to be governed by the provisions of the Accessibility for Ontarians with Disabilities Act (AODA).

13.7.2 The Contractor agrees to:

(a) Comply with the accessibility standards established under the AODA by the Ontario Government and adhere to the University's policies and procedures in regards to accessibility as well as to ensure all of its subcontractors similarly do the same.

(b) Ensure that training on the requirements of the accessibility standards are provided to those of its employees who will be working with the public (students, staff, faculty, visitors or other third parties) at, or on behalf of, the University and who participate in developing the proponent's policies, practices or procedures.

(c) Keep records of such training.

(d) Provide such records when required by the University.

(e) Upon Notice of Award, provide to the University with a signed AODA Supplier Compliance Form prior to commencing any work for the University.

**END OF SECTION**

**LANGUAGE FOR OWNER PERSONNEL OR FOR THIRD PARTY CONTRACTORS  
ENTERING A PROJECT SITE WHERE THE CONTRACTOR HAS ASSUMED OVERALL  
RESPONSIBILITY – IN CONTRACT – FOR OCCUPATIONAL HEALTH AND SAFETY**

I/We (trade or employee name) acknowledge that the work we will perform on behalf of the *Owner* requires us to enter a job site which is under the total control of a *Contractor* which has a *Contract* with the University of Guelph.

I/We (trade or employee) further acknowledge that [name of *Contractor*] has assumed overall responsibility for compliance with all aspects of the health and safety legislation of Ontario, including all the responsibilities of the "constructor" under the Occupational Health and Safety Act (Ontario).

Further, (trade or employee) acknowledges that [name of *Contractor*] is also responsible to the University of Guelph to co-ordinate and schedule the activities of our work with the *Work* of the *Contractor*.

We agree to comply with [name of *Contractor*] directions and instructions with respect to occupational health and safety and coordination.

We acknowledge that it will be cause for termination under our contract with the *Owner* should (I/we) fail or refuse to accept the direction and instruction of the *Contractor* with respect to matters of occupational health and safety or matters related to coordination of work.

We agree to have the [name of *Contractor*] named as an additional insured on our comprehensive liability policy.

**ACKNOWLEDGEMENT and SIGNATURES**

Signed and sealed by :

Note: Affix Corporate Seal

Seal:

\_\_\_\_\_  
Company Name

\_\_\_\_\_  
Printed Name

\_\_\_\_\_  
Signature

\_\_\_\_\_  
Name of Witness

\_\_\_\_\_  
Signature of Witness

Dated this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 PARTNERING**

- .1 The Owner proposes a team building approach to this contract called "Partnering." Partnering is a non-binding commitment by all parties, including the Owner, Consultant and Subconsultants, the Contractor and Subcontractors, and key equipment suppliers to work cooperatively as a team, in a spirit of trust and respect, to achieve common goals and objectives to promote smooth information exchange and creative problem solving. Partnering focuses on the strengths of each participant to efficiently and safely achieve a quality end product, on time and within budget, without unresolved disputes. The Contractor and Subcontractors directly benefit from the cooperation, fairness, openness, improved morale and efficiency of the partnering relationship. It is intended that Partnering will enhance all parties' commitment and good faith for the duration of the project.
- .2 The Partnering team includes key staff members from the Owner, Consultant, key suppliers, Contractor and Subcontractors. This includes project managers, work crew forepeople, project supervisors, quality assurance supervisors, off site construction administrators, and principals.
- .3 The Partnering process will involve:
  - .1 A commitment of all parties to work as a team to achieve the goals identified for all the parties.
  - .2 An agenda item at each progress meeting to evaluate the partnering arrangement and resolve conflict.
  - .3 An initial project partnering meeting scheduled following the first progress meeting.
  - .4 Follow-up partnering meetings scheduled at approximately three (3) month intervals to provide regular evaluation of the Partnering effectiveness throughout the duration of the Contract.
- .4 The Contractor shall record and distribute the minutes from the partnering meetings.
- .5 A Partnering Charter will be developed by the participants at the initial partnering meeting to document goals shared by all parties. This Charter will serve as a guide in monitoring the Partnering effectiveness, remind participants of the commitments made, and document the common goals established. The Partnering Charter will be sent to all key equipment suppliers not directly involved in the initial Partnering meeting for their information, and to seek their endorsement of the Partnering process.
- .6 Development of the Partnering Charter will take into account the Owner's goals and objectives for this project as they relate to the working relationship necessary to deliver a first class facility in a safe, effective and timely manner.
- .7 One of the key outcomes of the initial partnering meeting will be a non-binding "Dispute Resolution Ladder". This will establish a clear hierarchy for resolving disputes as they arise using a process that is respectful, responsive, open and fair to all parties.

## **PART 2 - PRODUCTS**

### **2.1 NOT USED**

- .1 Not Used.

## **PART 3 - EXECUTION**

### **3.1 NOT USED**

- .1 Not Used.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 WORK COVERED BY CONTRACT DOCUMENTS**

- .1 Work Covered by the Contract Documents generally comprises the renovation of Building #046, also known as the Former Veterinary Microbiology and Immunology (VMI) building, located on the University of Guelph campus and further identified as 50 College Avenue West.
- .2 The Owner for the purpose of this Contract is The University of Guelph.
- .3 The specifications are not a detailed description of installation methods, but serve to indicate particular requirements of the complete work.
- .4 It is the intention of the drawings and specifications to provide finished work. Any items omitted, which are clearly necessary for the completion of the Work, are part of the Work.
- .5 Material shown or specified on Drawings or Specifications, unless otherwise specified, shall conform to the standards designated in the Ontario Building Code. Similarly, unless otherwise specified, installation methods and standards of workmanship shall also conform to standards required by the Ontario Building Code.
- .6 Parts of the specifications are written in short form; therefore, it is understood that where a component of Work is stated in the heading followed by a material or operation, "shall be", "shall consist of" or similar words or phrases are implied which denote complete supply and installation of such material or operations for component of work designated by heading.
- .7 Division 01 of the specifications shall be read into and form part of each Section of the Specifications.
- .8 The Contract Documents are to be interpreted as a whole, although they are arranged in divisions and sections for convenience and clarity. The Contractor is responsible for all work, regardless of the division of the work in the Contract Documents, and such division does not impose any obligation on the Consultant or upon the Owner as arbiters to establish limits or responsibilities between the Contractor and Subcontractors.

### **1.2 SPECIFICATION FORMAT**

- .1 Specifications are not intended as a detailed description of installation methods but serve to indicate particular requirements to insure the performance of the completed work.
- .2 Material shown or specified on Drawings or in Specifications, unless otherwise specified, shall conform to standards designated in Ontario Building Code. Similarly, unless otherwise specified, installation methods and standards of workmanship shall also conform to standards required by Ontario Building Code.
- .3 Parts of specification are written in short form, therefore it is understood that where a component of Work is stated in heading followed by a material or operation, "shall be", "shall consist of" or similar words or phrases are implied which denote complete supply and installation of such material or operations for component of work designated by heading.
- .4 Division 1 of the specifications shall be read into and form part of each Section of the Specifications.
- .5 The Contract Documents are to be interpreted as a whole, although they are arranged in divisions and sections for convenience and clarity. The Contractor is responsible for all the work, regardless of the division of the work in the Contract Documents, and such division does not impose any obligation on the Consultant or upon the Owner as arbiters to establish limits or responsibility between the Contractor and the Subcontractors.

### 1.3 CONTRACT METHOD

- .1 Construct Work under a single lump sum, Stipulated Price Contract, based on the CCDC 2-2008 document, as amended by the University of Guelph Supplementary General Conditions herein.
- .2 Obtain Substantial Completion on or before time indicated on Bid Form, Declaration '1'.
- .3 Contractor Use of Premises: assume responsibility for complete use of the Construction Site.
- .4 Workplace Policies: Comply with all University of Guelph policies including, but not limited to the following:
  - .1 Human Rights and Sexual and Gender Harassment
  - .2 Accessibility for Ontarians with Disabilities
  - .3 Alcohol, Tobacco and Other Drugs – Consumption of tobacco, alcohol and other drugs on University property are strictly prohibited.
- .5 Approvals and Permits:
  - .1 Refer to CCDC 2, GC 10.2 and University of Guelph Supplemental Conditions.
  - .2 Work is subject to the approval, inspection, by-laws and regulations of all municipal, provincial, federal and other authorities having jurisdiction.

### 1.4 QUALITY OF WORK

- .1 Work shall be of the best quality, executed by workers experienced and skilled in the respective duties for which they are employed.
- .2 Do not employ any unfit persons or anyone unskilled in their required duties.
- .3 Decisions as to the quality or fitness of workmanship in cases of dispute rest solely with the Consultant, whose decision is final.

### 1.5 WORKING DAYS AND HOURS

- .1 Refer to Section 01 14 03 - Special Project Scheduling Requirements

### 1.6 CONTRACT TIME AND TIME FOR COMPLETION

- .1 The project shall commence immediately upon execution of the Contract and/or the Contractor receiving a Letter of Intent from the Consultant/Owner.
- .2 The Letter of Intent shall be a letter from the Consultant/Owner authorizing the Contractor to commence the Work. The start date indicated in the Letter of Intent shall have been agreed to in principle by all parties prior to issuance of the Letter of Intent.
- .3 The work shall continue in an expeditious manner in order to obtain Substantial Performance on or before time indicated on Bid Form, Declaration '1'.
- .4 The Work, save and except for the warranty period, shall be completed within 25 working days following Substantial Performance, deemed to be the 'Time for Completion'.
- .5 The Contractor shall include a reasonable allowance in their overall project schedule for individual working days lost due to inclement weather. No extension to the Contract Time or Time for Completion shall be made by the Owner for individual working days lost due to inclement weather, except as otherwise provided for in the Contract.

## **1.7 FEES, PERMITS AND CERTIFICATES**

- .1 Refer to GC 10.2, Laws, Notices, Permits and Fees.
- .2 The Owner will apply and pay for the Building Permit required under the Ontario Building Code. Contractor is advised that workload at the authorities having jurisdiction may delay permit issuance.
- .3 Application and payment for all damage deposits, and other permits, licenses, fees and costs remain the responsibility of the Contractor. For clarification, the Contractor is required to post all damage deposits required by the authorities having jurisdiction as a condition of permit issuance.
- .4 Obtain copy of Building Permit from Owner, complete with drawings on which authorities having jurisdiction may have made comments, and examine same. Advise Consultant of any changes required, complete with associated costs
- .5 Arrange all required inspections by authorities having jurisdiction on behalf of the Owner. Furnish inspection certificates as evidence that work conforms to requirements of authority having jurisdiction.
- .6 Pay all advertisement fees for substantial completion.
- .7 Maintain and pay for insurance requirements in accordance with the University of Guelph Supplemental Conditions.

## **1.8 PROJECT COORDINATION**

- .1 Coordinate progress of Work, progress schedules, submittals, use of site, temporary utilities, construction facilities, Owner's continued use and occupancy of the building and site during the Work.
- .2 Assume full responsibility for, and execute complete layout of work to locations, lines and elevations indicated including any existing utilities or services.
- .3 Provide devices needed to layout and construct work. Refer to Section 01 71 00 – Examination and Preparation.
- .4 Supply such devices as straight edges and templates required to facilitate Consultant's review of work.
- .5 Each trade shall examine the work upon which the trade or specification Section depends. Have all defects and deficiencies corrected prior to proceeding with work. The application of work or any part of it shall be deemed acceptance by the Contractor of the work upon which subsequent work depends.

## **1.9 CONTRACTOR USE OF PREMISES**

- .1 Execute work with least possible interference or disturbance to normal use of premises.
- .2 Limit use of premises for Work and access to allow:
  - .1 Owner occupancy and use of existing facilities on site.
- .3 Coordinate use of premises under direction of Owner and Consultant.
- .4 Obtain and pay for use of additional storage or work areas needed for operations under this Contract.

- .5 For work outside the construction area, traffic circulation and other normal use of the site is to be maintained at all times. Temporary security, fencing, trench covers, signage, flagmen, traffic control measures, etc., to be provided.
- .6 Project equipment, furnishings, Owner's and occupants' effects remaining in any area in which work is occurring as required, and as specified elsewhere. Make good all damage to the satisfaction of the Owner. Relocate all furnishings, equipment and effects in existing facilities, as needed to execute the Work, and return same to original location before Owner re-occupies existing facilities.
- .7 Maintain construction site in an organized and orderly state at all times.
- .8 Clean-up grounds and access roads daily and whenever directed.
- .9 Contractor shall be responsible to secure all buildings where construction is ongoing and to secure/lock all gates where site access is possible at the end of each workday.
- .10 All Contractor personnel are restricted to the job site and necessary access routes. No personnel shall visit other areas or buildings without specific authorization.
- .11 Remove or alter existing work to prevent injury or damage to portions of existing work which remain.
- .12 Repair or replace portions of existing work which have been altered during construction operations to match existing or adjoining work, as directed by Consultant.
- .13 At completion of operations condition of existing work: equal to or better than that which existed before new work started.

#### **1.10 RESTRICTIONS ON CONTRACTOR MOVEMENT**

- .1 Contractor personnel are restricted to the job site and necessary access routes. No personnel shall visit other areas or buildings without prior authorization. The extent of the work site shall be confined to the areas in which work is occurring and access routes to those areas.

#### **1.11 OWNER OCCUPANCY**

- .1 Owner will occupy premises during entire construction period for execution of normal operations. All work shall be scheduled and co-ordinated to accommodate this requirement and all necessary precautions shall be taken to ensure safe occupancy.
- .2 Cooperate with Owner in scheduling operations to minimize conflict and to facilitate Owner usage.

#### **1.12 OWNER FURNISHED ITEMS**

- .1 Owner Responsibilities:
  - .1 Arrange for delivery of shop drawings, product data, samples, manufacturer's instructions, and certificates to Contractor.
  - .2 Deliver supplier's bill of materials to Contractor.
  - .3 Arrange and pay for delivery to site in accordance with Progress Schedule.
  - .4 Inspect deliveries jointly with Contractor.
  - .5 Submit claims for transportation damage.
  - .6 Arrange for replacement of damaged, defective or missing items.
  - .7 Arrange for manufacturer's field services; arrange for and deliver manufacturer's warranties and bonds to Contractor.

- .2 Contractor Responsibilities:
  - .1 Designate submittals and delivery date for each product in progress schedule.
  - .2 Review shop drawings, product data, samples, and other submittals. Submit to Consultant notification of observed discrepancies or problems anticipated due to non-conformance with Contract Documents.
  - .3 Receive and unload products at site.
  - .4 Inspect deliveries jointly with Owner; record shortages, and damaged or defective items.
  - .5 Handle products at site, including uncrating and storage.
  - .6 Protect products from damage, and from exposure to elements.
  - .7 Assemble, install, connect, adjust, and finish products.
  - .8 Provide installation inspections required by public authorities.
  - .9 Repair or replace items damaged by Contractor Design-Builder or subcontractor on site (under his control).
  - .10 Refer also to requirements of Section 01 73 01 – Supplementary Conditions and Appendix
- .3 Schedule of Owner furnished and Contractor Installed items:
  - .1 Toilet and Bath Accessories – Refer to Section – 10 28 10 Toilet and Bath Accessories
  - .2 Soft Furnishings: The owner will procure the furniture under a separate contract. The contract will be responsible for the coordination of the furniture installation as it relates to The Work, including but not limited to, scheduling, supervision of the installation, coordination with the Owner and the Trades for location of services etc.
- .4 Video Capture System (VCAP): The owner will procure a priority video monitoring package, including physical cameras, microphones and software, which under a separate contract. The Contractor will be responsible for the coordination of the installation of this system as it relates to The Work, including but not limited to, scheduling, supervision of the installation, coordination with the Owner and the Trades for location of services etc.
- .5 System and Ancillary Furniture: The owner will procure furniture package under a separate contract. The Contractor will be responsible for the coordination of the installation of this system as it relates to The Work, including but not limited to, scheduling, supervision of the installation, coordination with the Owner and the Trades for location of services etc.

### 1.13 EXISTING SERVICES

- .1 Notify Consultant, Owner, and utility companies of intended interruption of services and obtain required permission.
- .2 Where Work involves breaking into or connecting to existing services, give Owner and Consultant five (5) business days' notice for necessary interruption of mechanical or electrical service throughout course of work. Minimize duration of interruptions. Carry out work at times as directed by governing authorities with minimum disturbance to Owner operations.
- .3 Where length of service shutdown will exceed twelve (12) hours, provide minimum seven (7) full working days advance notice.
- .4 Provide alternative routes for pedestrian and vehicular traffic.
- .5 Establish location and extent of service lines in area of work before starting Work. Notify Consultant of findings.

- .6 Submit schedule to and obtain approval from Consultant for any shut-down or closure of active service or facility including power and communications services. Adhere to approved schedule and provide notice to affected parties.
- .7 Provide temporary services to maintain critical building systems.
- .8 Provide adequate bridging over trenches which cross sidewalks or roads to permit normal traffic.
- .9 Where unknown services are encountered, immediately advise Consultant and confirm findings in writing.
- .10 Protect, relocate or maintain existing active services. When inactive services are encountered, cap off in manner approved by authorities having jurisdiction.
- .11 Record locations of maintained, re-routed and abandoned service lines.
- .12 Construct barriers in accordance with Section 01 56 00 – Temporary Barriers and Enclosures.

#### **1.14 PRE-CONSTRUCTION SURVEY**

- .1 The pre-construction survey shall be prepared by the Contractor for all utilities, structures, surfaces, facilities, and equipment within the building likely to be impacted due to the proposed construction activities.
- .2 The pre-construction survey means a detailed record in written form, accompanied by photos and/or video of the condition of the existing facilities prior to the commencement of any construction activities. All existing structures/cosmetic damage or defects shall be clearly documented.
- .3 The pre-construction survey will be considered the basis by which claims for damages caused by construction activities will be made.
- .4 Prior to commencing work, complete a survey of existing conditions within work area(s) and along path of travel for goods to be delivered and removed from the site.
- .5 Prior to commencing work, complete a survey of existing site services and utilities within work area(s) and along path of travel for goods to be delivered and removed from the site.
- .6 Owner will accompany Contractor on inventory tour. Arrange mutually agreeable time for survey.
- .7 Inventory all existing damage, accurately recording all observed conditions. Use photographs, written records, spreadsheets videography, etc. to fully document existing conditions, noting existing damage in sufficient detail to act as record of conditions.
- .8 Within two (2) business days of inventory, and prior to commencing demolition or construction, provide each of Owner and Consultant with copy of inventory records. Identify photographs using room numbers and detailed descriptions of observed damage.
- .9 Owner will review submission. Revise and resubmit rejected inventory. Demolition and/or construction may only commence after acceptance by Owner of inventory records.
- .10 Repair and make good any damage found subsequent to submission of inventory, which in the opinion of the Consultant is the result of the Work, and which is not documented in the inventory submitted to the Owner and Consultant to Owner. Repairs shall return damaged elements to their condition prior to start of work. Where work increases extent of existing damage, repair shall return element to match previous damaged condition. Refer to CCDC 2 – 2008, GC 9.1

- .11 Where repairs cannot, in the opinion of the Consultant, be expediently implemented the Consultant shall ascertain the value to be deducted from the amounts due the Contractor in the manner permitted under CCDC 2 – 2008, GC 2.4

#### **1.15 CONSTRUCTION EQUIPMENT**

- .1 Provide and maintain equipment such as temporary stairs, ladders, ramps, scaffolds, swing stages, runways, chutes and like as required for execution of work.
- .2 Provide and maintain conveying equipment such as cranes, hoists, derricks and like as required for execution of work.
- .3 Assume complete responsibility for construction strength, placing, anchoring and operation of cranes, derricks, hoists, and other mechanical equipment used for work and ensure that loads carried thereon can be safely supported.
- .4 Remove such equipment immediately when no longer required for work.
- .5 Ensure all construction vehicles and equipment are equipped with properly functioning noise attenuating devices.

#### **1.16 LOCATION OF EQUIPMENT AND FIXTURES**

- .1 Location of equipment, fixtures and outlets indicated or specified are to be considered as approximate.
- .2 Locate equipment, fixtures, and distribution systems to provide minimum interference and maximum usable space and in accordance with manufacturer's recommendations for safety, access, and maintenance.
- .3 Submit field drawings to indicate relative position of various services and equipment when required by the Consultant.
- .4 Provide detailed interference and coordination drawings when required by specific specification sections.

#### **1.17 EQUIPMENT PROTECTION**

- .1 Deliver and store materials according to manufacturer's written instructions and protect from damage.
- .2 Locate equipment, fixtures, and distribution systems to provide minimum interference and maximum usable space and in accordance with manufacture's recommendations for safety, access, and maintenance.
- .3 During construction, all equipment is to be protected against dust and/or moisture.

#### **1.18 EQUIPMENT MAINTENANCE**

- .1 Equipment started prior to Substantial Performance is to be maintained by the Contractor in accordance with the manufacturer's written instructions.
- .2 Maintain log of maintenance work as it is completed and submit to Owner prior to final acceptance.

#### **1.19 WARRANTIES**

- .1 Provide overall project warranty in accordance with CCDC 2-2008 and the University of Guelph Supplemental Conditions. Project warranty to be measured from date of Substantial Performance.
- .2 Provide individual equipment and systems warranties as called for in the documents.
- .3 All work or materials replaced or repaired during the warranty period to be warranted for an additional period equaling term of original guarantee.
- .4 Bind all warranties together and submit as a separate volume with the Operations and Maintenance Manual.

#### **1.20 ISSUED FOR CONVENIENCE DRAWINGS AND SPECIFICATIONS**

- .1 Upon award of the contract either by executing the Agreement or issuance of an order to commence work the Contractor will initiate the works immediately based on the tender drawings and specifications and any addenda issued during the tender period.
- .2 The Consultant will undertake to prepare drawings and specification that incorporate addenda and that are to be used as convenience to the Contractor. A time frame of approximately two (2) weeks is anticipated to complete this task, but is not guaranteed.
- .3 Adding the addenda information to the drawings and specifications is being done only for convenience of all parties to facilitate construction of the works. The updated drawings and specifications will be referred to as 'Issued with Addenda Information Added for Convenience'.
- .4 The official Contract Documents will remain as those listed in the executed Agreement. Should there be any conflict or discrepancies between the documents update with Addend Information and those listed in the executed Agreement, the latter shall govern in all matters.
- .5 There will be no guarantee to the completeness of the documents updated with Addenda Information. The Contractor will be responsible for checking these documents to ensure they account for all Addenda Information and ensuring the works are constructed fully in accordance the executed Agreement.
- .6 There will be no change in the Contract Time or Price as a result of information being made available.

#### **1.21 DAILY LOG**

- .1 Maintain a daily log recording the following data:
  - .1 An address directory recording the names, address, and telephone number of representatives of all sub-contractors, trades, and suppliers doing work or supplying material for the project.
  - .2 Record various items of work being carried out on each day including the number of workers and amount of work completed.
  - .3 Record the maximum and minimum daily weather temperatures both inside and outside of the building. In this regard, the Contractor shall maintain a minimum/maximum thermometer both inside and outside the building for the duration of the project.
  - .4 Record ordering dates and receiving dates of material F.O.B. job site to the site.
  - .5 Record of any accidents and first aid given.
  - .6 Record of any Fire Watch.

## **1.22 DOCUMENTS REQUIRED**

- .1 Maintain at job site, one copy each document as follows:
  - .1 Contract Drawings.
  - .2 Specifications.
  - .3 Addenda.
  - .4 Building Permit
  - .5 Reviewed Shop Drawings.
  - .6 List of Outstanding Shop Drawings.
  - .7 Change Orders.
  - .8 Other Modifications to Contract.
  - .9 Field Test Reports.
  - .10 Copy of Approved Work Schedule.
  - .11 Health and Safety Plan and Other Safety Related Documents.
  - .12 Record drawings.
  - .13 Other documents as specified.

## **1.23 DISCOVERED VALUABLES**

- .1 All articles of value, such as relics, antiquities, or items of historical or scientific interest which may be discovered during demolition, dismantling, or excavation of the Place of the Work are the property of the Owner and shall be immediately delivered into the custody of the Owner.

## **1.24 IDENTIFICATION**

- .1 All personnel engaged by the Contractor, directly or indirectly, in work of this Contract shall wear identification badge issued by Owner while on Owner's property.
- .2 Badges are the property of the Owner and shall be returned at the earlier of completion of work or upon request.

## **1.25 AVAILABLE DOCUMENTATION OF EXISTING BUILDING**

- .1 Refer also to Section 00 31 01 Information Available to Bidders.
- .2 Partial drawings of the existing site and building, as applicable, are available for review at the office of the Owner. Neither the Owner nor the Consultant represent or warranty that these drawings are complete or accurate, and these drawings are made available for information only.
- .3 The Contractor remains solely liable for site verification of conditions.

## **1.26 SITE EXAMINATION**

- .1 Contractor warrants that:
  - .1 The Contractor has visited and assessed the site prior to submitting a bid, including a review of any existing pertinent drawings and other documents.
  - .2 The Contractor and the subcontractors are familiar with all matters discussed at any bidder's site briefing.

- .3 The Contractor and the subcontractors are familiar with all visible, known, or reasonably inferable site conditions.
- .2 No claims for extra payment will be allowed for extra work made necessary or difficulties encountered due to conditions of the site which were visible upon or reasonably inferable from an examination of the site, and the Contract Documents prior to the closing of the bids. Execution of the form of Contract shall be deemed a waiver of all claims for extra payment due to any visible or reasonably inferable condition of the site existing prior to the closing of bids.
- .3 The Contractor expressly agrees that conditions above existing suspended acoustic tile ceilings but below the level of plaster or gypsum board at the underside of structure shall be considered exposed conditions for the purposes of making findings under the provisions of this Contract, and that there shall be no claims for extra costs under CCDC 2 - 2008, GC 6 for extra work due to hidden conditions in these areas.

#### 1.27 SAFETY

- .1 Refer to CCDC 2 – 2008, GC 9.4.
- .2 Contractor's current health and safety statement and policy shall be filed with University of Guelph - Design, Engineering and Construction prior to start of work, for the Owner's information only.
- .3 The health and safety statement and policy shall include:
  - .1 Current Material Safety Data Sheets for the products to be used.
  - .2 Provisions for safety including the use of continuous snow fencing in lieu of barricades or caution tape.
  - .3 Signage to indicate DANGER ZONES, CLOSURES, DETOURS, ETC.
  - .4 Set-up locations and procedures.
  - .5 Material storage and handling.
  - .6 Fire protection.
  - .7 Debris handling, storage, disposal and clean-up.
  - .8 Personnel safety required by the regulations including roof barriers, travel restraint systems and fall arrest systems.
  - .9 Other measures pertinent to the Work.
- .4 Owner's receipt of such policy is not approval of completeness and accuracy of policy, nor confirmation of compliance with applicable legislation. The Owner shall in no way be held liable for contents or enforcement of the Contractor's health and safety statement and policy, or the Contractor's detailed health and safety procedures. Owner's comments, or lack thereof, shall not be construed as approval of the Contractor's health and safety practices.
- .5 Observe and enforce construction safety measures required by Ontario Building Code, Canadian Construction Safety Code 1977, Occupational Health and Safety Act 1980 and all latest amendments including the Regulations for Construction Projects, , Ontario Regulations 413/90 and all latest amendments, Workers' Compensation Board and municipal statutes and authorities.
- .6 In the event of conflict between provisions of above authorities the most stringent provision applies.
- .7 The General Contractor shall be designated the "Constructor", as defined by the Occupational Health and Safety Act. All Contractors on the Work site shall consider themselves as "employers" as defined by the Occupational Health and Safety Act.

- .8 Do not permit any work in the existing building which may be hazardous or harmful to the occupants of the existing building. All such work must be scheduled for times the existing building will be unoccupied. Such work will include, but not be limited to, hoisting of materials and equipment over normally occupied spaces; the rise of toxic solvents or adhesives, the rise of carbon monoxide or carbon dioxide fumes generated by fuel-fired appliances or equipment, etc.
- .9 Contractor is solely liable for construction safety and for compliance with applicable legislation.
- .10 Provide a copy of the project registration filed with a Director under the Occupational Health and Safety Act (Ontario) called "Registration Forms of Construction and Employers of Workers".
- .11 Where legislation requires a joint health and safety committee, provide minutes of the committee's meetings to the Owner for the Owner's information.
- .12 Provide Owner and Consultant with a copy of Ministry of Labour inspection report and any orders arising within 24 hours of receiving report, for Owner's information.
- .13 Correct all safety deficiencies immediately.
- .14 Accidents
  - .1 In addition to requirements of applicable legislation, in any emergency requiring the use of a resuscitator, the University Fire Prevention Office shall be notified.
  - .2 Make arrangements for emergency treatment of accidents.
  - .3 Provide Owner and Consultant with a copy of WSIB injury report for all reportable accidents and injuries, for information purposes, within 24 hours of incident.
- .15 The Contractor will be responsible for verifying through locates the location of any utilities or services that cross or enter the area of the Work. Submit, as a record, documented locations of all utilities and services at the Place of the Work
- .16 Indemnify and hold harmless the Owner of any and all liability of every nature and description that may be suffered through bodily injuries, involving deaths of any persons, by reasons of negligence of the contractor, his agents, employees, or his sub-contractors.

#### **1.28 CONSULTANT'S REVIEW**

- .1 The Contractor shall render all necessary assistance to the Consultant and if required shall take and furnish him with levels, measurements, or anything else required by the Consultant to review the Work. The Contractor shall provide sufficient, safe and proper facilities at all times for the review of the Work by the Consultant.

#### **1.29 EXISTING ASSEMBLIES: FIRE SEPARATION INTEGRITY**

- .1 Unless otherwise indicated, assume all existing walls, floors and ceilings are fire separations that have a fire resistance rating of at least 1 hour. Assume all existing doors and frames have fire ratings, whether bearing a fire-rating label or not.
- .2 Execute work to maintain fire resistance rating integrity and fire separation integrity, including but not limited to reclipping acoustic ceiling tiles, and fire stopping openings to Building Dept. satisfaction, and as otherwise specified or indicated.

**1.30 SUBCONTRACTORS**

- .1 The Owner reserves the right to reject a proposed subcontractor in accordance with the provisions of CCDC 2 - 2008.
- .2 Subcontractors named in the Contractor's Bid Form shall be engaged for work of this Contract, and shall not be replaced by the Contractor except with the Owner's prior consent.

**PART 2 - PRODUCTS**

**2.1 NOT USED**

- .1 Not used.

**PART 3 - EXECUTION**

**3.1 NOT USED**

- .1 Not used.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 HAZARDOUS MATERIALS**

- .1 Comply with applicable legislation regarding asbestos. Should the Contractor encounter asbestos or material that is suspected to contain asbestos during the course of the Work, report same to Owner. Owner will advise means of confirming or denying asbestos is present and will advise regarding process for removal.
- .2 Refer also to the following sections:
  - .1 02 82 12 – Asbestos Abatement – Type 3 Procedures
  - .2 02 83 12 – Lead – Based Paint Abatement – Intermediate Precautions
  - .3 02 84 10 – PCB Packaging and Disposal
  - .4 02 84 11 – Mercury Packaging and Disposal
  - .5 02 87 00 – Biohazard Remediation

### **1.2 OTHER CONTRACTS: LEGISLATIVE COMPLIANCE**

- .1 Be advised that the Owner may let other contracts for other works in the building, and the work of this Contract shall be organized as directed by the Owner to prevent the Owner becoming the constructor for these projects as defined in applicable Occupational Health and Safety legislation.
- .2 Comply with directives to achieve objectives in sentence above.

### **1.3 SPECIAL SUSPENSION REQUIREMENTS FOR SUSPENDED CEILINGS, MECHANICAL AND ELECTRICAL ELEMENTS**

- .1 Existing suspended acoustic tile ceilings, and suspended mechanical and electrical items, when re-installed, shall be suspended from and anchored to structural loadbearing members. Where existing hangers and supports are of inadequate length, size or strength, provide new suspension systems. The term loadbearing shall be as defined in the Ontario Building Code.
- .2 For greater clarity, and in addition to other site conditions that affect support systems, note that suspended items are occasionally supported from suspended ceilings that will be demolished and not be replaced, requiring extended hangers to secure elements to loadbearing structural members. Unless otherwise indicated or accepted by the Consultant, existing suspended ceilings are not considered acceptable support for suspended elements.

### **1.4 TUNNEL ACCESS PROCEDURES**

- .1 The Owner restricts access to its service tunnels.
- .2 Comply with all provisions of the Owner's access procedures.
- .3 Tunnels contain high pressure steam piping, chilled water piping, high voltage cabling, asbestos, and other hazards. Obtain details of hazards from Owner and take appropriate precautions.

### **1.5 CONTRACTOR COORDINATION SUBMITTALS**

- .1 The Contractor shall prepare and submit Interference and co-ordination drawings for the entire area of Work.

- .2 These co-ordination drawings shall represent:
  - .1 The available space including all relevant structural and architectural components.
  - .2 All purchased / ordered equipment dimensions.
  - .3 Co-ordinate the installation of all duct and piping, and all other Divisions.
- .3 These drawings shall be submitted in both AutoCAD format and electronic PDF, to the Consultant for review.

#### **1.6 TELECOMMUNICATION PRE-CONSTRUCTION SURVEY**

- .1 The Contractor shall prepare and submit a complete survey, mapping and inventory of existing IT/Communication jacks, devices, cabling, tray and conduit in Wing C prior to demolition scope.
- .2 These drawings shall be submitted in both AutoCAD format and electronic PDF, to the Consultant for review.
- .3 Prior to completion of The Work, the Contractor must re-instate, through the use of un-spliced existing cabling or new cabling where required, all existing jacks and devices.

#### **1.7 CONSULTANT REVIEW PRIOR TO COMMENCEMENT OF WORK**

- .1 After completion of abatement, and prior to commencement of demolition of mechanical and electrical services, the Contractor is to allow the Consultant a period of 48 hours to review existing systems on site.
- .2 The Contractor must provide the Consultant seven (7) days written notice prior to commencement of the 48 hour period.
- .3 The Consultant and the Owner will conduct an onsite review of the existing systems. Any instruction to the Contractor resultant from the review will be issued within ten (10) working days of the review.

#### **1.8 SERVICES TO BE MAINTAINED TO WING A AND OTHER ADJACENT BUILDINGS**

- .1 Existing services serving Wing A currently run through Wings B and C of Building 046. Wing A must maintain full operation throughout entire duration of construction. Prior to disconnect or removal of any service, contractor to confirm it is not actively serving Wing A or adjacent buildings.

#### **1.9 STANDARD OPERATION PROCEDURES (SOP) FOR ENTRY INTO WING A**

- .1 Entry into Wing A will be required throughout the construction period to complete The Work.
- .2 All persons entering Wing A will require training provided by the Owner.
- .3 All persons entering Wing A are required to adhere to the following SOP appended to this specification:
  - .1 IU.324 – Procedures for Getting Supplies In and Out of the Facility.
  - .2 IU.326 – Donning and Doffing of Personal Protective Equipment (PPE).
  - .3 IU.329 – Personal Items in the Containment Zone.

## **PART 2 - PRODUCTS**

### **2.1 NOT USED**

- .1 Not used.

## **PART 3 - EXECUTION**

### **3.1 EXISTING CONDITIONS**

- .1 Examine areas to be selectively demolished or dismantled, and confirm that their condition is substantially the same as the date on which bids closed, and as indicated in the Contract Documents. Advise the Consultant of any conditions that vary from this.
- .2 Be familiar with structural system of the building, and the elements being demolished or dismantled.
- .3 Inspect site and verify with Consultant items designated for removal and items to remain. Protect existing items designated to remain and materials designated for salvage. In event of damage to such items, immediately replace or make repairs to approval of Consultant and at no cost to Owner.
- .4 Demolition of spray or trowel-applied asbestos can be hazardous to health. Should material resembling spray or trowel-applied asbestos be encountered in the course of demolition work stop work and notify the Consultant immediately. Do not proceed until written instructions have been received from the Consultant.
- .5 Demolition of applied asbestos materials can be hazardous to health. Should material resembling asbestos be encountered in the course of demolition work, stop work and notify the Consultant immediately. Do not proceed until written instructions have been received from the Consultant.

### **3.2 EXTENT OF DEMOLITION**

- .1 Drawings showing extent of selective demolition are intended to be schematic and do not indicate full extent of all selective demolition work. Examine all documents to determine complete scope of selective demolition, removals and re-instatement, repair and make good required to complete Work.

### **3.3 SAFETY**

- .1 Comply with all applicable legislation.

### **3.4 ALTERATIONS, CUTTING AND PROTECTION**

- .1 Extent:
  - .1 Perform cutting and removal work so as not to cut or remove more than is necessary and so as not to damage adjacent Work.
- .2 Responsibility and Assignment of Trades:
  - .1 Assign Work of moving, removal, cutting and patching and repair to trades under his/her supervision so as to cause the least damage to each type of Work encountered, and so as to return the building as much as possible to the appearance of new Work.
  - .2 Assigned only skilled tradesmen to perform patching and finishing Work.

- .3 Protection:
- .1 Protect remaining finishes, equipment and adjacent Work from damage caused by cutting, moving, removal and patching operations. Protect surfaces to remain as part of the finished Work.
  - .2 Prevent movement, settlement or damage of existing structures, services, walks, paving, trees, landscaping, adjacent grades and parts of existing building to remain.
  - .3 Provide bracing, shoring and underpinning as required. Make good damage caused by demolition.
  - .4 Take precautions to support affected structures and, if safety of building being demolished appears to be endangered, cease operations and notify Consultant.
  - .5 Prevent debris from blocking surface drainage system, elevators, mechanical and electrical systems which must remain in operation.
  - .6 Provide bracing, shoring, or needling as required to support portions of existing structure or building to remain, where demolition or dismantling, cutting out, or partial removal of any elements, as specified in other Sections degrades the structural integrity of the structure to a point where it will not support all imposed loads. All bracing, shoring, and needling shall be designed to cause no damage to existing surfaces upon which the bracing, shoring or needling bears.
  - .7 Shoring, bracing, or needling of structural items shall be designed by a Professional Engineer registered in the Province of Ontario, and drawings shall bear the seal of this Engineer. Submit drawings of shoring, bracing, or needling to the Consultant prior to installing.
  - .8 Maintain temporary supports in place until permanent structure is able to fully support all imposed loads.
  - .9 Make good damage to existing elements to remain caused by demolition.
  - .10 Prevent debris from blocking surface drainage system, and obstructing mechanical and electrical systems which must remain in operation.
  - .11 Protect salvaged elements from damage. Provide protective coverings and storage.
- .4 Debris:
- .1 Remove debris promptly from the site each day. Removed material, except that listed or marked by Consultant for retention, becomes the property of the Contractor. Load removed material directly on trucks for removal from site. Dispose of removed material legally. Do not burn on site. Do not allow debris to enter sewers. Refer to Section 01 74 21 – Construction Demolition Waste Management & Disposal.
  - .2 Do not let piled material endanger structure.
  - .3 Suppress dust. Prevent occurrence of unsanitary conditions, dirt or debris on the site and neighbouring property.
  - .4 As directed by Owner, deliver and store and/or dispose of, any salvaged items left over after completion of the Work.
- .5 Repair and make good any damage found subsequent to submission of inventory, which in the opinion of the Consultant is the result of the Work, and which is not documented in the inventory submitted to the Owner and Consultant to Owner. Repairs shall return damaged elements to their condition prior to start of work. Where work increases extent of existing damage, repair shall return element to match previous damaged condition. Refer to CCDC 2 – 2008, GC 9.1
- .6 Where repairs cannot, in the opinion of the Consultant, be expediently implemented the Consultant shall ascertain the value to be deducted from the amounts due the Contractor in the manner permitted under CCDC 2 – 2008, GC 2.4

### 3.5 DISMANTLING AND DEMOLITION

- .1 Do all work in a manner to prevent endangering safety of building or occupants.
- .2 Selectively dismantle parts of the building as required to suit installation of new work and remedial work. Salvage and reinstall elements unless otherwise indicated. Make good disturbed surfaces.
- .3 Remove existing equipment, services, and obstacles where required for refinishing or making good of existing surfaces, and replace as work progresses.
- .4 Do not disturb adjacent items designated to remain in place.
- .5 At end of each day's work, leave work in safe condition so that no part is in danger of toppling or falling. Protect interiors of parts not to be demolished from exterior elements at all times.
- .6 Demolish to minimize dusting. Keep materials wetted as directed by Consultant.
- .7 Do not throw or allow debris to fall uncontrolled from heights. Use chutes and other controls.

### 3.6 PATCHING, EXTENDING AND MATCHING

- .1 Patching:
  - .1 In areas where any portion of an existing finished surface is damaged, lifted, stained, peeling, cracked, or otherwise made or found to be imperfect, patch or replace imperfect surfaces with matching material.
  - .2 Do not incorporate salvaged material in new Work unless otherwise noted or approved by Consultant in writing.
  - .3 Provide adequate support or substrate for patching and finishing.
  - .4 For painted and/or coated imperfect surfaces, remove loose material, patch, sand, and repaint or recoat the patched portion to obtain a uniform colour and texture over the entire surface.
  - .5 Repaint or recoat entire surface where surrounding and/or adjacent surfaces cannot be matched.
- .2 Quality:
  - .1 In the sections of the Specifications which follow these general requirements, no concerted attempt has been made to describe each of the various existing products that must be used to patch, match, extend or replace existing Work. Obtain all such products in time to complete the Work on Schedule. Such products shall be provided in quality, which is in no way inferior to the existing products.
  - .2 The quality of the products that exist in the building, as apparent during pre-bid site visits, shall serve as the minimum specification requirement for strength, appearance and other characteristics.
- .3 Transitions:
  - .1 Where new Work abuts or finishes flush with existing Work, make the transition as smooth and workmanlike as possible. Perform patching Work to match existing adjacent Work in texture and appearance so as to make the patch or transition invisible to the eye at a distance of one (1) metre.
  - .2 In cases of extreme change of level such as 50mm or more, obtain instructions from Consultant as to method of making transition. Provide stepping, bulkheading, encasement, ramping, sloping or change of transition line, or any combination of these as directed in each case by Consultant.

- .4 Matching:
  - .1 Restore existing Work that is damaged during construction to a condition equal to its condition at the time of the start of such Work.
- .5 Overall requirement that the Work be complete:
  - .1 Where a product type of construction occurs in the existing building, and is not specified as a part of the new Work, provide such products or types of construction as needed to patch, extend or match the existing Work.
  - .2 These Specifications are not intended to describe existing products or standards of execution, nor will they enumerate products, which are not part of the new construction. The existing product is its own Specification.
  - .3 The presence of any product or type of construction in old Work shall cause its patching, extending or matching to be performed as necessary to make new Work complete and consistent, to identical standards of quality.

### **3.7 REPAIR**

- .1 Replace work damaged in the course of alterations, except at areas approved by Consultant in writing.
- .2 Where full removal of extensive amounts Work would be required to replace damaged portions, then filling, straightening and similar repair techniques, followed by full painting or other finishing, will be permitted.
- .3 If the repaired Work is not brought up to the standard for new Work, Consultant will direct that it be removed and replaced with new Work at no additional cost to the Owner.

### **3.8 CLEANING**

- .1 Clean in accordance with Section 01 74 11 – Cleaning.
- .2 Each Successive Trade:
  - .1 Clean Work area and make Work surfaces ready for the Work of the succeeding trades as each trade finishes its Work on each part of the alterations Work and related new Work.
  - .2 Clean or remedied immediately spillage, overspray, collections of dust or debris, damage to Owner-occupied spaces made by any responsible trade.
- .3 Each Area as it is Completed:
  - .1 Clean up all surfaces, remove equipment, salvage and debris and return in condition suitable for use by the Owner as quickly as possible as soon as Work in each area of the alterations is complete.
  - .2 Review final cleaning with Consultant prior to final acceptance.
  - .3 Reinstate areas and existing works outside areas of demolition to conditions that existed prior to commencement of work.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 WORKING DAYS AND HOURS**

- .1 The Contractor must observe all local by-laws with respect to working hours and noise.
- .2 Working day for construction shall be defined as Monday to Friday, excluding Statutory Holidays.
- .3 Weekend and night work beyond 6:00 p.m. will not normally be permitted, unless indicated or approved otherwise.
- .4 When required to meet owners requirements and as required to complete the Work on Schedule, the Contractor will perform work after normal work hours.
- .5 The Contractor shall submit a written request to the Consultant and Owner a minimum of five (5) working days in advance of any occasion on which the Contractor proposes to work outside of normal working days and hours. Written authorization shall be received from the Consultant or Owner prior to Contractor proceeding to work outside of normal working days and hours.
- .6 Arrange 48 hours in advance with Owner's representative to obtain keys and adjust security alarms for overtime work.
- .7 The Contractor is responsible for ensuring doors and windows are secured prior to leaving the building.
- .8 Work carried out during Owner's standard operating hours shall not adversely affect the Owner's ongoing use and occupancy of the existing facilities or site, otherwise work shall be carried out after hours, on weekends, and holidays. Schedule work with the Owner to minimize disruption to Owner's operations. The Contract Price includes all necessary overtime premium costs and cost to work statutory holidays, to ensure orderly progression of work and continuous operation of Owner's facilities.
- .9 Execute construction work starting February 7, 2019 (subject to receipt of regulatory approvals) achieve Completion of Contract as defined in applicable lien legislation not later than thirty (30) days following Substantial Performance. Comply with the following milestones:
  - .1 Submit shop drawings within 120 days of award.
  - .2 Substantial Performance no later than April 30, 2020.
  - .3 Occupancy no later than April 30, 2020.
- .10 Confine vehicles to paved areas of the work site.
- .11 Do not block fire access routes. Vehicles found parking in fire routes will be towed at vehicle owner's expense.

### **1.2 INTERRUPTION OF SERVICES TO WING A AND ADJACENT CONNECTED BUILDINGS**

- .1 Wing A of Building 046 and adjacent Buildings 146 and 049 will remain operational throughout the duration of the Work. Adjacent building's are 24-hour operations facilities, with restricted flexibility for shut-downs.
  - .1 Contractor shall coordinate with the Owner to meet the shutdown requirements of the adjacent buildings.
  - .2 The Work shall be performed in as many phases as required to meet these requirements.
  - .3 The Work shall be performed after hours as required to meet these requirements.

**PART 2 - PRODUCTS**

**2.1 NOT USED**

.1 Not used.

**PART 3 - EXECUTION**

**3.1 NOT USED**

.1 Not used.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 FIRE PROTECTION AND FIRE SAFETY**

- .1 Provide temporary fire protection throughout the period of construction.
- .2 Particular attention shall be paid to the elimination of fire hazards.
- .3 Take all necessary precautions to prevent fires, and to prevent damage to buildings, materials, personnel, equipment, furnishings and chattels.
- .4 Provide fire extinguishers as required by the stricter of the Occupational Health and Safety Act and regulations made thereunder, and the Ontario Fire Code.
- .5 Comply with the Owner's directives regarding fire safety.
- .6 Hot Work Permits
  - .1 A Contractor's Hot Work Permit must be submitted in writing to the Owner's Construction Coordinator for any and all work involving bitumen kettles, open flame, cutting, grinding, soldering or welding or any hot surface applications in occupied facilities. For clarification, all existing buildings are considered occupied facilities. Contractor's Hot Work Permit to contain, at a minimum, the following information:
    - .1 Company performing hot work.
    - .2 Location of hot work.
    - .3 Nature of hot work.
    - .4 Duration of hot work – including the time frame for fire watches.
    - .5 Name and contact information of person performing the work and of the person supervising hot work and of the person(s) conducting the fire watches.
    - .6 Protection method against false fire alarms and/or sprinkler activation including requests for any shutdown of any fire or life safety alarm system or fire suppression system, in part or in whole.
    - .7 Precautions being taken.
  - .2 Submit permits a minimum of 48 hours in advance of commencing hot work.
  - .3 Do not perform hot work without the Owner's written approval or sign-off on the Contractor's proposed Hot Work Permit.
  - .4 The approved hot work permit must be clearly displayed on site at the location of the hot work.
  - .5 Follow all applicable legislation and standards including but not limited to Ontario Fire Code O. Reg. 256/14 which amends O. Reg 213/07 and OHSA O. Reg 851 and CSA Standard W117.2-94 when performing hot work.
- .7 Electric & Gas Welding & Cutting Operations
  - .1 Conduct all work involving electric and gas welding and cutting and grinding operations in accordance with the safety standards specified in the latest edition of CSA W117.
- .8 Flammable Liquids
  - .1 Flammable liquids are to be kept to a minimum and shall be stored in approved safety containers. Obtain Owner's prior approval for storing flammable and combustible liquids in occupied buildings.

- .9 Fire
  - .1 In the event of a fire use the nearest pull station and/or call Owner's emergency number 52000 or 9-911. If the fire is extinguished without using City of Guelph Fire Department, immediately notify Owner's Security Services at extension 52000.
- .10 Emergency Telephone Numbers: be advised of the following emergency services telephone numbers:
  - .1 Guelph Ambulance, Fire and Police Service: 9-911
  - .2 Guelph General Hospital: 519-822-5350
  - .3 U. of G. Fire Division: 519-824-4120 (extension 52071 for administration, **extension 52000 for emergency**)
  - .4 U. of G. Police Division: 519-824-4120 (extension 52245 for administration, **extension 52000 for emergency**)

## 1.2 FIRE WATCHES

- .1 For any fire watch required for any hot work permit and the partial or whole shut-down of any fire or life safety alarm system or fire suppression system, conform to the requirements of Fire Watch Duties and Log Sheet, as amended to suit the requirements of this Project, as posted on PR website at <https://www.pr.uoguelph.ca/projects-planning/contractor-and-consultant-information>
- .2 Appoint personnel that are experienced and familiar with fire or life safety alarm system or fire suppression systems, have the knowledge and experience and are trained to the requirements of the Fire Watch Duties to conduct any fire watch.

## 1.3 FALSE FIRE ALARMS

- .1 Reimburse the Owner, by means of a deduction from any amounts due the Contractor by the Owner, for all costs related to false alarms of the fire alarm system or the security alarm system attributable to acts or omissions of the Contractor. Costs shall include charges levied by local authorities, charges levied by the Owner's alarm monitoring service, labour and expense costs for Owner's staff to attend at site in response to a false alarm, Consultant's cost related to any work for a false alarm, all to a minimum of \$500 per false alarm incident.

## 1.4 FIRE ALARM ACTIVATION

- .1 A fire alarm system that has been activated by other than testing shall not be reset until the cause of the alarm has been investigated and until authorized by the Owner's Fire Prevention Office and City of Guelph Fire Department.

## 1.5 FIRE PROTECTION EQUIPMENT IMPAIRMENT

- .1 Take all precautions when fire protection equipment (nearby hydrants, sprinklers, chemical fire suppression systems, standpipes, fire extinguishers, related water service, etc.) is taken out of service, including but not limited to restricting all hot work operations and hazardous processes.
- .2 Take measures to minimize the shut down or impairment of use of fire protection. Plan operations required to reduce system impairment time to the least amount possible.

- .3 Advise Owner of complete or partial impairment of fire protection system, including time required, areas affected, etc.
- .4 Provide temporary protection such as extra extinguishers during all periods of fire protection equipment impairment.
- .5 If fire protection system is restorable, either in whole or in part, assign personnel during the period of impairment to restore the system promptly in the event of a fire.
- .6 During periods when fire protection service is interrupted, establish and maintain a fire watch. including but not limited to the following:
  - .1 Patrol all halls, corridors, stairwells and high-risk areas affected.
  - .2 Fire patrol shall have immediate access to a telephone and call University of Guelph Campus Community Police Dispatch at 519-840-5000 if they see a fire.
  - .3 Report all other problems encountered.
- .2 Remain on patrol until fire and life safety system is restored to service

## **1.6 FIRE ROUTES**

- .1 Parking in posted fire routes will not be permitted. Vehicles found parked in a posted fire route will be towed without warning at vehicle owners' expense.
- .2 Conform to approved plans related to any construction in or along posted fire routes.
- .3 Where deliveries or pickups of large equipment are expected or the placement of large construction is required in or along a posted fire route, planning prior to any placement is required and is to include dates, duration of time, provision for alternative fire route access and acknowledgement that the delivery person or driver will be present at all times. Approval via the Owner's construction personnel is required.

## **1.7 FIRE SAFETY PLANS**

- .1 Conform to approved plans related to any construction that will affect existing fire alarm or life safety systems, fire suppression systems, existing means of egress and existing fire exits.
- .2 When logistics or phasing of the work will affect the systems and exits noted above in 1.7.1 and will alter the approved plans, alternative measures related to maintaining fire alarm or life safety systems, fire suppression systems, existing means of egress and existing fire exits are to be planned with all parties clearly set down in writing which is to include requirements for posting and construction requirements, clearly delineated on floor plans and submitted for approval.
- .3 Alternative measures must include signage, fire watches for the affected areas, procedures for notification to all occupants and users, construction personnel, Physical Resources, the University's Fire Prevention Office and City of Guelph Fire Department.
- .4 Alternative measures related to fire alarm and life safety system shall include modifications and temporary installations related to maintaining any fire alarm and life safety system including elements such as detectors, early warning lights and bells and fire alarm pull stations.
- .5 Approved alternative measures are to be posted in the building at the main entrance to the building.

## **PART 2 - PRODUCTS**

### **2.1 NOT USED**

.1 Not Used.

## **PART 3 - EXECUTION**

### **3.1 NOT USED**

.1 Not Used.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 OWNER'S USE OF PREMISES**

- .1 Take all measures necessary and as directed by the Owner to minimize disruption of facilities and their use by the Owner. Facilities generally include buildings, roads, parking lots, landscaped areas and all spaces normally occupied by the Owner and shall include any existing utilities and services.
- .2 Take all measures necessary and as directed by the Owner to minimize disruption of adjacent facilities and areas of the Owner's property, and use by the Owner.
- .3 Be advised that Owner's facilities and chattels include numerous scientific, research and other valuable efforts and goods, and the Owner's facilities contain irreplaceable contents. Unplanned loss of utilities may cause irreparable loss.
- .4 Work carried out during Owner's standard operating hours shall not adversely affect the Owner's ongoing use and occupancy of the building, the site or adjacent buildings or facilities, otherwise work shall be carried out after regular working hours, on weekends and statutory holidays. Schedule work with the Owner to minimize disruption to Owner's operations. Contract Price includes all necessary overtime premium costs and cost to work statutory holidays, to ensure orderly progression of work and continuous operation of the Owner's facilities.

### **1.2 SYSTEM SHUTDOWN REQUIREMENTS: OWNER'S SYSTEMS**

- .1 Arrangements for shut down of Owner's utility and building systems (interruption of service) will be mutually arranged between the Owner and the Contractor. No shutdown to occur without the prior written consent of the Owner. Provide minimum five (5) full working days advance notice of any required shutdown of an Owner's system, either in whole or in part.
- .2 Where length of service shutdown will exceed 12 hours, provide minimum seven (7) full working days advance notice of shutdown.
- .3 Schedule service shutdowns to occur outside Owner's regular operating hours, unless otherwise agreed.
- .4 Provide detailed schedule of operations for shutdown.
- .5 Obtain Owner's acceptance of proposed shutdown.
- .6 Unless otherwise agreed or as required by Contract Time, schedule steam system shutdowns to occur during warm weather where construction extends into periods of normally warm (summer) weather.
- .7 Unless otherwise agreed or as required by Contract Time, schedule chilled water system shutdowns to occur during cool or cold weather where construction extends into periods of normally cool or cold weather.
- .8 Unless otherwise agreed or as required by Contract Time, where construction extends into Owner's summer semester, schedule all other shutdowns to occur during this period.
- .9 Take all measures to minimize period of shutdown/interruption of service.

- .10 Systems that may require shutdown include, but are not limited to:
  - .1 Normal power, including power distribution, lighting, etc.
  - .2 Essential (emergency) power.
  - .3 Heating, cooling or ventilating systems.
  - .4 Domestic water.
  - .5 Chilled water.
  - .6 Sanitary sewer or drains.
  - .7 Storm sewer or storm drains.
  - .8 Steam.
  - .9 Compressed air.
  - .10 Natural gas.
  - .11 De-ionized water.
  - .12 Fire alarm or life safety system.
  - .13 Sprinkler system or fire suppression system.
  - .14 Hose and standpipe system.
  - .15 Medical and scientific gases.
  - .16 Telephone, data or other telecommunications systems.
  - .17 Roads, parking lots and walkways.
  - .18 Areas of buildings.
- .11 Subject to 1.2.12 below, the Contractor is responsible for providing qualified personnel to implement shutdown and re-activation of services. The Owner reserves the right to attend and monitor the shutdown and re-activation to assess effects on remainder of property and physical plant.
- .12 The Owner reserves the right to shutdown and reactivate Owner's utilities and/or services under the Contractor's direction, where the utility and/or service affects buildings or parts thereof outside the Contractor's work area and in the Owner's opinion there is a significant concern of adverse impacts outside the work area arising from the shutdown and re-activation. Where Owner elects to implement shutdown and re-activation, Contractor shall have qualified personnel attend and direct the shutdown and re-activation process.

### 1.3 FIRE ALARM SHUT DOWN PROCEDURE

- .1 Arrangements for shutdown (interruption of service) of fire alarm system will be mutually arranged between the Owner and the Contractor. No shutdown to occur without the prior consent of the Owner. Provide minimum five (5) full working days advance notice of any required shutdown of Owner's system, either in whole or in part. Where length of service shutdown will exceed 12 hours, provide minimum 7 full working days advance notice of shutdown.
- .2 Schedule service shutdowns to occur outside Owner's regular operating hours, unless otherwise agreed.
- .3 Provide detailed schedule of operations for shutdown.
- .4 Obtain Owner's acceptance of proposed shutdown.
- .5 A Certified Fire Alarm Technician, per the Ontario Fire Code section 1, subsection 1, shall supervise additions, shutdowns and changes to the fire alarm system, including but not limited to changes in device location, and removal and re-installation of devices.

- .6 Provide proof of staff certification upon request.
- .7 Minimize periods of interruption of existing fire alarm system (shut down).
- .8 Wherever possible, shut down only the devices or the zone needing work and schedule this down time in unoccupied hours to the greatest extent possible.
- .9 Place signs at all de-activated pull stations indicating pull station is out of service. Remove signs immediately once pull stations are re-activated.
- .10 During periods of audibility and visibility testing, place signs at all building entries indicating such testing is occurring, and indicating hours of testing. Remove signs upon completion of testing.
- .11 Review the proposed period when the system will be disabled, in whole or in part, with Owner prior to any partial or complete system shut down, and obtain Owner's prior approval for shut down.
- .12 The Owner will advise affected Owner's personnel normally resident in affected building of fire alarm system shut down. This will include instructions to call extension 52000 or to call 9-911 if a fire is observed.
- .13 Establish and maintain a fire watch and patrol which conforms to the requirements of Fire Watch Duties and Log Sheet as posted on PR website at <https://www.pr.uoguelph.ca/projects-planning/consultant-and-contractor-lists-and-information> for all periods when the fire alarm is shut down, in whole or in part, and such fire watch shall include but is not limited to the following:
  - .1 Patrol all halls and high-risk areas affected.
  - .2 Fire patrol shall have immediate access to a telephone and call University of Guelph Campus Community Police Dispatch at 519-840-5000 if they see a fire.
  - .3 Report all other problems encountered.
  - .4 Remain on patrol until system is restored to service.
  - .5 Where alarms (bells, etc.) are temporarily disabled, provide staff to monitor panel. Staff shall be knowledgeable with panel operation and be able and prepared to either immediately return panel to service, or be capable of raising fire alarm in the building through other means such as manual activation of bells, and through use of phones to alert Fire Dept. Such panel monitoring staff shall be equipped with two-way radios connected to other staff in the building who can advise the panel monitor to sound the alarm.
- .14 Provide full details to Owner's fire alarm monitoring service as requested including contact name, company name, and length of time service is interrupted.
- .15 An approved inspection firm shall verify all new and replaced fire alarm devices, in accordance with applicable regulations. Submit Certificate of Verification prior to applying for Substantial Performance, or Completion of Contract as defined in applicable lien legislation where no application is made for Substantial Performance.

#### **1.4 SYSTEM SHUTDOWN REQUIREMENTS: MUNICIPAL UTILITY SYSTEM**

- .1 Provide Owner with minimum five (5) full working days advance notice of any required shutdown of municipal utility, either in whole or in part.
- .2 Where length of service shutdown will exceed 12 hours, provide not less than seven (7) full working days advance notice of shutdown.

- .3 In general, schedule service shutdowns to occur outside Owner's regular operating hours.
- .4 Provide detailed written schedule of operations for shutdown.
- .5 Obtain Owner's written acceptance of proposed shutdown.
- .6 Take all measures to minimize period of shutdown/interruption of service.

## **1.5 SAFETY**

- .1 Provide all necessary safety measures resulting from or required by shutdown of utility or service.
- .2 Advise Owner of any safety precautions required of Owner during system shutdown. Such measures may include, with Owner's prior consent, rescheduling uses, cancellation of uses, etc.

## **PART 2 - PRODUCTS**

### **2.1 NOT USED**

- .1 Not Used.

## **PART 3 - EXECUTION**

### **3.1 NOT USED**

- .1 Not Used.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 REFERENCES**

- .1 Canadian Construction Documents Committee (CCDC):
  - .1 CCDC 2- 2008, Stipulated Price Contract.
- .2 Project Supplementary Conditions

### **1.2 CASH ALLOWANCES**

- .1 Refer to CCDC 2, GC 4.1.
- .2 Include in Contract Price specified cash allowances.
- .3 Expenditures under cash allowances shall be authorized by the Owner through the Consultant.
- .4 Cash allowances, unless otherwise specified, cover net cost to the Contractor of services, products, construction machinery and equipment, freight, handling, unloading, storage, and other authorized expenses incurred in performing Work.
- .5 Where costs under cash allowances exceed the total amount of the cash allowances indicated by less than 10% of the aggregate stated values, the Contractor will be compensated for any excess incurred and substantiated, without any allowances for overhead and profit.
- .6 Where costs under cash allowances exceed the total amount of the cash allowances indicated by more than 10% of the aggregate stated values, the Contractor will be compensated for any excess incurred and substantiated plus an allowance for overhead and profit as set out in the Contract Documents.
- .7 Contract Price, not cash allowance, includes Contractor's overhead and profit in connection with such cash allowance.
- .8 Include progress payments on accounts of work authorized under cash allowances in Consultant's monthly certificate for payment.
- .9 Prepare schedule jointly with Consultant 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.
- .10 Unexpended total balance of allowances shall be deducted from the Contract Price by Change Order.
- .11 Contractor to provide a minimum of three (3) quotations for all Work to be performed under the Allowances unless otherwise noted.
- .12 Unused balances of any allowance, at the sole discretion of the Owner, can be transferred to the balance of any other allowance.
- .13 Include in the Contract for the following allowances for Work specified:
  - .1 IT/Communications Work in Wing C
    - .1 Allowance:\$30,000

- .2 Scope of Work:
  - .1 Contractor to provide survey, mapping and inventory of existing IT/Communication jacks, devices, cabling, tray and conduit in Wing C prior to demolition scope.
  - .2 Supply and installation of IT/Communication jacks, devices, cabling, tray and conduit in Wing C required to re-instate system in accordance with initial survey, mapping and inventory.
  - .3 Prior to completion of The Work, the Contractor must re-instate, through the use of un-spliced existing cabling or new cabling where required, all existing jacks and devices.
- .2 Material Testing and Inspection Services
  - .1 Allowance: \$25,000.00
  - .2 Scope of Work:
    - .1 Material testing services for soils, compaction, concrete, and asphalt pavement to be completed by Contractor-appointed firm(s).
    - .2 Third party inspection of structural steel and metal fabrications to be completed by Contractor-appointed firm(s).
    - .3 Testing and inspections required for abatement of hazardous materials. Coordinate with the following Sections:
      - .1 02 82 12 – Asbestos Abatement – Type 3 Procedures
      - .2 02 83 10 – Lead-based paint abatement – Intermediate Precautions
      - .3 02 84 10 – PBC Packaging and Disposal
      - .4 02 84 11 – Mercury Packaging and Disposal
      - .5 02 87 00 – Biohazard Remediation
    - .4 Existing foundations underpinning inspections during construction.
    - .5 Contractor is responsible for engaging and coordinating all third-party material testing and inspections services.
    - .6 Allowance covers material testing and inspections firms' fees only.
    - .7 All other inspections, including those to be carried out by a Manufacturer's representative, are to be paid for separately by the Contractor, unless noted otherwise.
  - .3 Landscaping
    - .1 Allowance: \$5,000.00
    - .2 Scope of Work:
      - .1 Site landscaping as directed on site by Consultant including but not limited to clearing, grubbing, grading, top soil, hydro seeding and plantings.

## **PART 2 - PRODUCTS**

### **2.1 NOT USED**

- .1 Not Used.

## **PART 3 - EXECUTION**

### **3.1 NOT USED**

- .1 Not Used.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 GENERAL**

- .1 Prices included in the Agreement shall be complete for the applicable work, and shall constitute the full consideration, payment, compensation and remuneration to the Contractor for all such. For greater certainty, but without limitation to the foregoing, such prices will constitute full and complete consideration, payment, compensation and remuneration to the Contractor for the following (subject to adjustment only as specified in the Contract Documents):
  - .1 Expenditures for wages and for salaries of workmen, engineers, superintendents, draftsmen, foremen, timekeepers, accountants, expeditors, clerks, watchmen and other such personnel as may be approved, employed directly under the Contractor and while engaged on the applicable work at the site and expenditures for travelling and board allowances of such employees when required by location of the applicable work or when covered by trade agreements and when approved; provided, however, that nothing shall be included for wages or salary of the Contractor's firm if the Contractor is a firm or the salary of any officer of the Corporation if the Contractor is a corporation, unless otherwise agreed to in writing.
  - .2 Expenditures for material used in or required in connection with the construction of the applicable work including material tests and mix designs required by the laws or ordinances of any authority having jurisdiction and not included under Subparagraph .9 (or paid from a cash allowance in Section 01 21 00 – Allowances).
  - .3 Expenditures for preparation, inspection, delivery, installation and removal of materials, plant, tools, and supplies.
  - .4 Temporary facilities as required for the applicable work.
  - .5 Travelling expenses properly incurred by the Contractor in connection with the inspection and supervision of the applicable work in connection with the inspection of materials prepared or in course of preparation for the applicable work and in expediting their delivery.
  - .6 Rentals of all equipment whether rented from the Contractor or others, in accordance with approved rental agreements including any approved applicable insurance premiums thereon and expenditures for transportation to and from the site of such equipment, costs of loading and unloading, cost of installation, dismantling and removal thereof and repairs or replacements during its use on the applicable work, exclusive of any repairs which may be necessary because of defects in the equipment when brought to the work or appearing within thirty (30) days thereafter.
  - .7 The cost of all expendable materials, supplies, light, power, heat, water and tools (other than tools customarily provided by tradesmen) less the salvage value thereof at the completion of the applicable work.
  - .8 Assessments under the Workers' Compensation Act, the Unemployment Insurance Act, Canada Pension Act, statutes providing for government hospitalization, vacations with pay or any similar statutes; or payments on account of usual vacations made by the Contractor to his employees engaged on the applicable work at the site, to the extent to which such assessments or payments for vacations with pay relate to the work covered by the specified price; and all sales taxes or other taxes where applicable.
  - .9 The amounts of all Subcontracts related to the specified price.
  - .10 Premiums on all insurance policies called for under this Contract.
  - .11 Royalties for the use of any patented invention on the applicable work.

- .12 Fees for licences and permits in connection with the applicable work.
- .13 Duties/taxes imposed on applicable work.
- .14 Such other expenditures in connection with the applicable work as may be approved.
- .15 Provided always that except with the consent of the Owner, the above items of cost shall be at rates comparable with those prevailing in the locality of the work.

## 1.2 UNIT PRICES

- .1 Unit prices included in the Agreement, and which were submitted as a part of the bid, shall be based on units of measurement described in the bidding documents to include for labour, materials, preparation of shop drawings, design fees, delivery, handling, disposal of surplus material, applicable taxes, excluding Value Added Tax, and any other direct or indirect expenditures, of such work measured complete in place, and as further described in other Sections of the Specifications.
- .2 The above noted list together with the list provided in paragraph 6.3.7 of the Agreement (CCDC 2-2008) shall be used to determine the itemized accounting for any quotation or a Change Directive.
- .3 Unit prices for specified units of measurements, shall apply to any and all work which can be measured in the said units regardless of the variations in productivity and job conditions, or the time when instructions to carry out that work will be issued.
- .4 Unit prices shall apply only to the net change in quantities for each unit of work in each change to the work, provided that the instructions to change have been given before the start of applicable work and/or ordering of equipment. The Contract Price shall be adjusted by multiplying the unit price figure in the Contractor's Bid Form by the quantity used for measurement for payment. Consultant's determination of quantity used for measurement for payment shall be final.
- .5 After the applicable work has started, the unit prices shall cover the new work without any credit for the work already completed. Work completed and to be removed to accommodate new work shall be paid for as described for Changes in the Work in the General Conditions on a lump sum or by cost and fixed or percentage fee basis.

Changes to the quantities of the work executed under Unit Prices, which result in Change to the Contract value, shall not be subject to the allowable overhead and profit mark-ups specified elsewhere for changes.

- .6 Unit Prices for "CREDIT" shall be not less than 80% of Unit Prices for "EXTRA".
- .7 Value Added Taxes will be calculated on the net change.
- .8 The unit prices required are:
  - .1 Hourly Rates for: Construction Manager, Project Coordinator, Project Superintendent, Site Labour (General Contractor's Own Forces), Site Labour (Mechanical Sub-Contractor), Site Labour (Electrical Sub-contractor), Site Supervisor (Abatement Sub-contractor), Site Labour (Abatement Sub-contractor).
  - .2 After-hours Rates for: Construction Manager, Project Coordinator, Project Superintendent, Site Labour (General Contractor's Own Forces), Site Labour (Mechanical Sub-Contractor), Site Labour (Electrical Sub-contractor), Site Supervisor (Abatement Sub-contractor), Site Labour (Abatement Sub-contractor).

- .3 Unit Rates for the following abatement conditions:
  - .1 Price per square metre for the removal and disposal of asbestos containing floor tile and mastic.
  - .2 Price per fitting price for the removal and disposal of an additional asbestos containing parged pipe fitting.
  - .3 Price per ballast price for the removal and disposal of an additional PCB ballast.
  - .4 Price per tube price for the removal and disposal of an additional mercury containing light tube.
  - .5 Price per square metre for the removal and disposal of asbestos containing spray applied fireproofing.
- .4 Unit rate per square metre to repair and/or repoint existing brick.

### **1.3 SEPARATE PRICES**

- .1 Separate prices, requested in the Tender Documents, shall not be included in the Stipulated Price consistent with their acceptance or rejection by the Owner. They will be carried in the Agreement as an amount separated from the Contract Amount or in a separate agreement.
- .2 The required separate prices are as follows:
  - .1 Separate Price No. 1
    - .1 Provide separate price for the testing, abatement, demolition and removal of all piping and equipment associated with the receiving/holding tanks in the Sewage Room.
  - .2 Separate Price No. 2
    - .1 Provide separate price for the supply and installation of millwork MW123b.
  - .3 Separate Price No. 3
    - .1 Provide separate price for the replacement of existing panels LP-U, LP-R, LP-T, LP-P as indicated on electrical drawings.

### **1.4 PROJECT RECORD DOCUMENTS**

- .1 Contractor's as-built drawings shall show the quantity/extent of work executed under Prices.

## **PART 2 - PRODUCTS**

- .1 Refer to other Sections for requirements related to each material.

## **PART 3 - EXECUTION**

- .1 Refer to other Sections for requirements related to each material.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 REFERENCES**

- .1 Canadian Construction Documents Committee (CCDC):
  - .1 CCDC 2-2008, Stipulated Price Contract.

### **1.2 GENERAL**

- .1 All submissions under this section shall bear the project name, Owner's name and Project No., Consultant's Project No., and date.
- .2 Where a Certificate of Clearance from the Workplace Safety and Insurance Board (WSIB) is requested, the Certificate submitted shall clearly show that the Contractor is in good standing with the WSIB.
- .3 WSIB "independent operator" status for any Contractor is not acceptable.
- .4 Contractor is solely responsible for ensuring that each of the Contractor's personnel, including but not limited to employees, directors officers, principals and executives of the Contractor, are covered by WSIB insurance.
- .5 Contractor warrants and certifies to the Owner that each of the Contractor's personnel, including but not limited to employees, directors, officers, principals and executives of the Contractor, are covered by WSIB insurance.
- .6 Contractor shall defend, indemnify, and hold harmless the Owner against any and all claims made due to failure to pay WSIB premiums or provide WSIB coverage for any person engaged by the Contractor, directly or indirectly, for Work of this Contract.
- .7 Obtain a valid WSIB Certificate of Clearance from each Subcontractor or Supplier prior to releasing payment to the subcontractor or supplier. Indemnify and hold harmless the Owner against any failure of the Contractor to obtain valid Subcontractor's or Supplier's WSIB Certificate of Clearance prior to releasing payment to respective Subcontractor or Supplier.
- .8 All applications for payment after first shall be accompanied by CCDC Statutory Declaration 9A, duly executed. CCDC Statutory Declaration 9A is acceptable only where it bears an original CCDC Statutory Declaration 9A copyright seal.
- .9 All applications for payment must include an update project schedule, in accordance with 01 32 16 – Construction Progress Schedule – Bar Gantt Chart.

### **1.3 APPLICATIONS FOR PROGRESS PAYMENT**

- .1 Refer to CCDC 2, GC 5.2., and University of Guelph Supplemental Conditions.

### **1.4 SCHEDULE OF PROJECTED MONTHLY PROGRESS DRAWS**

- .1 A minimum of ten (10) business days prior to submission of the first application for payment, provide schedule of projected monthly progress draw values, supported by evidence as Consultant may reasonably direct.

## 1.5 SCHEDULE OF VALUES

- .1 Refer to CCDC 2, GC 5.2 and University of Guelph Supplemental Conditions.
- .2 A minimum of ten (10) working days prior to submission of the first application for payment provide schedule of values supported by evidence as Consultant may reasonably direct and when accepted by Consultant, be used as basis for applications for payment.
- .3 Include statement based on schedule of values with each application for payment.
- .4 Include in schedule of values a separate line item for bonds, insurances, and temporary facilities, and controls.
- .5 Costs of temporary facilities and utilities shall be amortized over the duration of the Work. Claims for 'mobilization', 'bidding costs' or similar lump sums at or before start of work are not acceptable.
- .6 Include in schedule of values a separate line item for each of the following items:
  - .1 Monthly update of Record Drawings,
  - .2 Submission of Operation and Maintenance Manuals, and Warranty Manuals, otherwise referred to as Closeout Submittals. Refer to Section 01 78 00 – Closeout Submittals.
  - .3 The value for each closeout submittal item included on the schedule of values shall be proportionate to the overall project value and shall be subject to review and acceptance by the Owner and Consultant.
  - .4 Submittals.
  - .5 Value Added Tax.
  - .6 Final cleaning – by a professional cleaning service.
  - .7 Commissioning, valued at 1% of the overall contract value. The Commissioning Authority (CxA) will review the construction draws from a commissioning perspective and provide recommendations to the Prime Consultant and the University. The chart below will be utilized by the CxA to evaluate the construction draws.

Carry 1% of overall contract value for cx'ing paperwork only. Validation of the cx'ing process is tied to progress draws and in particular Schedule of Values using the following chart. For example, fans cannot invoice more than 75%, if the pre-functional verifications are not complete, or more than 95% if the equipment start-up checklists & execution and functional performance testing is not complete.

Schedule of Values % Complete						
	10%	25%	75%	95%	97%	99%
Cx'ing Tasks to be Completed by these Milestone Percentages	* Cx'ing Kick Off Meeting Held	* Shop Drawing Submittal Review Process Complete	* Pre-functional Verifications Complete	* Equipment Start-up Checklists & Execution Complete	* As-built Drawings and O&M Manuals Submitted	* All Items on the Cx'ing Issues Log have been Addressed
	* Contractors Name Their Cx Agent (Designated Representative)	* Project Schedule has Incorporated Cx'ing Tasks		* Functional Performance Testing Complete	* Owner Training Complete	

## 1.6 PROGRESS PAYMENT

- .1 Refer to CCDC 2, GC 5.3, and University of Guelph Supplemental Conditions.
- .2 Submit monthly progress invoices. Invoices shall be dated last day of each month. Submit final invoice within 45 days of Completion of Contract as defined in applicable lien legislation. Failure to submit invoices within schedule voids Owner's obligations to pay invoices.

- .3 Progress Applications:
  - .1 Progress applications for payments shall indicate the value complete of each item in the Schedule of Values, percentage complete to date of application, value previously certified for payment by the Consultant, and value of work remaining.
  - .2 Include a summary of changes with application for payment, showing values complete.
  - .3 Refer to Section 01 29 03 for sample progress invoice format.
  - .4 All values shall be exclusive of Value Added Tax, except that Value Added Tax shall be applied to the total amount claimed, and the value of the Value Added Tax indicated on the application.
  - .5 Include a summary of changes with application for payment, showing values complete.
  - .6 No payment will be made for products ordered or manufactured, but not yet delivered to the Place of Work.
  - .7 Include evidence to support claims for products delivered to the place of the work, but not yet incorporated in the Work, as the Consultant may require to establish the value and delivery of the products.
  - .8 Products delivered to the place of work are the property of the Owner and shall not be removed without the Owner's consent, except where rejected as defective products or removed as legitimate debris. Any products delivered to the place of the work but not yet incorporated in the Work shall remain at the risk of the Contractor notwithstanding that title has passed to the Owner.
  - .9 In addition to other requirements, progress applications shall indicate the cost of the following items as separate items:
    - .1 Bonds
    - .2 Insurances
    - .3 Temporary facilities and controls
    - .4 Contract closeout, record and as-built drawings, maintenance and operating manuals.
    - .5 Value Added Tax

## **1.7 RECORD DRAWINGS**

- .1 Maintain project "As-Constructed" record drawings. Refer to Section 01 78 00 – Closeout Submittals. Record drawings are to be maintained current through course of construction and will be reviewed at each application for payment.

## **1.8 SUBSTANTIAL PERFORMANCE OF WORK**

- .1 Refer to CCDC 2, GC 5.4, University of Guelph Supplemental Conditions, and Section 01 78 00 – Closeout Submittals.
- .2 Applications for a Certificate of Substantial Performance, release of holdback, and Statement of Completion shall be completed in accordance with OAA/OGCA Document 100 Takeover Procedures (latest edition). In Document 100, substitute "Consultant" for "Architect", and "review" for inspection where it appears in relation to the Consultant's assessment of the Work.
- .3 The Contractor shall make written application to the Consultant or the Payment Certifier for the certificate.
- .4 The application shall also include:
  - .1 Statements that the contract is substantially performed.
  - .2 A statement that all required submissions have been made.

- .3 Statements of completion with a cost value for deficiencies, outstanding documentation, work that cannot be performed and which is beyond the Contractor's control, and any work which is to be completed at a later date as agreed to by the Owner.
- .4 A separate invoice showing the amount of holdback to be released.
- .5 If the Consultant finds the application to be complete, the Consultant will visit the Place of the Work to verify the validity of the application.
- .6 If the application is approved by the Consultant, the Consultant will issue a certificate of Substantial Performance to the Owner and to the Contractor.
- .7 Immediately following issuance of certificate of Substantial Performance of Work, in consultation with Consultant, establish reasonable date for finishing Work as permitted by lien legislation applicable to place of work.

#### **1.9 PAYMENT OF HOLDBACK UPON SUBSTANTIAL PERFORMANCE OF WORK**

- .1 Refer to CCDC 2, GC 5.5, and University of Guelph Supplemental Conditions.

#### **1.10 FINAL PAYMENT**

- .1 Refer to CCDC 2, GC 5.7 and University of Guelph Supplemental Conditions.

#### **1.11 SITE INSTRUCTIONS/SUPPLEMENTAL INSTRUCTIONS**

- .1 Site Instructions/Supplemental Instructions are issued only for the purpose of recording any clarifications of the Contract Documents or giving direction on field conditions. These instructions are subject to the provisions of the Contract Documents and unless stated herein and specifically co-authorized by the Owner, will not affect the contract price or contract time.
- .2 If in the Opinion of the Contractor a Supplemental Instruction involves an increase in the contract price or contract time, the Contractor shall within 7 working days of receipt of the Supplemental Instruction advise the Consultant in writing accordingly, complete with an itemized proposal. Failure to provide written notification within time stipulated shall be deemed acceptance of Supplemental Instruction by the Contractor without any increase to the contract price or contract time.
- .3 Where the Contractor requests a change in contract price or contract time due to the provisions of Supplemental Instruction, the Contractor shall not proceed with any work of the Supplemental Instructions until directed. If the Owner accepts the proposal, the Supplemental Instructions will be issued as a Change Order.
- .4 Where, in the reasonable opinion of the Consultant or the Owner, the Supplemental Instruction involves a decrease in the contract price or contract time, the Consultant or Owner through the Consultant shall advise the Contractor of such opinion, including the details of the proposed adjustment, in writing prior to the final payment being made. The Contractor shall provide satisfactory evidence that an adjustment is not warranted, failing which the Owner shall proceed to deduct the applicable amount from final payment or adjust the contract time as the case may be.

## 1.12 VALUATION OF CHANGES IN THE WORK

- .1 Further to CCDC 2-2008, Part 6, the method to be used in determining the value of a change to the Work, by either Change Order or Change Directive, shall be:
  - .1 Estimate and acceptance in a lump sum, unless the Consultant otherwise determines that the method shall be one of:
    - .1 Unit prices set out in Contract.
    - .2 Cost and a fee.
- .2 The Contractor shall provide the Consultant with a detailed cost analysis of the contemplated change indicating:
  - .1 Quantity of each material.
  - .2 Unit cost of each material.
  - .3 Time involved.
  - .4 Subtrade quotations including a complete analysis of costs.
  - .5 Cost of changes to bidding requirements, if applicable.
  - .6 Markups, if applicable.
  - .7 Value of Value Added Tax, as applicable.
  - .8 Proposed change in contract time.
- .3 The following shall not be included in the cost of the work but are covered by the allowance (mark-ups) for overhead and profit:
  - .1 The Contractor's head office and site office expenses, including stationary, postage and other office supplies.
  - .2 The costs of any and all of the Contractor's Project Manager, clerical and administrative personnel including but not limited to any estimator and assistances, and executive personnel.
  - .3 Use of temporary offices, sheds, small tools, etc., including the cost of telephone, light, power, water, and heat used therein.
  - .4 Insurance premiums.
  - .5 Licenses and permits, except where these are special for a particular item of work.
  - .6 Printing charges for Proposed Changes, Change Orders and Drawings for Contractor's and Subcontractor's use in the work.
  - .7 The cost of record drawings and shop drawings.
  - .8 The cost of clean-up and disposal of waste material.
- .4 The Contractor shall not be entitled to any additional compensation arising out of changes to the Work other than the amounts determined and agreed to under CCDC 2-2008 GC 6.2.
- .5 In computing accounts for extras and credits for any Proposed Change, all credits shall be deducted from the total sum of the extras before markups or charges for overhead and profit are added.

## 1.13 PERMITTED MARK-UPS

- .1 The following maximum net overhead and profit mark-ups by Contractors will be permitted for extra work under Change Order or Change Directive:

Cost of Extra Work, not including Value Added Tax	Contractor's Mark-Up on Work of Own Forces (%)	Contractor's Mark-Up on Subcontracted Work (%)
\$0 to \$5,000	10	7
>\$5,000 to \$10,000	10	7
>\$10,000 to \$50,000	7	5
>\$50,000	5	4

- .2 The following maximum net overhead and profit mark-ups by Subcontractors will be permitted for extra work:

Cost of Extra Work, not including Value Added Tax	Subcontractor's Mark-Up on Work of Own Forces (%)	Subcontractor's Mark-Up on Sub-subcontracted Work (%)
\$0 to \$5,000	10	7
>\$5,000 to \$10,000	10	7
>\$10,000 to \$50,000	7	5
>\$50,000	5	4

- .3 The permitted overhead and profit mark-ups are not cumulative or escalating. They are a one-time mark-up based on the total cost.
- .4 The maximum permitted overhead and profit mark-up on materials shall be 10%.
- .5 Where a proposed change order includes both credits and extras, overhead and profit mark-ups apply to the net extra or credits, if any, of the entire change.

#### 1.14 TAX RECOVERY

- .1 When an exemption or recovery of government sales taxes, duties or excise taxes is applicable to the Contract, the Contractor shall at the request of the Owner assist, join in, or make application for an exemption, recovery or refund of all such taxes and duties. 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 as may be required to implement the foregoing failing which the Owner is authorized to deduct the amount from any Contract payment that is then or may thereafter become due to the Contractor.

- .2 Maintain accurate records, tabulating equipment and component costs showing all respective taxes and duties or excise taxes. At the request of the Owner, assist, join in, or at Owner's expense, make application on behalf of the Owner for any exemption, recovery or refund, and provide the Owner with copies, or where required originals of records, invoices, purchase orders or other documentation as may be necessary to support such application.

#### **PART 2 - PRODUCTS**

##### **2.1 NOT USED**

- .1 Not Used.

#### **PART 3 - EXECUTION**

##### **3.1 NOT USED**

- .1 Not Used.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 SAMPLE INVOICE FORMAT**

- .1 Refer to Section 01 29 00.1 – Payment Procedures for invoicing requirements.
- .2 The following illustrates a **sample format** to follow when submitting progress invoices. Values shown are for illustration purposes only. Provide actual project name and numbers, and name of Owner's representative on completed invoices. Variations from this format are acceptable where all of the information indicated below is provided.
- .3 Invoice shall bear be printed on the Contractor's corporate letterhead or otherwise bear the Contractor's name, address, telephone number, and HST registration number.

**Attention: Project Coordinator (Name)**

Design, Engineering and Construction  
Physical Resources, Hersey Building  
University of Guelph  
Guelph, Ontario N1G 2W1  
Facsimile (519) 837-0581

**Project: Project Name**

University of Guelph, Guelph  
Consultant File No.:  
Physical Resources Project No.:  
Date:

### **Application for Payment No. XX**

This is to certify that the value of Work performed and Products delivered to the Place of the Work as of					
February-28-13		by the Contractor is		\$ 45,000.00	(exclusive of Value Added Taxes
<b>Contract Summary</b>					
1	Original Contract Price (excluding HST)				\$100,000.00
2	Change Orders (numbers 1 to 2 )				\$2,000.00
3	Current value of Change Directives				\$0.00
4	Value of <i>Contract Price</i> on last day of payment period (1+2+3)				\$102,000.00
5	<i>Value Added Taxes</i> at 13%				\$13,260.00
6	Total amount payable for the construction of the <i>Work</i> including <i>Value Added Taxes</i> (4+5)				\$115,260.00
<b>Certification Summary</b>					
7	Total Certified		44.1%		\$45,000.00
	Value of Change Orders included above (7)			\$2,000.00	
	Value of Change Directives included above (7)			\$0.00	
8	Total Holdback @ 10%				\$4,500.00
9	Holdback Released				\$0.00
10	Current Holdback (8-9)				\$4,500.00
11	Amount (value of <i>Work</i> performed and <i>Products</i> delivered to the <i>Place of the Work</i> less holdback retained) (7-10)				\$40,500.00
12	Less amount from previous certificate for payment (include any holdback release)				\$15,000.00
13	amount of <i>Contract Price</i> payable current period (11-12)				\$25,500.00
14	Value Added Taxes at 13%				\$3,315.00
15	Amount payable this Certificate including <i>Value Added Taxes</i>				\$28,815.00

### **Invoice to be signed by Contractor**

#### **INCLUDE:**

- .1 Name, credentials, and position of person signing.
- .2 Contractor's HST Registration No.
- .3 Attachments (WSIB, Stat Dec 9A, summary of change orders, contract price breakdown, substantiation for cash allowance expenditures, project schedule, etc.).

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 SECTION INCLUDES**

- .1 Scheduled pre-construction and progress meetings.

### **1.2 ADMINISTRATIVE**

- .1 The Contractor shall schedule and administer project meetings throughout the progress of Work.
- .2 The Contractor shall provide physical space and make arrangements for meetings.
- .3 The Contractor shall record the minutes. The purpose of the meeting minutes is to document significant proceedings and decisions and identify actions by parties
- .4 The Contractor shall reproduce and issue a copy of minutes within three (3) business days after each meeting to the Owner, Consultant and all parties in attendance for their review. Within two (2) business days of receipt of the meeting minutes, the Contractor shall be notified of any noted errors and/or omissions. Contractor will revise the meeting minutes if deemed appropriate and return the revised meeting minutes to the Owner, Consultant and all parties in attendance.
- .5 Representative of Contractor, Subcontractor and suppliers attending meetings shall be qualified and authorized to act on behalf of party each represents.

### **1.3 PRE-CONSTRUCTION MEETING**

- .1 Submit at this meeting, proof that application has been made to the Ministry of Labour for "Notice of Project" where legislation requires this notification be made. Work may not proceed until the Ministry has been notified.
- .2 Within seven (7) days after award of Contract, request a meeting of parties in contract to discuss and resolve administrative procedures and responsibilities.
- .3 Senior representatives of Owner, Consultant, Contractor, major Subcontractors, and supervisors will be in attendance.
- .4 Establish time and location of meeting and notify parties concerned a minimum of five (5) days before meeting.
- .5 Incorporate mutually agreed variations to Contract Documents into Agreement, prior to signing.
- .6 Agenda to include:
  - .1 Appointment of official representative of participants in the Work.
  - .2 Status of Building Permit.
  - .3 Contractor use of premises, and workplace policies in accordance with Section 01 11 00 – Summary of Work.
  - .4 Schedule of Work: in accordance with Section 01 32 16 – Construction Progress Schedules - Bar (GANTT) Chart.

- .5 Schedule of submission of shop drawings, samples, colour chips. Submit submittals in accordance with Section 01 33 00 – Submittal Procedures.
- .6 Requirements for temporary facilities, site sign, offices, storage sheds, utilities, fences in accordance with Section 01 52 00 – Construction Facilities.
- .7 Delivery schedule of specified equipment in accordance with Section 01 32 16 Construction Progress Schedules – Bar (GANTT) Chart.
- .8 Site security in accordance with Section 01 56 00 – Temporary Barriers and Enclosures.
- .9 Proposed changes, change orders, procedures, approvals required, mark-up percentages permitted, time extensions, overtime, administrative requirements.
- .10 Owner provided products.
- .11 Record drawings in accordance with Section 01 33 00 – Submittal Procedures.
- .12 Maintenance manuals in accordance with Section 01 78 00 – Closeout Submittals.
- .13 Take-over procedures, acceptance, warranties in accordance with Section 01 78 00 – Closeout Submittals.
- .14 Monthly progress claims, administrative procedures, photographs, hold backs.
- .15 Appointment of inspection and testing agencies or firms in accordance with Section 01 45 00 – Quality Control.
- .16 Insurances, transcript of policies.
- .17 Site concerns/inquiries to date.
- .18 List of outstanding project specific building permit conditions.
- .19 Environmental protection, measures specific to the project and place of work in accordance with Section 01 35 43 – Environmental Procedures.
- .20 Commissioning Requirements in accordance with 01 91 01 – Commissioning.
- .21 Next Meeting.
- .22 Other Business.

#### **1.4 PROGRESS MEETINGS**

- .1 During course of Work and two (2) weeks prior to project completion, schedule and administer bi-weekly progress meetings.
- .2 Schedule and administer additional progress meetings as directed by the Consultant.
- .3 Contractor, major Subcontractors involved in Work, Consultant, and Owner are to be in attendance.
- .4 Notify parties a minimum of five (5) working days prior to meetings.
- .5 Contractor shall record minutes of meetings and circulate to attending parties and affected parties.
- .6 Agenda to include the following:
  - .1 Owner's guidelines and policies.
  - .2 Review, approval of minutes of previous meeting.
  - .3 Review of Work progress since previous meeting.
  - .4 Review and update critical path construction schedule including a "look ahead" of construction activities for the next month.
  - .5 Field observations, problems, conflicts.
  - .6 Problems that impede construction schedule.

- .7 Review of off-site fabrication delivery schedules.
  - .8 Review material delivery dates/schedule.
  - .9 Corrective measures and procedures to regain projected schedule.
  - .10 Revision to construction schedule.
  - .11 Progress schedule, during succeeding work period.
  - .12 Review submittal schedules: expedite as required.
  - .13 Review status of submittals.
  - .14 Maintenance of quality standards, quality plan submissions, and third-party testing and inspections
  - .15 Review proposed changes for effect on construction schedule and on completion date.
  - .16 Review of Contract modifications and interpretations including, but not limited to: requests for interpretation and log, contemplated change orders, Change Orders, Change Directives, Supplemental Instructions, for effect on construction schedule and on Contract Time.
  - .17 Review of status of as-built documents.
  - .18 Review of site safety including review of approved plans and alternatives related to means of egress and exiting, parking in fire routes, fire alarm and life safety and fire suppression shut-downs.
  - .19 Review of commissioning schedule and requirements and commissioning status.
  - .20 Other business.
- .7 The tracking documents specified above shall be provided for information purposes and shall not be subject to the review process specified under Section 01 33 01 unless otherwise directed by the Consultant, and an absence of comment on such tracking documents by the Consultant or the Owner shall not imply approval or acceptance of the logs so submitted.
- .8 Sub-trades who have work in progress or imminent at the time of the meeting shall attend project meetings.
- .9 Attendees at progress meetings shall include the following:
- .1 Contractor
  - .2 Contractor's site superintendent(s)
  - .3 Consultant
  - .4 Owner
  - .5 Commissioning Authority
  - .6 Commissioning Agent (appointed by GC)
  - .7 Major Sub-trades including mechanical and electrical

## **1.5 PRE-INSTALLATION MEETINGS**

- .1 During the course of the Work prior to Substantial Performance of the Work, schedule pre-installation meetings as required by the Contract Documents and coordinated with the Consultant.
- .2 As far as possible, pre-installation meetings shall be scheduled to take place on the same day as regularly scheduled progress meetings.
- .3 Agenda to include the following:
  - .1 Owner's guidelines and policies.
  - .2 Appointment of official representatives of participants in the Project.
  - .3 Review of existing conditions and affected work, and testing thereof as required.

- .4 Review of installation procedures and requirements.
  - .5 Review of environmental and site condition requirements.
  - .6 Schedule of the applicable portions of the Work.
  - .7 Schedule of submission of samples, colour chips, and items for Consultant's consideration.
  - .8 Requirements for temporary facilities, site sign, offices, storage sheds, utilities, fences.
  - .9 Requirements for notification for reviews. Allow a minimum of 48 hours' notice to Consultant for review of the Work.
  - .10 Requirements for inspections and tests, as applicable. Schedule and undertake inspections and tests.
  - .11 Delivery schedule of specified equipment.
  - .12 Special safety requirements and procedures.
- .4 The following shall be in attendance:
- .1 Contractor.
  - .2 Subcontractors affected by the work for which the pre-installation meeting is being conducted.
  - .3 Consultant.
  - .4 Manufacturer's representatives, as applicable.
  - .5 Inspection and testing company, as applicable.

## **1.6 COMMISSIONING MEETINGS**

- .1 Refer also to Section 01 91 01.

## **1.7 SPECIAL MEETINGS:**

- .1 Owner and/or Consultant reserve the right to require special meetings which may be held on short notice and at which attendance by Contractor and representatives of affected Subcontractors and Suppliers is mandatory. Contractor shall keep detailed and accurate meeting notes and distribute copies promptly to all in attendance and those affected by agreements made at such meetings.

## **PART 2 - PRODUCTS**

### **2.1 NOT USED**

- .1 Not Used.

## **PART 3 - EXECUTION**

### **3.1 NOT USED**

- .1 Not Used.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 DEFINITIONS**

- .1 Activity: element of Work performed during course of project. Activity normally has expected duration, expected cost, and expected resource requirements. Activities can be subdivided into tasks.
- .2 Bar Chart (GANTT Chart): graphic display of schedule-related information. In typical bar chart, activities or other Project elements are listed down left side of chart, dates are shown across top, and activity durations are shown as date-placed horizontal bars. Generally Bar Chart should be derived from commercially available computerized project management system.
- .3 Baseline: original approved plan (for project, work package, or activity), plus or minus approved scope changes.
- .4 Construction Work Week: Monday to Friday, inclusive, will provide five (5) day work week and define schedule calendar working days as part of Bar (GANTT) Chart submission.
- .5 Duration: number of work periods (not including holidays or other nonworking periods) required to complete activity or other project element. Usually expressed as workdays or workweeks.
- .6 Master Plan: summary-level schedule that identifies major activities and key milestones.
- .7 Milestone: significant event in project, usually completion of major deliverable.
- .8 Project Schedule: planned dates for performing activities and the planned dates for meeting milestones. Dynamic, detailed record of tasks or activities that must be accomplished to satisfy Project objectives. Monitoring and control process involves using Project Schedule in executing and controlling activities and is used as basis for decision making throughout project life cycle.
- .9 Project Planning, Monitoring and Control System: overall system operated by Consultant to enable monitoring of project work in relation to established milestones.

### **1.2 REQUIREMENTS**

- .1 Ensure Master Plan and Detail Schedules are practical and remain within specified Contract duration.
- .2 Plan to complete Work in accordance with prescribed milestones and time frame.
- .3 Limit activity durations to maximum of approximately ten (10) business days, to allow for progress reporting.
- .4 Ensure that it is understood that Award of Contract or time of beginning, rate of progress, Interim Certificate and Final Certificate as defined times of completion are of essence of this contract.

### **1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Submit to Consultant within five (5) business days of Award of Contract Bar (GANTT) Chart as Master Plan for planning, monitoring and reporting of project progress.
- .3 Submit Project Schedule complete with an electronic copy in a format acceptable to Consultant within five (5) business days of receipt of acceptance of Master Plan.

#### 1.4 PROJECT MILESTONES

- .1 Project milestones form interim targets for Project Schedule. Indicate project milestone dates with Master Plan for the following:
  - .1 Abatement work completion date from Award of Contract date.
  - .2 Demolition work completion date from Award of Contract date.
  - .3 Completion IT Inventory of Wing C from Award of Contract date.
  - .4 Interior finishing and fitting work completion date from Award of Contract date.
  - .5 Mechanical work completion date from Award of Contract date.
  - .6 Electrical work completion date from Award of Contract date.
  - .7 VCAP installation date from Award of Contract date.
  - .8 Furniture installation date from Award of Contract date.
  - .9 Substantial Completion date from Award of Contract date.

#### 1.5 MASTER PLAN

- .1 Structure schedule to allow orderly planning, organizing and execution of Work as Bar Chart (GANTT).
- .2 Consultant will review and return comments within five (5) business days.
- .3 Revise impractical schedule and resubmit within five (5) business days.
- .4 Accepted revised schedule will become Master Plan and be used as baseline for updates.

#### 1.6 PROJECT SCHEDULE

- .1 Develop detailed Project Schedule derived from Master Plan.
- .2 Ensure detailed Project Schedule includes as minimum milestone and activity types as follows:
  - .1 Award.
  - .2 Shop Drawings, Samples.
  - .3 Permits.
  - .4 Mobilization.
  - .5 Abatement.
  - .6 Demolition.
  - .7 Interior Architecture (Walls, Floors and Ceiling).
  - .8 Plumbing.
  - .9 Lighting.
  - .10 Electrical.
  - .11 Piping.
  - .12 Controls.
  - .13 Heating, Ventilating, and Air Conditioning.
  - .14 Millwork.
  - .15 Fire Systems.
  - .16 IT/Communications.
  - .17 Security.
  - .18 Exterior Envelope Upgrades including window replacement.

- .19 Scheduled shutdowns.
- .20 Testing and Commissioning.
- .21 Supplied Equipment Long Delivery Items.
- .22 Close-out Documentation.

## **1.7 PROJECT SCHEDULE MONITORING AND REPORTING**

- .1 Monitor progress of work relative to approved schedule.
- .2 Prior to each project meeting as per Section 01 31 19 –Project Meetings, update Project Schedule to reflect activity changes and completions, as well as activities in progress.
- .3 Include as part of Project Schedule, narrative report identifying Work status to date, comparing current progress to baseline, presenting current forecasts, defining problem areas, anticipated delays and impact with possible mitigation.
- .4 Advise Consultant and Owner where progress of work varies from schedule, paying particular attention to variances that may result in delay of completion of Work, in whole or in part, or achievement of any milestone dates.
- .5 Where progress of work varies from approved schedule, revise and resubmit schedule, showing means to recover from delays and achieve completion date(s).
- .6 Revise and resubmit schedule to reflect extensions in Contract Time agreed to in Change Orders.
- .7 All Site Instructions, Change Orders and Requests for Information must be entered on the schedule and then indicated how they affect the overall schedule. All weather conditions initiating resulting in lost days must also be entered on the schedule with their overall affect noted. Owner's or Consultant's acceptance of revised schedules showing completion dates later than contractually agreed shall not relieve Contractor of any responsibility for compensating Owner for costs incurred as a result of delayed completion of work, nor result in any liability by the Owner or the Consultant to the Contractor for additional costs due to the Contractor's delay in completing Work.

## **1.8 PROJECT MEETINGS**

- .1 Discuss Project Schedule at regular site meetings, identify activities that are behind schedule and provide measures to regain slippage. Activities considered behind schedule are those with projected start or completion dates later than current approved dates shown on baseline schedule.

## **PART 2 - PRODUCTS**

### **2.1 NOT USED**

- .1 Not used.

## **PART 3 - EXECUTION**

### **3.1 NOT USED**

- .1 Not used.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 SECTION INCLUDES**

- .1 Documentation required
- .2 Shop drawings and product data
- .3 Samples
- .4 Certificates and transcripts
- .5 Building Permit

### **1.2 REFERENCES**

- .1 Canadian Construction Documents Committee (CCDC):
  - .1 CCDC 2-2008, Stipulated Price Contract.

### **1.3 ADMINISTRATIVE**

- .1 Submit to Consultant submittals listed for review. Submit promptly and in orderly sequence to not cause delay in Work. Failure to submit in ample time is not considered sufficient reason for extension of Contract Time and no claim for extension by reason of such default will be allowed. Allow a minimum of 10 working days for Consultant's review. The review time commences when the submittal is received at the Consultant's office and ends when the submittal leaves the Consultant's office. Larger, more complex shop drawing submissions may require longer review periods than 10 working days. The Contractor is to take this into account when preparing submittals schedule.
- .2 Do not proceed with Work affected by submittal until review is complete.
- .3 Present shop drawings, product data, samples and mock-ups in units as indicated on Contract Drawings.
- .4 Review submittals prior to submission to Consultant. This review represents that necessary requirements have been determined and verified, or will be, and that each submittal has been checked and coordinated with requirements of Work and Contract Documents. Submittals not stamped, signed, dated and identified as to specific project will be returned without being examined and considered rejected.
- .5 Notify Consultant in writing at time of submission, identifying deviations from requirements of Contract Documents stating reasons for deviations.
- .6 Verify field measurements and affected adjacent Work is coordinated.
- .7 Contractor's responsibility for errors and omissions in submission is not relieved by Consultant's review of submittals.
- .8 Contractor's responsibility for deviations in submission from requirements of Contract Documents is not relieved by Consultant review.
- .9 Keep one (1) reviewed copy of each submission on site.

## 1.4 DOCUMENTATION REQUIRED

- .1 Refer to CCDC 2, GC 3.5. - Construction Schedule.
- .2 Prior to construction start, submit the following:
  - .1 An executed construction contract.
  - .2 Performance Bond(s) and Labour and Material Bond(s).
  - .3 Proof of liability insurance, with provisions preventing unilateral cancellation, and with the names of the Owner(s) and Consultant(s) listed as additional insured.
  - .4 Proof that a building permit or applicable clearances from authorities having jurisdiction, has been issued.
  - .5 Proof of environmental clearances, permits as required by authorities having jurisdiction.
  - .6 Proof of compliance with site specific requirements as prescribed in the site plan control agreement with the township, municipality, or city.
  - .7 Copy of 'Notice of Project' to Ontario Ministry of Labour.
  - .8 Certificate of good standing from the Worker's Compensation Board.
  - .9 Copy of company health and safety policies complete with names of employees and subcontractor employees.
  - .10 A Detailed Breakdown of Stipulated Price Contract amount, in a form and detail acceptable to the Consultant.
  - .11 Construction schedule.

## 1.5 ALTERNATIVE PRODUCTS, MATERIALS AND EQUIPMENT

- .1 Alternatives submitted as approved equals to Specified Products, Materials and Equipment may be proposed by the Contractor(s) **up** to ten (10) days before the Tender closure; otherwise, one of the named products listed in the Tender documents shall be included in the Tender price. Proposals can still be submitted by the successful Contractor after Tender close following the procedures listed herein. Proposals must be submitted with a completed form, included as Section 013410 Submission Form Schedule 'A'— Alternative Products, Materials or Equipment and include detailed engineering information, references, etc. Alternatives will be accepted into the contract documents prior to Tender close only by way of written addendum. There are no guarantees that an alternative will be accepted prior to Tender close even if a proposal is received ten (10) days before Tender close.
- .2 Products, materials and equipment are specified throughout the Contract Documents in one of the following ways:
  - .1 **Specified/First Named Manufacturer/Supplier** of Products, Materials and Equipment for which the contract documents and design have been based upon – no alternative Manufacturer/Supplier of products, materials or equipment will be considered, unless accepted into the contract documents by way of written addendum, prior to Tender closing or unless listed as part of the "Acceptable Other Manufacturers/Suppliers" and subject to Clauses 1.5.4 and 1.5.8 of this Section. The design has been developed with the specified / first named products, materials or equipment and considering alternatives risks design integrity; hence the need to comply with Clauses 1.5.4 and 1.5.8 of this Section.
  - .2 **Standard of Acceptance** – lists one product, material or equipment. Other products, materials or equipment may be accepted by way of submitting a Request for Alternate Products, Materials or Equipment form, included as 013410 Submission Form Schedule 'A'. Proposals will not necessarily be accepted by the Consultant.

- .3 **Acceptable or Alternative Named Manufacturers/Suppliers** – list one or more acceptable named alternative Manufacturers/Suppliers of products, materials or equipment after the specified/first named manufacturer/supplier.
- .4 **Or Approved Equal** – following a list of one or more manufacturers/suppliers or products, if “or approved equal” is added, Contractor may propose an alternative following the guidelines noted above and as per the General Conditions. Proposals will not necessarily be accepted by the Consultant.
- .5 A written specification only without a named manufacturer/supplier in which case the Contractor is to propose a product that meets the written specification requirements during shop drawing submission.
- .3 Submission for alternative products, materials and equipment supply will be accepted only from the Contractor and not directly from suppliers.
- .4 Listing of an acceptable manufacturer supplier in the documents does not automatically indicate that their standard material, product or equipment meets the requirements of the written specifications. Listing of a name in the specification is an indication that the manufacturer or supplier may be capable of providing a product equal to the requirements of the written specification. Contractor to provide products, materials and equipment which meets the written specifications with respect to performance through the range of operation, quality of material, spatial requirements, workmanship and other specified details. Include all accessories and options to meet contract requirements. All characteristics and/or performance requirements of specified product may not be specifically listed in the specifications. Product proposed by Acceptable Manufacturers/Suppliers to provide a similar performance capability through the range of operation for the equipment, similar installation, similar operation and level of maintenance. The Consultant/Owner will be the sole judge of equivalency or not to the specified product.
- .5 Where alternate products, materials and equipment are proposed by the Contractor or selected by the Contractor from the “Acceptable Manufacturers/Suppliers” list, the Contractor shall be responsible for all related modifications and their coordination to piping, wiring, controls, accessories, etc. necessary to complete the works, at no extra cost to the Owner.
- .6 Where alternative products, materials and equipment are proposed by the Contractor or listed in the specification as an Acceptable Manufacturer/Supplier, the Contractor shall reimburse the Owner in the form of a Credit to the Contract for all additional Consultant costs for re-design resulting from the alternate products, materials or equipment to be agreed upon in writing prior to acceptance of the use of the product.
- .7 Alternative products, materials and equipment must meet the specification requirements with respect to performance, quality of material, spatial requirements, workmanship and other specified details.

## 1.6 SHOP DRAWINGS AND PRODUCT DATA

- .1 Refer to CCDC 2 GC 3.10 and Supplementary Conditions.
- .2 The term "shop drawings" means drawings, diagrams, illustrations, schedules, performance charts, brochures and other data which are to be provided by Contractor to illustrate details of a portion of Work.
- .3 Submit shop drawings as described in each specification section.

- .4 Do not proceed with any component of the Work nor provide Products without reviewed shop drawings being accepted and returned to the Contractor. Should Work commence, or Products be supplied prior to Contractor's receipt of reviewed shop drawings, the Contractor shall be liable for all corrections and costs incurred.
- .5 Submit where indicated, shop drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
- .6 Indicate materials, methods of construction and attachment or anchorage, erection diagrams, connections, explanatory notes and other information necessary for completion of Work. Where articles or equipment attach or connect to other articles or equipment, indicate that such items have been coordinated, regardless of Section under which adjacent items will be supplied and installed. Indicate cross references to design drawings and specifications.
- .7 Adjustments made on shop drawings by Consultant are not intended to change Contract Price or Contract Time. If adjustments affect value of Work or the construction schedule, state such in writing to Consultant prior to proceeding with Work.
- .8 Make changes in shop drawings as Consultant may require, consistent with Contract Documents. When resubmitting, notify Consultant in writing of revisions other than those requested.
- .9 Accompany submissions with transmittal letter containing:
  - .1 Date.
  - .2 Project title and number.
  - .3 Contractor's name and address.
  - .4 Identification and quantity of each shop drawing, product data and sample.
  - .5 Other pertinent data.
- .10 Submissions to include:
  - .1 Date and revision dates.
  - .2 Project title and number.
  - .3 Name and address of:
    - .1 Subcontractor.
    - .2 Supplier.
    - .3 Manufacturer.
  - .4 Contractor's stamp, signed by Contractor's authorized representative certifying approval of submissions, verification of field measurements and compliance with Contract Documents. Shop drawings submitted without the Contractor's executed stamp of review will not be considered and will be returned to the Contractor for review and re-submission.
  - .5 Details of appropriate portions of Work as applicable:
    - .1 Fabrication.
    - .2 Layout, showing dimensions, including identified field dimensions, and clearances.
    - .3 Setting or erection details.
    - .4 Capacities.
    - .5 Performance characteristics.
    - .6 Standards.
    - .7 Operating weight.
    - .8 Wiring diagrams.
    - .9 Single line and schematic diagrams.
    - .10 Relationship to adjacent work.

- .11 Should the Consultant deem the Contractor has not complied with the requirements of this section, the Contractor shall be held fully responsible for all delays in the Work to the same extent as if no shop drawings or details had been submitted for that section of the Work.
- .12 Submit electronic copy of shop drawings for each requirement requested in specification Sections and as Consultant may reasonably request.
- .13 Submit electronic copy of product data sheets or brochures for requirements requested in specification Sections and as requested by Consultant where shop drawings will not be prepared due to standardized manufacture of product.
- .14 Submit electronic copy of test reports for requirements requested in specification Sections and as requested by Consultant.
  - .1 Report signed by authorized official of testing laboratory that material, product or system identical to material, product or system to be provided has been tested in accord with specified requirements.
  - .2 Testing must have been within three (3) years of date of contract award for project.
- .15 Submit electronic copy of certificates for requirements requested in specification Sections and as requested by Consultant.
  - .1 Statements printed on manufacturer's letterhead and signed by responsible officials of manufacturer of product, system or material attesting that product, system or material meets specification requirements.
  - .2 Certificates must be dated after award of project contract complete with project name.
- .16 Submit electronic copy of manufacturer's instructions for requirements requested in specification sections and as requested by Consultant.
  - .1 Pre-printed material describing installation of product, system or material, including special notices and Material Safety Data Sheets concerning impedances, hazards and safety precautions.
- .17 Submit electronic copy of Manufacturer's Field Reports for requirements requested in specification Sections and as requested by Consultant.
  - .1 Documentation of the testing and verification actions taken by manufacturer's representative to confirm compliance with manufacturer's standards or instructions.
- .18 Submit electronic copy of Operation and Maintenance Data for requirements requested in specification Sections and as requested by Consultant.
- .19 Delete information not applicable to project.
- .20 Supplement standard information to provide details applicable to project.
- .21 If upon review by the Consultant, no errors or omissions are discovered or if only minor corrections are made, a copy with appropriate comments where applicable will be returned electronically in PDF format and fabrication and installation of Work may proceed. If shop drawings are rejected, a copy complete with appropriate comments where applicable will be returned electronically in .PDF format and resubmission procedure indicated above, shall be repeated prior to fabrication and installation of Work.

## **1.7 SAMPLES**

- .1 Submit samples for each product together in one submission with all other required submittals for the various specification sections. Submittals for the building interior may however be submitted independently from that for the building exterior.
- .2 Submit for review samples in duplicate as requested in respective specification sections. Label samples with origin and intended use.
- .3 Deliver samples prepaid to Consultant's business address.
- .4 Notify Consultant in writing, at time of submission of deviations in samples from requirements of Contract Documents.
- .5 Where colour, pattern or texture is criterion, submit full range of samples.
- .6 Adjustments made on samples by Consultant are not intended to change contract price or contract time. If adjustments affect value of Work or contract time, state such in writing to Consultant prior to proceeding with Work.
- .7 Make changes in samples which Consultant may require, consistent with Contract Documents.
- .8 Reviewed and accepted samples will become standard of workmanship and material against which installed Work will be verified.
- .9 Keep all approved samples at the Place of the Work. Maintain in good order and available to the Consultant and his representatives for the duration of the Work.

## **1.8 MOCK-UPS**

- .1 Erect mock-ups in accordance with Section 01 45 00 – Quality Control.

## **1.9 CERTIFICATES AND TRANSCRIPTS**

- .1 Prior to commencing work on site, and with each application for progress payment, submit Workplace Safety Insurance Board Certificate (WSIB) of good standing.
- .2 Prior to commencing work on site submit:
  - .1 Certificate of General Liability Insurance.

## **1.10 BUILDING PERMIT**

- .1 Refer to GC 10.2
- .2 Unless otherwise indicated, the Owner shall obtain and pay for building permit as required.
- .3 Prior to commencing work on site:
  - .1 Obtain notification from Owner that required permits had been approved and paid for.
- .4 No person shall construct or demolish a building, or any part of a building, unless a permit has been issued by the juridical authorities.

## **1.11 PROOF OF PURCHASE**

- .1 Submit proof of purchase as requested by the Consultant.
  - .1 Acceptable proof of purchase: purchase order, or letter of confirmation from supplier.
  - .2 Proof of purchase to include a delivery date.
- .2 Delay in shop drawing approval WILL NOT excuse delay in purchase orders.
- .3 Provide letter of intent or purchase order prior to submission of shop drawings.
- .4 Provide production confirmation within five (5) business days of shop drawing return.

## **1.12 ENGINEERED SUBMITTALS**

- .1 Submittals for items required to be sealed by professional engineer (engineered) shall be duly prepared, sealed, and signed under the direct control and supervision of a qualified professional engineer registered in the Place of the Work, having in force, professional liability insurance with minimum limit of liability of \$1,000,000 per claim.
- .2 Include with engineered submittal, proof of insurance identifying insurer, policy number, policy term, and limit of liability, on duly signed letterhead and / or certificate of insurance.
- .3 Design includes life safety, sizing of supports, anchors, framing, connections, spans, and as additionally required to meet or exceed requirements of applicable codes, standards, regulations, authorities having jurisdiction, and design requirements of the Contract Documents.
- .4 Engineered submittals shall include design calculations, complete with references to codes and standards used in such calculations, supporting the proposed design represented by the submittal. Prepare calculations in a clear and comprehensive manner so that they can be properly reviewed.
- .5 Professional engineer responsible for the preparation of engineered submittals shall undertake periodic field review, including review of associated mock-ups where applicable, at locations wherever the work as described by the engineered submittal is in progress, during fabrication and installation of such work, and shall submit a field review report after each visit. Field review report shall be submitted to the Consultant, to authorities having jurisdiction as required, and in accordance with the building code.
- .6 Field reviews shall be at intervals as necessary and appropriate to the progress of the work described by the submittal to allow the engineer to be familiar with the progress and quality of such work and to determine if the work is proceeding in general conformity with the Contract Documents, including reviewed shop drawings and design calculations.
- .7 Upon completion of the parts of the Work covered by the engineered submittal, the professional engineer responsible for the preparation of the engineered submittal and for undertaking the periodic field reviews described above, shall prepare and submit to the Consultant and authorities having jurisdiction, as required, a letter of general conformity for those parts of the Work, certifying that they have been Provided in accordance with the requirements both of the Contract Documents and of the authorities having jurisdiction over the Place of the Work.
- .8 Costs for such field reviews and field review reports and letters of general conformity are included in the Contract Price.

---

**PART 2 - PRODUCTS**

**2.1 NOT USED**

.1 Not Used.

**PART 3 - EXECUTION**

**3.1 NOT USED**

.1 Not Used.

END OF SECTION

## SUBMISSION FORM SCHEDULE A

- .1 Request for Quality Assurance Listing of manufacturer/supplier to be submitted by Contractor prior to ten (10) days before close of tenders. Refer to Section 01 33 00 – Submittal Procedures for additional details.
- .2 Specification Section Reference \_\_\_\_\_
  - .1 Equipment Tag No. \_\_\_\_\_
- .3 Manufacturer/Supplier
  - .1 Name \_\_\_\_\_
  - .2 Address \_\_\_\_\_
  - .3 City/Province \_\_\_\_\_
  - .4 Product Representative
    - .1 Contact Name \_\_\_\_\_
    - .2 Telephone \_\_\_\_\_
    - .3 Fax \_\_\_\_\_
    - .4 Email \_\_\_\_\_
  - .5 Equipment:
    - .1 Model \_\_\_\_\_ Size \_\_\_\_\_
    - .2 Type \_\_\_\_\_
  - .6 Include the following **product specific** information with this submission:
    - .1 Technical specifications and general requirements
    - .2 Performance charts
    - .3 Accessories Listing
    - .4 Options Listing
    - .5 List of References
- .4 Reasons for proposing alternate:
  - .1 Cost: yes/no (provide details)
  - .2 Improved Schedule Delivery: yes/no (provide details)
  - .3 Availability: yes/no (provide details)
  - .4 Others (provide details)

List three (3) recent Canadian projects where above equipment has been used.

Project Name	Location	Equipment Start Up Installation Date

Above product is submitted as information only for the purpose of including the above manufacturer in the Quality Assurance List of Manufacturers. Contractor is fully responsible for all requirements and conditions of these specifications.

Signed: \_\_\_\_\_ Contractor Name: \_\_\_\_\_  
Date: \_\_\_\_\_ Title: \_\_\_\_\_

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 REFERENCES**

- .1 Canada Labour Code, Part 2, Canada Occupational Safety and Health Regulations.
- .2 Province of Ontario:
  - .1 Occupational Health and Safety Act and Regulations for Construction Projects, R.S.O. 1990, c.0.1, as amended and O. Reg. 213/91 as amended - Updated 2005.

### **1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Make submittals in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Submit site-specific Health and Safety Plan: Within five (5) business days after date of Notice to Proceed and prior to commencement of Work. Health and Safety Plan must include:
  - .1 Results of site specific safety hazard assessment.
  - .2 Results of safety and health risk or hazard analysis for site tasks and operation.
- .3 Submit electronic copy of Contractor's authorized representative's work site health and safety inspection reports to Consultant as per their request.
- .4 Submit copies of reports or directions issued by Federal, Provincial and Territorial health and safety inspectors.
- .5 Submit copies of incident and accident reports.
- .6 Submit WHMIS MSDS - Material Safety Data Sheets.
- .7 Consultant's review of Contractor's final Health and Safety plan should not be construed as approval and does not reduce the Contractor's overall responsibility for construction Health and Safety.

### **1.3 FILING OF NOTICE**

- .1 File Notice of Project with Provincial authorities prior to beginning of Work.
- .2 Agree to install proper site separation and identification in order to maintain time and space at all times throughout life of project.

### **1.4 SAFETY ASSESSMENT**

- .1 Perform site specific safety hazard assessment related to project.

### **1.5 REGULATORY REQUIREMENTS**

- .1 Perform Work in accordance with Section 01 41 00 – Regulatory Requirements.

## **1.6 PROJECT/SITE CONDITIONS**

- .1 Work at site will involve contact with:
  - .1 Owner.
  - .2 Public.
  - .3 Staff/Students.

## **1.7 GENERAL REQUIREMENTS**

- .1 Develop written site-specific Health and Safety Plan based on hazard assessment prior to beginning site Work and continue to implement, maintain, and enforce plan until final demobilization from site. Health and Safety Plan must address project specifications.
- .2 Consultant may respond in writing, where deficiencies or concerns are noted and may request re-submission with correction of deficiencies or concerns.

## **1.8 RESPONSIBILITY**

- .1 Be responsible for health and safety of persons on site, safety of property on site and for protection of persons adjacent to site and environment to extent that they may be affected by conduct of Work.
- .2 Be responsible and assume the role Constructor as described in the Ontario Occupational Health and Safety Act and Regulations for Construction Projects.
- .3 Comply with and enforce compliance by employees with safety requirements of Contract Documents, applicable federal, provincial, and local statutes, regulations, and ordinances, and with site-specific Health and Safety Plan.

## **1.9 COMPLIANCE REQUIREMENTS**

- .1 Comply with Ontario Occupational Health and Safety Act, R.S.O. 1990, c. 0.1 and Ontario Regulations for Construction Projects, O. Reg. 213/91.

## **1.10 UNFORESEEN HAZARDS**

- .1 When unforeseen or peculiar safety-related factor, hazard, or condition occur during performance of Work, advise Health and Safety coordinator, follow procedures in accordance with Acts and Regulations of Ontario, and advise Consultant verbally and in writing.

## **1.11 HEALTH AND SAFETY COORDINATOR**

- .1 Employ and assign to Work, competent and authorized representative as Health and Safety Co-coordinator. Health and Safety Co-coordinator must:
  - .1 Have site-related working experience specific to activities associated with the Work.
  - .2 Have working knowledge of occupational safety and health regulations.

- .3 Be responsible for completing Contractor's Health and Safety Training Sessions and ensuring that personnel not successfully completing required training are not permitted to enter site to perform Work.
- .4 Be responsible for implementing, enforcing daily and monitoring site-specific Contractor's Health and Safety Plan.
- .5 Be on site during execution of Work.
- .2 It is acceptable for the site supervisor to also act as the Health and Safety Coordinator if the above requirements are met and if deemed appropriate by the Contractor.

#### **1.12 POSTING OF DOCUMENTS**

- .1 Ensure applicable items, articles, notices and orders are posted in conspicuous location on site in accordance with Acts and Regulations of Ontario.

#### **1.13 CORRECTION OF NON-COMPLIANCE**

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

#### **1.14 WORK STOPPAGE**

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

#### **1.15 ADDITIONAL OWNER HEALTH AND SAFETY REQUIREMENTS**

- .1 Contractor's current health and safety statement and policy shall be filed with University of Guelph - Design, Engineering and Construction prior to start of work, for the Owner's information only.
- .2 The health and safety statement and policy shall include:
  - .1 Current Material Safety Data Sheets for the products to be used.
  - .2 Provisions for safety including the use of continuous snow fencing in lieu of barricades or caution tape.
  - .3 Signage to indicate DANGER ZONES, CLOSURES, DETOURS, ETC.
  - .4 Set-up locations and procedures.
  - .5 Material storage and handling.
  - .6 Fire protection.
  - .7 Debris handling, storage, disposal and clean-up.
  - .8 Personnel safety required by the regulations including roof barriers, travel restraint systems and fall arrest systems.
  - .9 Other measures pertinent to the Work.

- .3 Owner's receipt of such policy is not approval of completeness and accuracy of policy, nor confirmation of compliance with applicable legislation. The Owner shall in no way be held liable for contents or enforcement of the Contractor's health and safety statement and policy, or the Contractor's detailed health and safety procedures. Owner's comments, or lack thereof, shall not be construed as approval of the Contractor's health and safety practices.
- .4 Accidents
  - .1 In addition to requirements of applicable legislation, in any emergency requiring the use of a resuscitator, the University Fire Prevention Office shall be notified.
  - .2 Make arrangements for emergency treatment of accidents.
  - .3 Provide Owner and Consultant with a copy of WSIB injury report for all reportable accidents and injuries, for information purposes, within 24 hours of incident.
- .5 The Contractor will be responsible for verifying through locates the location of any utilities or services that cross or enter the area of the Work.

## **PART 2 - PRODUCTS**

### **2.1 NOT USED**

- .1 Not used.

## **PART 3 - EXECUTION**

### **3.1 NOT USED**

- .1 Not used.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 REFERENCES**

#### **.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.
- .3 Adequate Ventilation: ventilation, including air circulation and air changes, required to cure material, dissipate humidity, and prevent accumulation of dust fumes, vapours or gases.
- .4 Construction and Demolition Waste: includes solid wastes, such as building materials, packaging, rubbish, debris, and rubble resulting from construction, remodeling, repair, and demolition operations.
  - .1 Includes both combustible and non-combustible wastes, such as paper, boxes, glass, crockery, metal and lumber scrap, metal cans and bones.
- .5 Debris: includes both combustible and non-combustible wastes, such as leaves and tree trimmings that result from construction or maintenance and repair work.
- .6 Chemical Waste: includes petroleum products, bituminous materials, salts, acids, alkalis, herbicides, pesticides, organic chemicals, and inorganic wastes.
- .7 Environmental Pollution and Damage: the presence of chemical, physical, or biological elements or agents that adversely affect human health or welfare; unfavourably alter ecological balances; or degrade the utility of the environment for aesthetic, cultural, or historical purposes.
- .8 Hazardous Materials: includes pesticides, biocides, and carcinogens, as listed by recognized authorities.
- .9 Interior Final Finishes: materials and products that will be exposed at interior, occupied spaces, including flooring, wall coverings, finish carpentry and ceilings.
- .10 Municipal Solid Waste Landfill: a permitted facility that accepts solid, nonhazardous waste such as household, commercial and industrial waste, including construction and demolition waste.
- .11 Packaged Dry Products: materials and products that are installed in dry form and are delivered to the site in manufacturer's packaging, including carpets, resilient flooring, ceiling tiles, and insulation.
- .12 Sediment: soil and other debris that has been eroded and transported by storm or well production runoff water.
- .13 Sanitary Wastes:
  - .1 Garbage: refuse and scraps resulting from preparation, cooking, distribution, or consumption of food.
  - .2 Sewage: domestic sanitary sewage.
- .14 Wet Products: materials and products installed in wet form, including paints, sealants, adhesives and special coatings.

- .2 Reference Standards:
  - .1 CCDC 2-2008 Stipulated Price Contract.
  - .2 U.S. Environmental Protection Agency (EPA)/Office of Water:
    - .1 EPA 832/R-92-005-92, Storm Water Management for Construction Activities, Chapter 3.

## 1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Prior to commencing construction activities or delivery of materials to site, provide Environmental Protection Plan for review by Consultant.
- .3 Ensure Environmental Protection Plan includes comprehensive overview of known or potential environmental issues to be addressed during construction.
- .4 Address topics at level of detail commensurate with environmental issue and required construction tasks.
- .5 Include in Environmental Protection Plan:
  - .1 Names 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 Drawings showing locations of proposed temporary material storage areas, structures, sanitary facilities, and stockpiles of excess or spoil materials including methods to control runoff and to contain materials on site.
  - .6 Traffic Control. Ensure plans include measures to minimize amount of mud transported onto paved public roads by vehicles or runoff.
  - .7 Spill Control Plan including procedures, instructions, and reports to be used in event of unforeseen spill of regulated substance.
  - .8 Non-Hazardous solid waste disposal plan identifying methods and locations for solid waste disposal including clearing debris.
  - .9 Air pollution control plan detailing provisions to assure that dust, debris, materials, and trash, are contained on project site.
  - .10 Contaminant Prevention Plan identifying potentially hazardous substances to be used on job site; intended actions to prevent introduction of such materials into air, water, or ground; and detailing provisions for compliance with Federal, Provincial, and Municipal laws and regulations for storage and handling of these materials.
  - .11 Waste Water Management Plan identifying 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.

### **1.3 SUBMITTALS**

- .1 Submittals: in accordance with Section 01 33 00 – Submittal Procedures.

### **1.4 SUBSTITUTIONS**

- .1 Notify Consultant in writing when Contractor is aware of materials, equipment, or products that meet the aesthetic and programmatic intent of Contract Documents but are more environmentally sensitive than materials, equipment, or products specified or indicated in the Contract Documents.

### **1.5 FIRES**

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

### **1.6 DISPOSAL OF WASTE**

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

### **1.7 DRAINAGE**

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

### **1.8 SITE CLEARING AND PLANT PROTECTION**

- .1 Protect trees and plants on site and adjacent properties.
- .2 Wrap in burlap, trees and shrubs adjacent to construction work, storage areas and trucking lanes, and encase with protective wood framework from grade level to height of 2 m minimum.
- .3 Protect roots trees to dripline to prevent disturbance or damage. Avoid unnecessary traffic, dumping and storage of materials over root zones.
- .4 Restrict tree removal to areas indicated or designated by Consultant.

## 1.9 POLLUTION CONTROL

- .1 Control emissions from equipment and plant to local authorities' emission requirements.
- .2 Prevent sandblasting and other extraneous materials from contaminating air and waterways beyond application area.
- .3 Cover or wet down dry materials and rubbish to prevent blowing dust and debris. Provide dust control for temporary roads.
- .4 Collection: implement a recycling / reuse program that includes separate collection of waste materials of the following types:
  - .1 Metal:
    - .1 Ferrous
    - .2 Nonferrous
  - .2 Wood
  - .3 Debris
  - .4 Glass
  - .5 Paper:
    - .1 Bond
    - .2 Newsprint
    - .3 Newsprint
- .5 Environmental Controls: disposal operations for waste materials that are not identified to be salvaged, recycled or reused:
  - .1 Remove debris, rubbish, and other waste materials from construction operations from site.
  - .2 No burning permitted.
  - .3 Transport materials with appropriate vehicles, and dispose off-site to areas that are approved for disposal by governing authorities having jurisdiction.
  - .4 Avoid spillage by covering and securing loads when hauling on or adjacent to public streets or highways. Remove spillage, and sweep, wash or otherwise clean project site, streets, or highways.
  - .5 Comply with applicable regulations.
- .6 Air Resources: prevent creation of dust, air pollution, and odours.
  - .1 Use water sprinkling, temporary enclosures, and other appropriate methods to limit to lowest practical level dust and dirt rising and scattering in air.
    - .1 Do not use water when it may create hazardous or other adverse conditions such as flooding and pollution.
  - .2 Store volatile liquids, including fuels and solvents, in closed containers.
  - .3 Properly maintain equipment to reduce gaseous pollutant emissions.
  - .4 Interior final finishes: schedule construction operations involving wet products prior to packaged dry products to the greatest extent possible.
  - .5 Temporary Ventilation:
    - .1 Provide adequate ventilation during and after installation of interior wet products and interior final finishes.

- .2 Provide adequate ventilation of packaged dry products prior to installation. Remove from packaging and ventilate in a secure, dry, well-ventilated space free from strong contaminant sources, and residues. Do not ventilate within limits of Work unless otherwise approved by Consultant.
- .3 Preoccupancy Ventilation: after final completion and prior to initial occupancy, provide adequate ventilation for minimum five (5) days. Preoccupancy ventilation procedures:
  - .1 Use supply air fans and ducts only.
  - .2 Temporarily seal exhaust ducts.
  - .3 Temporarily disable exhaust fans.
  - .4 Provide exhaust through operable windows or temporary openings.
  - .5 Provide temporary exhaust fans as required to pull exhaust air from deep interior locations. Stair towers may be used for exhausting air from the building during the temporary ventilation.

#### **1.10 INDOOR AIR QUALITY MANAGEMENT DURING CONSTRUCTION**

- .1 HVAC Protection
  - .1 Prevent dust from settling into HVAC system. Seal off any duct work during construction and then keep ducts sealed in plastic to prevent dust from getting into them.
  - .2 Do not use HVAC system during construction.
  - .3 Do not store construction or waste materials in mechanical rooms.
  - .4 Seal diffusers and grilles with plastic.
  - .5 Inspect and clean all ducts, diffusers and grilles at completion of the Work.
- .2 Source Control
  - .1 Prohibit the idling of motors and internal combustion engines on site during construction.
  - .2 Use bottled gases for equipment rather than diesel.
  - .3 Switch to electrical equipment rather than fossil fuel equipment wherever possible.
  - .4 Ensure any exhaust is emitted directly to the exterior and well away from any intakes or door or window openings.
  - .5 Use enclosed tankers rather than open kettles for roofing operations.
- .3 Work Area Separation
  - .1 Use dust curtains, continuous heavy duty sheet plastic seals to separate work areas containing any dust and dirt particulates from other cleaner areas
- .4 Housekeeping
  - .1 Minimize dust with wetting agents or sweeping compounds.
  - .2 Remove spills quickly when dealing with odorous or noxious materials.
  - .3 Remove any accumulated water. Keep all work areas dry and dehumidify when and where necessary.
  - .4 Vacuum with HEPA filtered vacuums to reduce airborne dust particles.
  - .5 Keep porous materials dry. Do not allow any insulation to become wet.
  - .6 Clean site daily.

.5 Scheduling

- .1 If the building is occupied after substantial completion, on-going work areas are to be kept under negative pressure to prevent the migration of dust and dirt into the occupied spaces.
- .2 Wherever possible, work, where off-gassing occurs is to be scheduled during off-hours.

**1.11 HISTORICAL / ARCHAEOLOGICAL CONTROL**

- .1 Refer to CCDC-2.

**1.12 NOTIFICATION**

- .1 Consultant will notify Contractor in writing of observed noncompliance with Federal, Provincial or Municipal environmental laws or regulations, permits, and other elements of Contractor's Environmental Protection plan.
- .2 Contractor: after receipt of such notice, inform Consultant of proposed corrective action and take such action for approval by Consultant.
- .3 Do not take action until after receipt of written approval by Consultant.
- .4 Consultant will issue stop order of work until satisfactory corrective action has been taken.
- .5 No time extensions granted or equitable adjustments allowed to Contractor for such suspensions.

**PART 2 - PRODUCTS**

**2.1 NOT USED**

- .1 Not Used.

**PART 3 - EXECUTION**

**3.1 NOT USED**

- .1 Not Used.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 REFERENCES AND CODE**

- .1 Perform Work in accordance with Ontario Building Code (OBC) including amendments up to tender closing date and other codes of local application provided that in case of conflict or discrepancy, more stringent requirements apply.
- .2 Meet or exceed requirements of:
  - .1 Contract documents.
  - .2 Specified standards, codes and referenced documents.

### **1.2 HAZARDOUS MATERIAL DISCOVERY**

- .1 Asbestos: demolition of spray or trowel-applied asbestos is hazardous to health. Stop work immediately when material resembling spray or trowel-applied asbestos is encountered during demolition work. Notify Consultant. Refer to Section 02 82 12 – Asbestos Abatement – Type 3 Procedures.
- .2 PCB: Polychlorinated Biphenyl: stop work immediately when material resembling Polychlorinated Biphenyl is encountered during demolition work. Notify Consultant. Refer to Section 02 84 10 – PCB Packaging and Disposal.
- .3 Mercury: stop work immediately when material resembling mercury is encountered during demolition work. Notify Consultant. Refer to Section 02 84 11 – Mercury Packaging and Disposal
- .4 Lead-based paint: Refer to Section 02 83 10 – Lead-based paint abatement – Intermediate Precautions.
- .5 Biohazard: Refer to Section 02 87 00 – Biohazard Remediation.

### **1.3 BUILDING SMOKING ENVIRONMENT**

- .1 Comply with smoking restrictions and municipal by-laws.
- .2 Smoking or vaping is forbidden within all buildings on the Owner's property and within 9.0 meters of any entrance or exit. Failure to comply will require offenders to leave the property and may result in loss of future business. Repeat offenders shall be removed from the site.
- .3 The Contractor and any sub-trades shall comply with all Owner restrictions regarding smoking, vaping and drug use on campus.

## **PART 2 - PRODUCTS**

### **2.1 NOT USED**

- .1 Not Used.

## **PART 3 - EXECUTION**

### **3.1 NOT USED**

- .1 Not Used.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 SECTION INCLUDES**

- .1 Concept.
- .2 Requirements.
- .3 Submissions.

### **1.2 REFERENCES**

- .1 Canadian Construction Documents Committee (CCDC):
  - .1 CCDC 2-2008, 'Stipulated Price Contract'.

### **1.3 CONCEPT**

- .1 The Contractor is to develop, submit for approval and implement an overall Quality Plan for the project that outlines a course of action to ensure quality standards for all materials and workmanship provided meet the Contract Specifications and Contract Drawings (Contract Documents).
- .2 In order to ensure accountability towards all Quality Assurance and field quality control responsibilities, the Quality Plan shall clearly identify all tasks, inspections, third parties and submissions that are required by the Contractor for each section of this contract.
- .3 Individual sections within the Contract may also require their own specific Quality Plans. The Quality Plan requirements outlined in this section are not a substitute for individual Quality Plan/ Quality Submission requirements outlined in individual specification sections. Refer to sections for details.

### **1.4 REQUIREMENTS**

- .1 The Quality Plan shall describe, as a minimum, the following:
  - .1 Identify the personnel responsible for the implementation and oversight of the Quality Plan for the entirety of this Contract.
  - .2 Identify the personnel responsible to ensure the Contractor's Quality Assurance requirements for each Section of this Contract are met.
  - .3 Identify the personnel responsible to ensure the Field Quality Control requirements for each Section of this Contract are met.
  - .4 Describe the roles and responsibilities for each individual above, pertaining to the Quality Plan.
- .2 The Quality Plan shall include, as a minimum, the following:
  - .1 Samples of the Contractor's Field Quality Control forms to be used. These would include, but are not limited to the following:
    - .1 Inspection forms
    - .2 Logs
    - .3 Shop Drawing Review and Sign Off
    - .4 Consultant/Third Party Review Request
    - .5 Deficiency Sign-Off
  - .2 Procedural steps for the review of shop drawings by the Contractor prior to submission to the Consultant.
  - .3 Identifies the anticipated timeframes for scheduling of conformance reviews by the Consultant or the appointed qualified professional.

- .4 Identifies the anticipated timeframes for scheduling of Material Testing.
  - .5 Identifies the anticipated timeframes for scheduling of Manufacturer's Representative/Third Party review.
  - .6 Procedures to identify and document defective supplies, materials and workmanship, including their proposed repair procedures or corrective action follow-up.
  - .7 Risk Management: List and describe any anticipated project specific risk associated and outline proposed means of mitigation.
- .3 The Quality Plan shall be of sufficient detail to demonstrate the performance requirements of the contract.
- .4 Construction Schedule:
- .1 Contractor is to identify each Quality Control procedural step within the Construction Schedule. The minimum schedule milestones to identify shall include:
    - .1 Shop drawing submissions.
    - .2 Site inspections/reviews as identified in the specifications.
    - .3 Mock-ups
    - .4 Equipment Commissioning
    - .5 Factory and site acceptance testing of equipment where identified in specifications.
- .5 Review of Quality Plan Effectiveness:
- .1 The implementation of the Contractor's Quality Plan will be an agenda item at each progress meeting.

## **1.5 SUBMISSIONS**

- .1 Submit Quality Plan in accordance with Section 01 33 00 – Submittal Procedures.
- .2 The Quality Plan shall be prepared by the Contractor taking into account the specific requirements of this Contract. Generic Quality Plans that, in the Consultant reasonable opinion, fail to address the specific contract requirements will be returned, "Revise and Resubmit".
- .3 The Quality Plan shall be submitted to the Consultant for review within (10) business days following the pre-construction meeting.
- .4 The Consultant will have ten (10) business days to review and provide comments upon receipt of the Quality Plan.

## **PART 2 - PRODUCTS**

### **2.1 NOT USED**

- .1 Not Used.

## **PART 3 - EXECUTION**

### **3.1 NOT USED**

- .1 Not Used.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 SECTION INCLUDES**

- .1 Inspection and testing, administrative and enforcement requirements.
- .2 Tests and mix designs.
- .3 Mock-ups.
- .4 Mill tests.

### **1.2 REFERENCES**

- .1 Canadian Construction Documents Committee (CCDC)
  - .1 CCDC 2-2008, Stipulated Price Contract.

### **1.3 SITE REVIEW**

- .1 Refer to CCDC 2, GC 2.3 Review and Inspection of the Work and Supplemental Conditions.
- .2 Allow Owner and Consultant access to Work. If part of Work is in preparation at locations other than Place of Work, allow access to such Work whenever it is in progress.
- .3 Give timely notice requesting inspection if Work is designated for special tests, inspections or approvals by Consultant instructions, or law of Place of Work.
- .4 If Contractor covers or permits to be covered Work that has been designated for special tests, inspections or approvals before such is made, uncover such Work, have inspections or tests satisfactorily completed and make good such Work.
- .5 Consultant will order part of Work to be examined if Work is suspected to be not in accordance with Contract Documents. If, upon examination such work is found not in accordance with Contract Documents, correct such Work and pay cost of examination and correction.

### **1.4 INDEPENDENT INSPECTION AGENCIES**

- .1 Independent Inspection/Testing Agencies to be engaged by Contractor for purpose of inspecting and/or testing portions of Work.
- .2 Acceptable costs to be invoiced under allowances, refer to Section 012100 – Allowances. All other testing and inspection to be included in Contract Price.
- .3 Provide equipment required for executing inspection and testing by appointed agencies.
- .4 Employment of inspection/testing agencies does not relax responsibility to perform Work in accordance with Contract Documents.

- .5 Independent Inspection/Testing Agency to submit copies of all inspection/testing reports directly to Consultant.
- .6 If defects are revealed during inspection and/or testing, appointed agency will request additional inspection and/or testing to ascertain full degree of defect. Correct defect and irregularities as advised by Consultant and/or Inspection/Testing Agency at no cost to Owner. Pay costs for retesting and re-inspection.

## **1.5 SUPERINTENDENT**

- .1 Refer to CCDC 2, GC 3.6 – Supervision.
- .2 The Superintendent shall be satisfactory to the Owner and Consultant and shall not be changed except for good reason and only then after consultation with and agreement by the Owner and Consultant.
- .3 The Superintendent shall represent the Contractor at Work site and directions given to him by the Consultant shall be held to have been given to the Contractor.
- .4 The Contractor shall remove the Superintendent of the Work if in the opinion the Superintendent is unable to carry out their proper functions and duties, due to whatever reason, to the complete satisfaction of the Consultant and the Owner.
- .5 Should the Contractor wish to replace the Superintendent, the Contractor shall submit to the Consultant, a request for the change in writing. Include in the written request the reason for the change and the experience and qualifications of the replacement superintendent. The acceptance of the replacement superintendent will be at the sole discretion of Owner and Consultant and issued to the Contractor in writing. Should the replacement superintendent be deemed unacceptable to the Owner or Consultant, submit experience and qualifications of other superintendents for review and approval by the Owner and Consultant until a suitable replacement is accepted.
- .6 The Superintendent of the work shall remain at the place of Work until all deficiencies of all trades have been rectified and the project is deemed Totally Performed by the Consultant.
- .7 The duties of the Superintendent shall include, but not be limited to the following:
  - .1 Co-ordination of the Work of all trades including own forces.
  - .2 Expediting labour and Products of all trades including own forces.
  - .3 Total project control and co-ordination.
  - .4 Project scheduling.
  - .5 Quality control and supervision as required to ensure the project is constructed in accordance with the Contract Documents.

## **1.6 ACCESS TO WORK**

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

## **1.7 PROCEDURES**

- .1 Notify appropriate agency and Consultant two (2) business days in advance of 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 orderly sequence to not cause delays in Work.
- .3 Provide labour and facilities to obtain and handle samples and materials on site. Provide sufficient space to store and cure test samples.

## **1.8 REJECTED WORK**

- .1 Refer to CCDC, GC 2.4.
- .2 Remove defective Work, whether result of poor workmanship, use of defective products or damage and whether incorporated in Work or not, which has been rejected by Consultant as failing to conform to Contract Documents. Replace or re-execute in accordance with Contract Documents.
- .3 Make good other Contractor's work damaged by such removals or replacements promptly at no cost to the Owner.
- .4 If in opinion of the Consultant it is not expedient to correct defective Work or Work not performed in accordance with Contract Documents, Owner will deduct from Contract Price difference in value between Work performed and that called for by Contract Documents, amount of which will be determined by the Consultant.

## **1.9 REPORTS**

- .1 Submit electronic copy of inspection and test reports to Consultant.
- .2 Provide copies to subcontractor of work being inspected or tested and/or manufacturer or fabricator of material being inspected or tested.

## **1.10 TESTS AND MIX DESIGNS**

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

## **1.11 MOCK-UPS**

- .1 Prepare mock-ups for Work specifically requested in specifications. Include for Work of Sections required to provide mock-ups.
- .2 Construct in locations as directed by Consultant.

- .3 Prepare mock-ups for Consultant's review with reasonable promptness and in orderly sequence, to not cause delays in Work.
- .4 Failure to prepare mock-ups in ample time is not considered sufficient reason for extension of Contract Time and no claim for extension by reason of such default will be permitted.
- .5 Failure to prepare mock-ups to Consultant approval is not considered sufficient reason for an increase to Contract Price and no claim for increase by reason of such default will be accepted.
  - .1 Rectify, and/or remove and replace all such rejected mock-ups to Consultant approval.
- .6 Approved mock-ups may remain as part of Work subject to the approval of the Consultant

#### **1.12 MILL TESTS**

- .1 Submit mill test certificates as required of specification Sections.

#### **1.13 EQUIPMENT AND SYSTEMS**

- .1 Submit adjustment and balancing reports for mechanical, electrical and building equipment systems.

#### **1.14 TOLERANCES**

- .1 Unless more stringent tolerances are required by a Section of the Specifications or a referenced standard, meet the following tolerances for installed Work:
  - .1 "plumb" shall mean plumb within 3 mm ( $\frac{1}{8}$ ") in 3 m (10 ft.).
  - .2 "level" shall mean level within 3 mm ( $\frac{1}{8}$ ") in 3 m (10 ft.).
  - .3 "square" shall mean not in excess of 10 seconds less or more than 90°.
  - .4 "straight" shall mean within 3 mm ( $\frac{1}{8}$ ") in 3 m (10 ft.) under a 3 m (10 ft.) straight edge.

#### **1.15 BUILDING COMPONENTS**

- .1 Requirements specified herein apply to all elements of the building components.
- .2 Continuity of fire separations, air barriers, vapour barriers, air/vapour barriers and insulation components are critical and must be maintained at all locations. Where different systems meet, ensure proper interface and continuity between adjacent components by implementing suitable construction sequences and by using compatible materials only.
- .3 Provide control joints in interior and exterior building components of design and spacing which will permit expansion and contraction of components without causing distortion, failure of joint seals, undue stress, cracking, bowing or other defects detrimental to appearance and performance. Review design and location of control joints with Consultant prior to start of Work and follow directions given by Consultant.
- .4 Anchor exterior components to structure in manner suitable to accommodate structural deflection and creep. Design anchorage to withstand expected wind loads, positive and negative, in accordance with applicable regulations.

- .5 Ensure that air spaces within building components are fire stopped in accordance with applicable regulations.
- .6 Ensure that air spaces on the outside of vertical air barrier/vapour barriers (walls) are constructed with adequate drainage provisions to the exterior.

#### **1.16 DRAINAGE**

- .1 Lay out and construct Work to ensure that positive drainage is provided to roof drains, floor drains, site drains and catch basins, as set in their final position, preventing undrained areas and ponding.
- .2 Ensure that allowable construction tolerances and structural deflection do not cause ponding of water.
- .3 Report to Consultant in writing prior to executing Work affected, in case adequate drainage cannot be provided.

### **PART 2 - PRODUCTS**

#### **2.1 NOT USED**

- .1 Not Used.

### **PART 3 - EXECUTION**

#### **3.1 NOT USED**

- .1 Not Used.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 REFERENCES**

- .1 U.S. Environmental Protection Agency (EPA) / Office of Water:
  - .1 EPA 832R92005, Storm Water Management for Construction Activities: Developing Pollution Prevention Plans and Best Management Practices.

### **1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.

### **1.3 INSTALLATION AND REMOVAL**

- .1 Provide temporary utilities controls in order to execute work expeditiously.
- .2 Remove from site all such work after use.
- .3 Maintain temporary utilities and plant in good operating order.
- .4 Use utilities and execute work to prevent waste of utilities.

### **1.4 TEMPORARY HEATING AND VENTILATION**

- .1 Provide temporary heating required during construction period, including attendance, maintenance and fuel.
- .2 Construction heaters used inside building must be vented to outside or be non-flameless type. Solid fuel salamanders are not permitted.
- .3 Provide temporary heat and ventilation in enclosed areas as required to:
  - .1 Facilitate progress of Work.
  - .2 Protect Work and products against dampness and cold.
  - .3 Prevent moisture condensation on surfaces.
  - .4 Provide ambient temperatures and humidity levels for storage, installation and curing of materials.
  - .5 Provide adequate ventilation to meet health regulations for safe working environment.
- .4 Maintain temperatures of minimum 10 degrees C in areas where construction is in progress.
- .5 Do not use electricity for temporary heating except with Owner's prior permission.
- .6 Ventilating:
  - .1 Prevent accumulations of dust, fumes, mists, vapours or gases in areas occupied during construction.
  - .2 Provide local exhaust ventilation to prevent harmful accumulation of hazardous substances into atmosphere of occupied areas.
  - .3 Dispose of exhaust materials in manner that will not result in harmful exposure to persons.
  - .4 Ventilate storage spaces containing hazardous or volatile materials.
  - .5 Ventilate temporary sanitary facilities.
  - .6 Continue operation of ventilation and exhaust system for time after cessation of work process to assure removal of harmful contaminants.

- .7 Maintain strict supervision of operation of temporary heating and ventilating equipment to:
  - .1 Conform to 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.
- .8 Pay costs for maintaining temporary heat and ventilation.
- .9 Be responsible for damage to Work due to failure in providing adequate heat and protection during construction.
- .10 With Owner's permission, temporary connection may be made to natural gas service for construction purposes. Provide meter, and compensate Owner for cost of fuel consumed at Owner's costs. Obtain all necessary permits and inspections. Owner shall be final authority to determine costs. Provide all other piping, fittings, connections, hoses, etc. as required for temporary connection.
- .11 Be responsible for damage to work due to failure in providing adequate heat and protection during construction.
- .12 Prevent excessive use or waste of utilities, and minimize utility costs to Owner.
- .13 New and existing equipment and systems shall not be used for temporary ventilating.

#### **1.5 TEMPORARY POWER AND LIGHT**

- .1 Provide and pay for temporary power during construction for temporary lighting, operating of power tools, project job site temporary offices, and other construction requirements.
- .2 Arrange for connection with appropriate utility company. Pay costs for installation, maintenance and removal.
- .3 Provide temporary power for electric cranes and other equipment as required.
- .4 Provide and maintain temporary lighting throughout project. Ensure level of illumination on all floors and stairs is not less than 162 lx.
- .5 Connect to power supply according to Canadian Electrical Code and provide meters and switching. Maintain fire watch during use of open flame heaters.

#### **1.6 TEMPORARY COMMUNICATION FACILITIES**

- .1 Provide and pay for temporary fax, telephone, cell phones, computers with email and high speed internet access, and other equipment necessary for own use.

#### **1.7 FIRE PROTECTION**

- .1 Provide and maintain temporary fire protection equipment during performance of Work required by governing codes, regulations and bylaws.
- .2 "Hot work" shall not be performed unless:
  - .1 The area can be made safe for the work;
  - .2 The work has been approved by the Owner; and
  - .3 The Hot Work is performed within the authorized time frame and only as long as conditions remain safe.

- .3 "Hot work" shall not be performed if:
  - .1 Processes involving flammable liquids, gases and dusts cannot be shut down and made safe;
  - .2 Lint conditions are severe beyond correction;
  - .3 Partitions, walls, ceilings, or roofs have combustible coverings (e.g., expanded plastic insulation);
  - .4 Partitions are made of combustible sandwich-type construction.
- .4 Burning rubbish and construction waste materials is not permitted on site.

#### **1.8 CONSTRUCTION AID**

- .1 Provide temporary stairs, ladders and ramps required for movement and placing of materials, equipment and personnel.
- .2 Use of Owner's temporary facilities such as portable ladders, work lights, extension cords, tools etc. is prohibited. Contractor to provide all such items.
- .3 Provide mechanical hoisting equipment and fully qualified operators as required during construction.
- .4 Erect required scaffolding independent of walls. Arrange to avoid interference with work of other Sections as much as possible. Design and construct scaffolding in accordance with CSA S269.2-1975.
- .5 Provide and maintain regular shoring and bracing in accordance with Construction Safety Act and other applicable regulations. Design and construct falsework in accordance with CSA S269.1-1975.

#### **1.9 DEWATERING**

- .1 Provide temporary drainage and pumping facilities to keep excavations and site free from standing water.

#### **1.10 WATER SUPPLY**

- .1 The Owner will provide a continuous supply of potable water for construction use.
- .2 Provide temporary connections to existing supply points, and pay all costs for installation, maintenance and removal

### **PART 2 - PRODUCTS**

#### **2.1 NOT USED**

- .1 Not Used.

### **PART 3 - EXECUTION**

#### **3.1 NOT USED**

- .1 Not Used.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 REFERENCES**

- .1 Canadian Construction Documents Committee (CCDC):
  - .1 CCDC 2-2008, Stipulated Price Contract.
- .2 Canadian General Standards Board (CGSB):
  - .1 CAN/CGSB 1.189-00, Exterior Alkyd Primer for Wood.
  - .2 CGSB 1.59-97, Alkyd Exterior Gloss Enamel.
- .3 Canadian Standards Association (CSA International):
  - .1 CSA-A23.1/A23.2-04, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
  - .2 CSA-0121-M1978 (R2003), Douglas Fir Plywood.
  - .3 CAN/CSA-S269.2-M1987 (R2003), Access Scaffolding for Construction Purposes.
  - .4 CAN/CSA-Z321-96 (R2001), Signs and Symbols for the Occupational Environment.
- .4 U.S. Environmental Protection Agency (EPA) / Office of Water:
  - .1 EPA 832R92005, Storm Water Management for Construction Activities: Developing Pollution Prevention Plans and Best Management Practices.

### **1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.

### **1.3 INSTALLATION AND REMOVAL**

- .1 Prepare site plan indicating proposed location and dimensions of area to be fenced and used by Contractor, number of trailers to be used, avenues of ingress/egress to fenced area and details of fence installation.
- .2 Identify areas which have to be gravelled to prevent tracking of mud.
- .3 Indicate use of supplemental or other staging area.
- .4 Provide construction facilities in order to execute work expeditiously.
- .5 Remove from site all such work after use.

### **1.4 COLD WEATHER CONDITIONS**

- .1 The term "cold weather periods" shall mean the periods between the 15<sup>th</sup> of September to the 31<sup>st</sup> day of May of the following year; from the date of commencement of the Work until the Work is completed.
- .2 Assume full responsibility and pay all costs for snow or ice removal from the project site. Maintain site during cold weather periods including but not limited to cleaning and/or clearing any snow or ice accumulation as required to perform the Work and to provide a safe working environment around the building and project site. Remove snow from project site. Dump snow at properly designated areas to the requirements of local authorities.

- .3 Where the climate may affect in any manner the ways and means for the performance of the work or the timing for the project, thoroughly examine the climatic data for the past 10 year period, and incorporate all information reasonably inferable from such data into the Contract Price, Construction Schedule and Contract Time.

## **1.5 SCAFFOLDING**

- .1 Scaffolding in accordance with CAN/CSA-S269.2.
- .2 Provide and maintain scaffolding, ramps, ladders, swing staging, platforms, and temporary stairs as required to perform Work.

## **1.6 HOISTING**

- .1 Provide, operate and maintain hoists cranes required for moving of workers, materials and equipment. Make financial arrangements with Subcontractors for their use of hoists.
- .2 Hoists cranes to be operated by qualified operator.

## **1.7 SITE STORAGE/LOADING**

- .1 Refer to CCDC 2, GC 3.11.
- .2 Confine work and operations of employees to limits indicated by Contract documents or where no limits shown on drawings, to immediate area of work. Do not unreasonably encumber premises with products.
- .3 Do not load or permit to load any part of work with a weight or force that will endanger the work, or any part of existing structures, components or elements.
- .4 On-site storage of construction materials and equipment shall be kept to a minimum at all times. All materials being stored shall be protected by the Contractor from damage or loss and shall be repaired or replaced by the Contractor should damage or loss occur.
- .5 Do not store goods and materials within existing buildings except with Owner's prior permission. Materials are to be stored in a location and manner to cause the least interference with work activities, pedestrian or vehicular traffic.
- .6 Where storage is not permitted within existing buildings, provide lockable sheds and trailers to store goods and materials. Pay parking costs associated with storage trailers.
- .7 Determine with the Owner locations that are suitable for receiving/storage of materials and equipment.
- .8 All materials and equipment shall be kept in a secure area, at contractor's expense, or removed from the job site when work is not actually in progress.

## **1.8 CONSTRUCTION PARKING**

- .1 Except as noted below, pay costs of parking. Owner's available parking is subject to charge. Obtain schedule of available parking locations, rate schedule and permits from Owner's Parking Services, Trent Lane.
- .2 Parking costs will apply to office and/or storage trailers occupying parking spaces.

- .3 Parking within construction hoarding is without charge. Owner reserves right to approve extent of hoarding. Owner's requirements take precedence over Contractor's use of site.
- .4 Parking in posted fire routes will not be permitted. Vehicles found parked in a posted fire route will be towed without warning at vehicle owners' expense.

## 1.9 SECURITY AND KEYS

- .1 Comply with Owner's policy and practices regarding site and building security. Do not reduce level of security afforded to building and site by work of this Contract.
- .2 Provide and pay for security as may be required to guard site and contents of site after working hours and during holidays.
- .3 For unoccupied buildings, ensure that buildings are maintained locked at all times, except when doors are unlocked and continuously monitored by Contractor.
- .4 For occupied buildings, cooperate with Owner's schedule of unlocking and locking. Maintain locking schedule unless otherwise directed by Owner. Continuously monitor all doors unlocked at periods when Owner would normally maintain locked doors.
- .5 Owner will issue keys for areas upon receipt of cheque, made payable to the University of Guelph as refundable deposit upon return of keys in good condition.
  - .1 Service keys--NSK, HOSK singular or as a pair \$500.00 each
  - .2 Building masters \$500.00 each
  - .3 Building sub masters \$300.00 each
  - .4 Housekeeping keys \$300.00 each
  - .5 Individual room keys \$200.00 each
- .6 Owner's policy requirements include but are not limited to:
  - .1 Minimum 48 hours prior to start of work arrange with Owner to obtain keys and adjust security alarms for overtime work.
  - .2 Do not copy Owner's keys. Return Owner's keys to Owner prior to issuing final invoice for work. Owner reserves the right to withhold all or part of final payment, in addition to deposit made, until keys have been returned. In the event of loss of key, the Contractor shall reimburse the Owner, by means of a deduction from any amounts due the Contractor and by direct reimbursement, for all costs associated with keying plus 100% overhead.
  - .3 Upon return of keys obtain receipt of keys from Owner. Make arrangements via Owner's representative for refund of key deposit.
  - .4 Calls to the Owner from the subcontractors for keys or access to the building are prohibited. It shall be the Contractor's responsibility to arrange access for workers.
- .7 Ensure all doors and windows are locked and secured prior to leaving the site.

## 1.10 OFFICES

- .1 Provide office heated to 22 degrees C, lighted, and ventilated, of sufficient size to accommodate site meetings and furnished with drawing layout table and filing cabinets for construction documents as follows:
  - .1 Contract Drawings.
  - .2 Specifications.
  - .3 Addenda.
  - .4 Reviewed Shop Drawings.

- .5 List of Outstanding Shop Drawings.
  - .6 Site Instructions.
  - .7 Change Notices.
  - .8 Change Orders.
  - .9 Other Modifications to Contract.
  - .10 Field Test Reports.
  - .11 Copy of Most Recent and Approved Work Schedule.
  - .12 Health and Safety Plan and Other Safety Related Documents.
  - .13 'Notice of Project' from Ontario Ministry of Labour.
  - .14 Building permit.
  - .15 Meeting Minutes.
  - .16 Other documents as specified.
- .2 Provide marked and fully stocked first-aid case in a readily available location.
  - .3 Subcontractors to provide their own offices as necessary. Direct location of these offices.

#### **1.11 EQUIPMENT, TOOL AND MATERIALS STORAGE**

- .1 Provide and maintain, in clean and orderly condition, lockable weatherproof sheds for storage of tools, equipment and materials.
- .2 Locate materials not required to be stored in weatherproof sheds on site in manner to cause least interference with work activities.

#### **1.12 SANITARY FACILITIES**

- .1 Provide sanitary facilities for work force in accordance with governing regulations and ordinances.
- .2 Post notices and take precautions as required by local health authorities. Keep area and premises in sanitary condition.

#### **1.13 CONSTRUCTION SIGNAGE**

- .1 Provide within two (2) weeks of signing Contract, and prior to submitting first claim for payment, minimum 4' x 8' x 5/8" G1S plywood sign, complete with wood framing and supports, showing University's cornerstone logo; listing project title, Owner's project number, name of Owner's representative (Construction Co-ordinator) complete with telephone extension; consultant and contractor name and address for all; sign background and rear face of sign shall be white; letters for names 1.25" high, black paint; typeface as respective corporate standard; provide logo for each firm listed, in corporate colour. Provide 1.25" vertical space between parties.

Submit sign sketch to the Consultant for the Owner's approval before fabrication. Sign shall be executed with exhibit lettering produced by a professional sign manufacturer/painter.

- .2 Locate sign as directed by Consultant and with Owner's consent.
- .3 Maintain sign in good condition for duration of work. Clean periodically. Remove immediately after Substantial Performance of the Contract, or at Completion of Contract as defined in applicable lien legislation where there is no application for Substantial Performance of the Contract.
- .4 No other signs or advertisements, other than warning signs, or signs required by law, are permitted on site, without Owner's consent.

#### **1.14 PROTECTION AND MAINTENANCE OF TRAFFIC**

- .1 Provide access and temporary relocated roads as necessary to maintain traffic.
- .2 Maintain and protect traffic on affected roads during construction period except as otherwise specifically directed by Consultant.
- .3 Provide measures for protection and diversion of traffic, including provision of watch-persons and flag-persons, erection of barricades, placing of lights around and in front of equipment and work, and erection and maintenance of adequate warning, danger, and direction signs
- .4 Protect travelling public from damage to person and property.
- .5 Contractor's traffic on roads selected for hauling material to and from site to interfere as little as possible with public traffic.
- .6 Verify adequacy of existing roads and allowable load limit on these roads. Contractor: responsible for repair of damage to roads caused by construction operations.

#### **1.15 CLEAN-UP**

- .1 Remove construction debris, waste materials, packaging material from work site daily.
- .2 Clean dirt or mud tracked onto paved or surfaced roadways.
- .3 Store materials resulting from demolition activities that are salvageable.
- .4 Stack stored new or salvaged material not in construction facilities.

#### **1.16 WASTE DISPOSAL CONTAINERS AND SERVICES**

- .1 Provide for garbage chutes, on-site debris collection and disposal equipment, and services needed to dispose of all debris. Do not use Owner's waste containers for disposal of debris arising from work of this Contract. Provide and pay for dedicated waste disposal for work of this Contract.
- .2 Locating garbage chutes, on-site debris collection and disposal equipment, and services needed to dispose of all debris in posted fire routes will not be permitted. Vehicles and equipment found located in a posted fire route will be towed or moved without warning at vehicle owners' or Contractors' expense.

#### **1.17 COMPRESSED GAS OR EXPLOSIVE-ACTUATED FASTENER TOOLS**

- .1 Use of compressed gas or explosive-actuated fasteners and associated tools is prohibited in buildings occupied by the Owner.
- .2 Use of compressed gas or explosive-actuated fasteners and associated tools is accepted in buildings unoccupied by the Owner, and where stray fasteners will not injure personnel.
- .3 Use explosive-actuated and compressed gas fastener tools only under strictest safety conditions. Keep equipment locked in storage cabinet unless in active use by personnel. Equipment shall not be left unattended, or be accessible to anyone other than authorized users.

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**PART 2 - PRODUCTS**

**2.1 NOT USED**

.1 Not Used.

**PART 3 - EXECUTION**

**3.1 NOT USED**

.1 Not Used.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 SITE**

- .1 Lines, levels, and locations for building as per site plan.
- .2 Lay out Work with reference to building and as shown on Drawings.
- .3 Verify grades, lines, levels and dimensions indicated and report any errors or inconsistencies to Project Manager before commencing work. Confirm job dimensions at once to allow prompt checking of shop and other drawings.
- .4 Locate and fix locations of walls, partitions, shafts and all parts of the construction, as work proceeds.

### **1.2 BUILDING DIMENSIONS**

- .1 Prior to undertaking construction, the Contractor shall be responsible for determining from measurements taken at the Place of the Work the exactness of unconfirmed dimensions.  
  
If required, the Contractor shall obtain and pay for the services of a licensed Ontario Land Surveyor to ascertain and determine unconfirmed dimensions. Once established, the Contractor shall provide the Consultant with the results.  
  
Also, in consultation with the Consultant, the Contractor shall determine if adjacent dimensions are affected. If they are, the Consultant shall adjust same to comply with dimensions obtained at the Place of the Work. Such determinations shall not affect the Contract Price.
- .2 Ensure necessary job dimensions are taken and trades are coordinated for accuracy and completeness of such dimensions and for coordination.
- .3 Verify that Work as it proceeds, is executed in accordance with dimensions and positions indicated which maintain levels and clearances to adjacent Work, as set out by requirements of the Drawings, and ensure that Work installed in error is rectified before construction continues.
- .4 Check and verify dimensions referring to Work and interfacing of services. Dimensions, when pertaining to the Work of other Trades, shall be verified with the Trade concerned. Ensure that Subcontractors from various Trades cooperate for the proper performance of the Work.
- .5 Do not scale directly from drawings. If there is ambiguity or lack of information, immediately inform Consultant. Any change through disregarding of this clause to be the responsibility of Subcontractor concerned.
- .6 All dimensional changes resulting from the above shall be noted on the Contractor's as-built drawings.
- .7 All details and measurements of any Work which is to fit or to conform to Work installed shall be taken at the Site.
- .8 Where verified and determined dimensions from the Place of the Work are required in the preparation of Shop Drawings, the Contractor shall determine the exactness of the dimensions prior to the preparation of these drawings.
- .9 Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.

### **1.3 LAYOUT AND SURVEY**

- .1 Survey Requirements: Where the work consists of an addition or extension of an existing building, or a new building, provide a survey, undertaken by an Ontario Land Surveyor, referencing the foundation and exterior walls to adjacent site features, including: existing buildings, roads, walks, trees, hydrants, and light fixtures. Submit three (3) hard copies of plan of survey and one (1) digital copy in AutoCAD format.

### **1.4 UTILIY AND SITE SERVICE LOCATES**

- .1 Employ an Ontario Land Surveyor to:
  - .1 Locate by whatever means necessary, all existing services and utilities that cross or enter the Place of the Work.
  - .2 Lay out all existing services and utilities on site with stakes, flags and paint.
  - .3 Verify elevations of levels all existing services and utilities and relate to bench mark datum.
  - .4 Verify that present, or known future restrictions, are not violated by construction on the site or lines of traverse to all public utilities.
  - .5 Correlate geodetic elevation of bench mark datum with elevations in use by public utilities adjacent to Project.
  - .6 Document, clearly on a copy of the site plan, the locations and elevations of all existing services and utilities and provide a copy of the documentation with other as-built documentation.

### **1.5 DRAINAGE**

- .1 Ensure that positive drainage is provided to roof, floor, and site drains and catch basins, as set in their final positions. Provide constant slopes for drained surfaces to drains and drainage courses.
- .2 Ensure that allowable construction tolerances and structural tolerances do not permit ponding of water.
- .3 Verify the extent of each area served by a drain, or drainage course, to eliminate possible undrained surfaces. Coordinate the work of involved trades before each proceeds.

## **PART 2 - PRODUCTS**

### **2.1 NOT USED**

- .1 Not Used.

## **PART 3 - EXECUTION**

### **3.1 NOT USED**

- .1 Not Used.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 REFERENCES**

- .1 Canadian General Standards Board (CGSB):
  - .1 CGSB 1.59-97, Alkyd Exterior Gloss Enamel.
  - .2 CAN/CGSB 1.189-00, Exterior Alkyd Primer for Wood.
- .2 Canadian Standards Association (CSA International):
  - .1 CSA-O121-M1978 (R2003), Douglas Fir Plywood.

### **1.2 INSTALLATION AND REMOVAL**

- .1 Provide temporary controls in order to execute Work expeditiously.
- .2 Remove from site all such work after use.

### **1.3 HOARDING**

- .1 Erect hoarding and solid overhead protection to the requirements of the authorities having jurisdiction as required to protect public, workers, occupants, public and private property from injury or damage.
- .2 Erect walkways, hoarding, guards, or other protective measures and directional devices required to provide persons with safe access to the building. Temporary accesses shall permit persons to have access to the buildings over excavated areas by means of duckboards or other suitable measures to keep persons free of mud or other tracking and soiling substances. Temporary lighting to a minimum level of 20 foot-candles shall be provided for lighting of the walkways at all times.
- .3 Provide hoarding at all exterior work areas, including but not limited to outdoor storage areas, garbage bins, below all exterior work operations above grade, and at other hazardous exterior work areas, and as may be indicated.

Unless otherwise indicated, or as otherwise agreed with the Owner and as may be required by legislation, acceptable exterior hoarding shall be minimum 6' high, and be galvanized steel fence, or plywood on wood framing. "InstaFence" (905) 842-3545 portable fencing will be accepted as galvanized fencing in place of fixed galvanized fencing. Panels must be provided with T base suitable for pinning and shall be clipped together at top corners.

Contractor remains solely responsible for site security and safety and shall supplement these requirements as necessary. Erect hoarding as required to protect all persons, and all public and private property from injury and damage. Ensure conformance with all requirements of authorities having jurisdiction.

- .4 Provide hoarding at interior work areas as indicated or required. Unless otherwise indicated, or as otherwise agreed with the Owner and as may be required by legislation, acceptable interior hoarding shall be vinyl-clad gypsum board screwed to steel studs or other acceptable framing/supports.
- .5 Where required, provide lockable gates/doors within hoarding for access. Ensure that requirements for exiting /egress from the area are maintained and provide panic hardware as required.

- .6 Provide and maintain required hoardings, barricades, guardrails, and lights in accordance with applicable regulations.
- .7 Erect and maintain pedestrian walkways including roof and side covers, complete with signs and electrical lighting as required by law.
- .8 Provide barriers around trees and plants designated to remain. Protect from damage by equipment and construction procedures.
- .9 Erect signs to prohibit entry of unauthorized personnel into work areas.

#### **1.4 GUARD RAILS, BARRICADES AND WARNING NOTICES**

- .1 Provide and maintain all required signage, construction barriers, dust screens etc. to adequately restrict and protect the public from the work site and the work being undertaken.
- .2 Provide secure, rigid guard rails and barricades around deep excavations, open shafts, open stair wells, open edges of floors and roofs, and as otherwise required by governing authorities.
- .3 Wherever the Contractor's work may expose persons to danger, provide all necessary protection to prevent injury and post notices advising of the hazard.

#### **1.5 WEATHER AND SECURITY ENCLOSURES**

- .1 Provide weather-tight closures to unfinished door and window openings, tops of shafts and other openings in floors and roofs.
- .2 Close off floor areas where walls are not finished; seal off other openings; enclose building interior work for temporary heat.
- .3 Design enclosures to withstand wind pressure and snow loading.
- .4 Where the existing building envelope is opened, breached, or otherwise compromised by work of this Contract, possibly permitting entry of wind or precipitation into the building, or possibly adversely affecting usual interior temperatures and humidity, provide temporary weathertight and dust-tight enclosures and protection for exterior openings made until permanently enclosed.
- .5 Where the existing building envelope is opened, breached, or otherwise compromised by work of this Contract, reducing or adversely affecting the Owner's normal level of security, install temporary closures to prevent unauthorized entry and maintain Owner's usual level of security until the exterior openings permanently enclosed.
- .6 Where existing interior partitions that afford security to the Owner's personnel and chattels are opened, breached, or otherwise compromised by work of this Contract, reducing or adversely affecting the Owner's normal level of security, install temporary closures to prevent unauthorized entry and maintain Owner's usual level of security until the openings permanently enclosed.

## **1.6 DUST TIGHT SCREENS**

- .1 Provide dust tight screen partitions or insulated partitions where required to localize dust generating activities, and for protection of workers, finished areas of Work and public.
  - .1 Provide dust tight wood door frame and wood door complete with hinges, door closer, lockset and weatherstripping at all required access points.
  - .2 Provide positive dust tight seal at all:
    - .1 Plywood joints using continuous 38 mm / 1½" wide foam tape.
    - .2 Access doors using weather stripping at jamb, head and sill.
    - .3 Around entire perimeter using continuous foam rods between dust tight screen partition and floor, walls, and ceilings.
  - .3 Apply plywood panels vertically flush and butt jointed.
- .2 Maintain and relocate dust tight screen protection until such work is complete.
- .3 Maintain and relocate protection until such work is complete.
- .4 Install temporary filters to existing mechanical grilles, louvers, exhausts, etc., unless the Owner has consented to disconnect the equipment involved in which case seal off with temporary plastic sheet dust barriers.
- .5 Use fans to maintain appropriate positive/negative pressure to limit migration of dust outside barriers.

## **1.7 FIRE SEPARATIONS**

- .1 Where required, erect fire separations for any temporary alternative exits from the building including any exit doors and exit corridors and including signage and lighting.
- .2 Maintain all components for the temporary alternative exit during construction.

## **1.8 ODOUR CONTROL**

- .1 Where work, such as painting, asphaltting or roofing, will generate odours, take all necessary measures to limit migration of odours outside immediate work area and limit effect on Owner's operations.
- .2 Acceptable measures include working outside normal working hours to permit smells to dissipate by the time Owner's personnel return to work, extending ductwork. Only as a last resort, and the absence of any other acceptable measure, arrange shutdown of Owner's air handling equipment, and/or Owner's operations.

## **1.9 NOISE CONTROL**

- .1 Take all efforts to limit adverse impact of noise generating operations on Owner's ongoing use of adjacent areas.
- .2 Be advised that low frequency vibrations, in particular, such as those from coring and drilling, transmit throughout structures.

- .3 Execute work that creates noise unacceptable to the Owner outside Owner's normal working hours, and such work shall be included in Contract Price.

#### **1.10 ACCESS TO SITE**

- .1 Use existing driveways, roads, parking areas, and sidewalk crossings as may be required for access to the work.
- .2 Maintain reasonable access at all times to all buildings, roads, walkways, service roads and adjacent parking areas.
- .3 Arrange with the Owner for use of building loading docks, where applicable.
- .4 Protect existing driveways, roads, parking areas and sidewalk crossings from damage, and make good damage arising.
- .5 Keep public roads clean of soiling. Clean as required.
- .6 Provide and maintain access roads, sidewalk crossings, ramps and construction runways as may be required for access to Work.

#### **1.11 PUBLIC TRAFFIC FLOW**

- .1 Provide and maintain competent signal flag operators, traffic signals, barricades and flares, lights, or lanterns as required to perform Work and protect public.
- .2 Parking in posted fire routes will not be permitted. Vehicles found parked in a posted fire route will be towed without warning at vehicle owners' expense.
- .3 Conform to approved plans related to any construction in or along posted fire routes.
- .4 Where deliveries or pickups of large equipment are expected or the placement of large construction is required in or along a posted fire route, planning prior to any placement is required and is to include dates, duration of time, provision for alternative fire route access and acknowledgement that the delivery person or driver will be present at all times. Approval via the Owner's construction personnel is required.

#### **1.12 FIRE ROUTES**

- .1 Maintain access to property including overhead clearances for use by emergency response vehicles.

#### **1.13 PROTECTION FOR OFF-SITE AND PUBLIC PROPERTY**

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

#### **1.14 PROTECTION OF BUILDING FINISHES AND EQUIPMENT**

- .1 Provide protection for finished and partially finished building finishes and equipment during performance of Work.
- .2 Provide necessary screens, covers, and hoardings.
- .3 Be responsible for damage incurred due to lack of or improper protection.
- .4 Furnishings and Equipment Relocation and Protection:
  - .1 Unless otherwise indicated, the Owner will not remove portable furnishings and equipment from the work area to suit work of this Contract. Protect and keep safe all chattels remaining in place.
  - .2 Subject to the Owner's approval, furnishings and equipment may be relocated by the Contractor to other areas of the facility in which work occurs. Contractor to protect and relocate these furnishings and equipment to suit work. Return furnishings and equipment to original location when location ready to receive furnishings.
  - .3 Protect all finishes, furnishings, fittings, equipment, occupants' effects, etc. from damage and soiling. Protect building, equipment, furnishings and remaining in or adjacent to any area in which work is occurring as required, and as specified elsewhere. Make good all damage to the satisfaction of the Owner. Erect dust protection as needed to maintain existing building clean of all disruption and debris from work of this Contract.
- .5 Provide 6 mil polyethylene coverings to prevent soiling of complex surfaces and compartments. Tape polyethylene in place. Provide additional protection to prevent other damage where required. This includes but is not limited to using plywood or OSB sheets to prevent impact damage. Fastening shall not damage elements being protected.
- .6 At wall murals, plaques, display cabinets, and other elements of significance in rooms in which work will occur, provide temporary protection consisting of 6 mil polyethylene dust protection and minimum 1/2" OSB impact protection, secured to wood framing and blocking. Fastening shall not damage elements being protected. Protection shall remain in place until all adjacent work is complete.
- .7 Provide all necessary protection to furnishings and chattels that remain in place during the Work. Use 6 mil polyethylene coverings, movers' quilts, OSB, etc., as required. Prevent all damage.

#### **1.15 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 – Construction/Demolition Waste Management and Disposal.

#### **1.16 GARBAGE CHUTES**

- .1 Debris shall not be allowed to free-fall from openings in the building's exterior walls. Provide garbage chutes in compliance with applicable legislation where debris from upper floors is dropped from the building. Existing windows may be removed and re-installed to suit this requirement, subject to maintaining weather and security protection.

## **1.17 LOCKOUT PROCEDURES**

- .1 All work to be done on systems or machinery, where the unexpected switching on or off of the system or machinery could result in personal injury, shall be done in accordance with the Contractor's standard lockout procedure. The Contractor shall provide his/her own locks for the above procedure. At a minimum, lock out procedures shall consist of switches padlocked in off position, and tagged to advise of inadvertent operation.
- .2 Where there is risk of injury to both the Owner's and the Contractor's personnel due to equipment re-activation, double lockout procedures shall be employed, with each of the Contractor and the Owner providing separately keyed locks and tags to the switches. Do not remove locks and tags until each party's responsible has:
  - .1 Independently ascertained that no injury will be caused to personnel by re-activating the equipment.
  - .2 Verified to the other party that no injury will be caused to personnel by re-activating the equipment.

## **PART 2 - PRODUCTS**

### **2.1 NOT USED**

- .1 Not Used.

## **PART 3 - EXECUTION**

### **3.1 NOT USED**

- .1 Not Used.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 SECTION INCLUDES**

- .1 Product quality, availability, storage, handling, protection, and transportation.
- .2 Manufacturer's instructions.
- .3 Quality of Work, coordination, and fastenings.

### **1.2 REFERENCES**

- .1 Canadian Construction Documents Committee (CCDC):
  - .1 CCDC 2-2008, Stipulated Price Contract.
- .2 Within text of each specifications section, reference may be made to reference standards.
- .3 Conform to these reference standards, in whole or in part as specifically requested in specifications.
- .4 If there is question as to whether products or systems are in conformance with applicable standards, Consultant reserves right to have such products or systems tested to prove or disprove conformance.
- .5 Cost for such testing will be borne by Owner in event of conformance with Contract Documents or by Contractor in event of non-conformance.
- .6 Conform to latest date of issue of referenced standards in effect on date of submission of bids, except where a specific date or issue is specifically noted.

### **1.3 QUALITY**

- .1 Refer to CCDC 2.
- .2 Products, materials, equipment and articles incorporated in Work shall be new, not damaged or defective, and of best quality for purpose intended. If requested, furnish evidence as to type, source and quality of products provided.
- .3 Procurement policy is to acquire, in cost effective manner, items containing highest percentage of recycled and recovered materials practicable consistent with maintaining satisfactory levels of competition. Make reasonable efforts to use recycled and recovered materials and in otherwise utilizing recycled and recovered materials in execution of work.
- .4 Defective products, whenever identified prior to completion of Work, will be rejected, regardless of previous reviews. Consultant review does not relieve responsibility, but is precaution against oversight or error. Remove and replace defective products at own expense and be responsible for delays and expenses caused by rejection.
- .5 Should disputes arise as to quality or fitness of products, decision rests strictly with Consultant based upon requirements of Contract Documents.
- .6 Unless otherwise indicated in specifications, maintain uniformity of manufacture for any particular or like item throughout building.
- .7 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.

- .8 Products, which are specified by their proprietary names, or by parts or catalogue number, shall form the basis for the specifications and the Contract. No substitutes for these products may be used without the Consultant's approval in writing. Substitutes will be considered only when submitted in sufficient time to permit proper investigation by the Consultant.
- .9 In applying for permission to use substitutes, the Contractor shall prove to the Consultant's satisfaction that the substitute meets or exceeds the characteristics of the specified product. Each application shall be accompanied by a list of properties of the specified product and the proposed substitute. When requesting approval for the use of substitutes, the Contractor shall include in his submission any effect that the substitution may have on the Contract Price and Contract Time. No application to use substitutes will be considered unless made in this way.
- .10 Whenever more than one product is specified for use, the Contractor may use any of the products so specified unless the drawings or specifications indicate otherwise.
- .11 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

#### **1.4 AVAILABILITY**

- .1 In submitting Bid, Contractor warrants that all materials are available in suitable time to meet Contract dates.
- .2 Immediately upon signing Contract, review product delivery requirements and anticipate foreseeable supply delays for items. If delays in supply of products are foreseeable, notify Consultant of such, in order that substitutions or other remedial action may be authorized in ample time to prevent delay in performance of Work.
- .3 In event of failure to notify Consultant at commencement of Work and should it subsequently appear that Work may be delayed for such reason, Consultant reserves right to substitute more readily available products of similar character, at no increase in Contract Price or Contract Time.
- .4 Where the Contractor can show that the Contractor promptly ordered the originally specified materials the Owner will pay the differential in cost between the originally specified material and the substitute material without any mark-ups applicable by the Contractor, subcontractors, subcontractors or suppliers. For greater certainty, the Contractor's failure to submit shop drawings or other submittals or seek direction in those instances where the Contract Documents so require in sufficient time to permit ordering materials is not cause for the Owner to pay the cost differential in 1.4.2 above.

#### **1.5 STORAGE, HANDLING AND PROTECTION**

- .1 Handle and store products in manner to prevent damage, adulteration, deterioration and soiling and in accordance with manufacturer's instructions when applicable.
- .2 Store packaged or bundled products in original and undamaged condition with manufacturer's seal and labels intact. Do not remove from packaging or bundling until required in 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, lumber and other similar materials on flat, solid supports and keep clear of ground. Slope to shed moisture.
- .7 Store and mix paints in 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 satisfaction of Consultant.
- .9 Touch-up damaged factory finished surfaces to Consultant's satisfaction. Use touch-up materials to match original. Do not paint over name plates.

#### **1.6 TRANSPORTATION**

- .1 Pay costs of transportation of products required in performance of Work.
- .2 Transportation cost of products supplied by Owner will be paid for by Owner. Unload, handle and store such products.

#### **1.7 MANUFACTURER'S INSTRUCTIONS**

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

#### **1.8 QUALITY OF WORK**

- .1 Ensure Quality of Work is of highest standard, executed by workers experienced and skilled in respective duties for which they are employed. Immediately notify Consultant if required Work is such as to make it impractical to produce required results.
- .2 Do not employ anyone unskilled in their required duties. Consultant reserves right to require dismissal from site, workers deemed incompetent or careless.
- .3 Decisions as to standard or fitness of Quality of Work in cases of dispute rest solely with Consultant, whose decision is final.

#### **1.9 COORDINATION**

- .1 Ensure cooperation of workers in laying out Work. Maintain efficient and continuous supervision.
- .2 Be responsible for coordination and placement of openings, sleeves and accessories.

#### **1.10 CONCEALMENT**

- .1 In finished areas conceal pipes, ducts and wiring in floors, walls and ceilings, except where indicated otherwise.
- .2 Before installation inform Consultant if there is interference. Install as directed by Consultant.

#### **1.11 REMEDIAL WORK**

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

#### **1.12 LOCATION OF FIXTURES**

- .1 Consider location of fixtures, outlets, and mechanical and electrical items indicated as approximate.
- .2 Inform Consultant of conflicting installation. Install as directed.
- .3 Where job conditions require reasonable changes in indicated locations and arrangements, make changes at no change to the Contract Price. Similarly, where existing conditions interfere with new installation and require relocation, include such relocation in the work of this Contract.
- .4 Install and arrange fixtures and equipment to maintain maximum headroom and space.

#### **1.13 FASTENINGS**

- .1 Provide permanent fastenings, anchors, adhesives and accessories required for performance of the work in same texture, colour and finish as adjacent materials, unless indicated otherwise.
- .2 Provide metal fastenings and accessories in same texture, colour and finish as adjacent materials, unless indicated otherwise.
- .3 Prevent electrolytic action between dissimilar metals and materials.
- .4 Use non-corrosive hot dip galvanized steel fasteners and anchors for securing exterior work, unless stainless steel or other material is specifically requested in affected specification Section.
- .5 Space anchors within individual load limit or shear capacity and ensure they provide positive permanent anchorage. Wood, or any other organic material plugs are not acceptable.
- .6 Keep exposed fastenings to a minimum, space evenly and install neatly.
- .7 Fastenings which cause spalling or cracking of material to which anchorage is made are not acceptable.
- .8 Fastenings, anchors, accessories and adhesive shall be of appropriate type and of sufficient quantity and in such a manner as to provide positive permanent anchorage of the unit to be anchored in position. Install anchors at spacing within limits of load bearing and shear capacity to accommodate applied loads so that the secured unit cannot work loose, fall, or shift out of position. Ensure fastenings, anchors, accessories and adhesives provide positive permanent anchorage.

#### **1.14 FASTENINGS - EQUIPMENT**

- .1 Use fastenings of standard commercial sizes and patterns with material and finish suitable for service.
- .2 Use heavy hexagon heads, semi-finished unless otherwise specified. Use No. 304 stainless steel for exterior areas.
- .3 Bolts may not project more than one diameter beyond nuts.
- .4 Use plain type washers on equipment, sheet metal and soft gasket lock type washers where vibrations occur. Use resilient washers with stainless steel.

#### **1.15 PROTECTION OF WORK IN PROGRESS**

- .1 Prevent overloading of parts of building. Do not cut, drill or sleeve load bearing structural member, unless specifically indicated without written approval of Consultant.

### **PART 2 - PRODUCTS**

#### **2.1 NOT USED**

- .1 Not Used.

### **PART 3 - EXECUTION**

#### **3.1 NOT USED**

- .1 Not Used.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 REFERENCES**

- .1 Canadian Construction Documents Committee (CCDC):
  - .1 CCDC 2-2008, Stipulated Price Contract.

### **1.2 EXISTING SERVICES**

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

### **1.3 LOCATION OF EQUIPMENT AND FIXTURES**

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

### **1.4 SUBSURFACE CONDITIONS**

- .1 Promptly notify Consultant in writing if subsurface conditions at Place of Work differ materially from those indicated in Contract Documents, or a reasonable assumption of probable conditions based thereon.
- .2 After prompt investigation, should Consultant determine that conditions do differ materially, instructions will be issued for changes in Work as provided in Changes and Change Orders.

## **PART 2 - PRODUCTS**

### **2.1 NOT USED**

- .1 Not Used.

## **PART 3 - EXECUTION**

### **3.1 NOT USED**

- .1 Not Used.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submittals: in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Submit written request in advance of cutting or alteration which affects:
  - .1 Structural integrity of elements of project.
  - .2 Integrity of weather-exposed or moisture-resistant elements.
  - .3 Efficiency, maintenance, or safety of operational elements.
  - .4 Visual qualities of sight-exposed elements.
  - .5 Work of Owner or separate contractor.
- .3 Include in request:
  - .1 Identification of project.
  - .2 Location and description of affected Work.
  - .3 Statement on necessity for cutting or alteration.
  - .4 Description of proposed Work and products to be used.
  - .5 Alternatives to cutting and patching.
  - .6 Effect on Work of Owner or separate contractor.
  - .7 Written permission of affected separate contractor.
  - .8 Date and time work will be executed.

### **1.2 MATERIALS**

- .1 Required for original installation.
- .2 Change in Materials: submit request for substitution in accordance with Section 01 33 00 – Submittal Procedures.

### **1.3 PREPARATION**

- .1 Inspect existing conditions, including elements subject to damage or movement during cutting and patching.
- .2 After uncovering, inspect conditions affecting performance of Work.
- .3 Beginning of cutting or patching means acceptance of existing conditions.
- .4 Provide supports to assure structural integrity of surroundings; provide devices and methods to protect other portions of project from damage.
- .5 Provide protection from elements for areas which are to be exposed by uncovering work; maintain excavations free of water.

### **1.4 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.

- .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 includes 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 occupants to evacuate building to extent required for protection required from radiation.
  - .2 Post on all exterior doors of any building in which radiography will occur a completed "Construction X-Ray Advisory" form. Where the radiography occurs on an outdoor site, or affects outdoor areas, or is otherwise not in an occupied building, place a completed "Construction X-Ray Advisory" form on all faces of the hoarding, in the most visible locations, and on the exterior doors of any affected buildings. Where the area that is off-limits to persons extends outside hoarding, place signs on approaches at least 10'3m outside the point where warning barricades will be erected.
  - .3 Sign postings shall occur on or before the day on which the work will occur. Immediately prior to x-ray image exposure verify signs are in place, replace any missing signs. Remove upon completion of x-ray work.
  - .4 At least 5 days prior to x-rays being completed, provide to the Owner the name(s) of the supervising radiographer and the personnel who will be posted as watchpersons at the barricades. Provide details of where each watchperson will be located and confirm full coverage to prevent inadvertent exposure of occupants to radiation.
  - .5 The radiographer supervising the x-ray work shall have a cell phone on his/her person during the work and it shall remain 'on' at all times during x-ray work. Provide the supervising radiographer's cell phone number to the Owner.
  - .6 Provide barriers and watch persons at each barrier during x-ray image exposures. Minimum acceptable barrier is pre-printed plastic tape. Continuous sawhorse barricades, hoarding, fencing (where equipped with signage required by regulations) also acceptable.
  - .7 Post all required safety and warning notices in advance of scanning and remove same immediately upon completion of scanning.
  - .8 On request provide copies of all exposure records or exposure logs to Owner. Provide material within 72 hours of request.
- .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 Make good all damage arising from cutting reinforcing steel in concrete slabs and beams.

## **1.5 EXECUTION**

- .1 Execute cutting, fitting, and patching to complete Work.
- .2 Fit several parts together, to integrate with other Work.
- .3 Uncover Work to install ill-timed Work.
- .4 Remove and replace defective and non-conforming Work.
- .5 Provide openings in non-structural elements of Work for penetrations of mechanical and electrical Work.
- .6 Execute Work by methods to avoid damage to other Work, and which will provide proper surfaces to receive patching and finishing.
- .7 Employ original installer to perform cutting and patching for weather-exposed and moisture-resistant elements, and sight-exposed surfaces.
- .8 Cut rigid materials using masonry saw or core drill. Pneumatic or impact tools not allowed on masonry work without prior approval.
- .9 Restore work with new products in accordance with requirements of Contract Documents.
- .10 Fit Work to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
- .11 At penetration of fire rated wall, ceiling, or floor construction, completely seal voids with fire stopping material in accordance with Section 07 84 00 – Fire stopping, full thickness of the construction element.
- .12 Refinish surfaces to match adjacent finishes: refinish continuous surfaces to nearest intersection. Refinish assemblies by refinishing entire unit.
- .13 Conceal pipes, ducts and wiring in floor, wall and ceiling construction of finished areas except where indicated otherwise.

## **1.6 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 – Construction/Demolition Waste Management and Disposal.

## **PART 2 - PRODUCTS**

### **2.1 NOT USED**

- .1 Not Used.

## **PART 3 - EXECUTION**

### **3.1 NOT USED**

- .1 Not Used.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 SECTION INCLUDES**

- .1 Progressive cleaning.
- .2 Final cleaning.

### **1.2 REFERENCES**

- .1 Canadian Construction Documents Committee (CCDC):
  - .1 CCDC 2-2008, Stipulated Price Contract.

### **1.3 PROJECT CLEANLINESS**

- .1 Maintain Work in tidy condition, free from accumulation of waste products and debris.
- .2 Remove waste materials from site at daily regularly scheduled times or dispose of as directed by Consultant. Do not burn waste materials on site.
- .3 Clear snow and ice from access to building. Remove from site.
- .4 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.
- .5 Provide on-site waste containers for collection of waste materials and debris.
- .6 Provide and use marked separate bins for recycling. Refer to Section 01 74 2 – Construction/ Demolition Waste Management and Disposal.
- .7 Dispose of waste materials and debris-off-site, in accordance with authorities having jurisdiction.
- .8 Clean interior areas prior to start of finishing work, and maintain areas free of dust and other contaminants during finishing operations.
- .9 Store volatile waste in covered metal containers, and remove from premises at end of each working day.
- .10 Provide adequate ventilation during use of volatile or noxious substances. Use of building ventilation systems is not permitted for this purpose.
- .11 Use only cleaning materials recommended by manufacturer of surface to be cleaned, and as recommended by cleaning material manufacturer.
- .12 Schedule cleaning operations so that resulting dust, debris and other contaminants will not fall on wet, newly painted surfaces nor contaminate building systems.

- .13 Where walks and roads are soiled by work of this Contract:
  - .1 At a minimum, weekly sweep and wash Owner's roads and walks soiled by work of this Contract. Sweep and wash roads and walks more frequently where soiling may be tracked into adjacent buildings. Sweep and wash public roads and walks weekly, at a minimum, and more frequently as required by local municipality.
- .14 Clean work area(s) upon completion of each day's work, and maintain areas free of dust and other contaminants during finishing operations. On a daily basis maintain project site and public properties free from debris and waste material.
- .15 Provide for garbage chutes, on-site debris collection and disposal equipment, and services needed to dispose of all debris. Do not use Owner's waste containers for disposal of debris arising from work of this Contract. Provide and pay for dedicated waste disposal for work of this Contract.

#### **1.4 FINAL CLEANING**

- .1 Refer to CCDC 2, GC 3.13.
- .2 When Work is Substantially Performed remove surplus products, tools, construction machinery and equipment not required for performance of remaining Work.
- .3 Remove waste products and debris other than that caused by others, and leave Work clean and suitable for occupancy.
- .4 Prior to final review remove surplus products, tools, construction machinery and equipment.
- .5 Remove waste products and debris.
- .6 Remove waste materials from site at regularly scheduled times. Do not burn waste materials on site.
- .7 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.
- .8 Clean and polish glass, mirrors, hardware, wall tile, stainless steel, chrome, porcelain enamel, baked enamel, plastic laminate, and mechanical and electrical fixtures. Replace broken, scratched or disfigured glass.
- .9 Remove stains, spots, marks and dirt from decorative work, electrical and mechanical fixtures, furniture fitments, walls, and floors.
- .10 Clean lighting reflectors, lenses, and other lighting surfaces.
- .11 Vacuum clean and dust building interiors, behind grilles, louvres and screens.
- .12 Unless noted otherwise wax, seal, shampoo or prepare floor finishes, as recommended by manufacturer.
- .13 Inspect finishes, fitments and equipment and ensure specified workmanship and operation.
- .14 Broom clean and wash exterior walks, steps and surfaces, paved areas and rake clean other surfaces of grounds affected by the Work.

- .15 Remove dirt and other disfiguration from exterior surfaces affected by the Work.
- .16 Clean and sweep roofs, gutters, areaways, and sunken wells.
- .17 Sweep and wash clean paved areas.
- .18 Clean equipment and fixtures to sanitary condition; clean or replace filters of mechanical equipment.
- .19 Clean roofs, downspouts, and drainage systems.
- .20 Remove debris and surplus materials from crawl areas and other accessible concealed spaces.
- .21 Remove snow and ice from access to building.

#### **1.5 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 – Construction/Demolition Waste Management and Disposal.

### **PART 2 - PRODUCTS**

#### **2.1 NOT USED**

- .1 Not Used.

### **PART 3 - EXECUTION**

#### **3.1 NOT USED**

- .1 Not Used.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 REFERENCES**

- .1 Definitions:
  - .1 Approved/Authorized Recycling Facility: waste recycler approved by applicable provincial authority
  - .2 Class III: non-hazardous waste - construction renovation and demolition waste.
  - .3 Construction, Renovation and/or Demolition (CRD) Waste: Class III solid, non-hazardous waste materials generated during construction, demolition, and/or renovation activities
  - .4 Recyclable: ability of product or material to be recovered at end of its life cycle and re-manufactured into new product for reuse.
  - .5 Recycle: process by which waste and recyclable materials are transformed or collected for purpose of being transferred into new products.
  - .6 Recycling: process of sorting, cleansing, treating and reconstituting solid waste and other discarded materials for purpose of using in altered form. Recycling does not include burning, incinerating, or thermally destroying waste.
  - .7 Reuse: repeated use of product in same form but not necessarily for same purpose. Reuse includes:
    - .1 Salvaging reusable materials from re-modelling projects, before demolition stage, for resale, reuse on current project or for storage for use on future projects.
    - .2 Returning reusable items including pallets or unused products to vendors.
  - .8 Salvage: removal of structural and non-structural materials from deconstruction/disassembly projects for purpose of reuse or recycling.
  - .9 Source Separation: act of keeping different types of waste materials separate beginning from the point they became waste.
- .2 Reference Standards:
  - .1 Ontario Ministry of Environment:
    - .1 Ontario 3 R's Regulations (regulation 102/94) for waste management programs applicable to construction and demolition projects greater than 2,000 m<sup>2</sup>.
    - .2 Ontario Environmental Protection Act (EPA)
      - .1 Regulation 102/94, Waste Audits and Waste Reduction Workplans.
      - .2 Regulation 103/94, Source Separation Programs.
  - .2 Canadian Construction Association (CCA):
    - .1 CCA 81-2001: A Best Practices Guide to Solid Waste Reduction.

### **1.2 USE OF SITE AND FACILITIES**

- .1 Execute Work with minimal interference and disturbance to normal use of premises.
- .2 Maintain security measures established by facility.

### **1.3 WASTE PROCESSING SITES**

- .1 Contractor is responsible to research and locate waste diversion resources and service providers. Salvaged materials are to be transported off site to approved and/or authorized recycling facilities or to users of material for recycling.

### **1.4 STORAGE, HANDLING AND PROTECTION**

- .1 Unless specified otherwise, materials for removal become Contractor's property.
- .2 Protect, stockpile, and store salvaged items.
- .3 Separate non-salvageable materials from salvaged items. Transport and deliver non-salvageable items to licensed disposal facility.
- .4 Protect structural components not removed for demolition from movement or damage.
- .5 Support affected structures. If safety of building is endangered, cease operations and immediately notify Consultant.
- .6 Protect surface drainage, mechanical and electrical from damage and blockage.
- .7 Provide on-site facilities and containers for collection and storage of reusable and recyclable materials.
- .8 Separate and store materials produced during dismantling of structures in designated areas.
- .9 Prevent contamination of materials to be salvaged and recycled and handle materials in accordance with requirements for acceptance by designated facilities.
  - .1 On-site source separation is recommended.
  - .2 Remove co-mingled materials to off-site processing facility for separation.
  - .3 Materials reused on-site are considered to be diverted from landfill and as such are to be included in all reporting.

### **1.5 DISPOSAL OF WASTES**

- .1 Do not bury rubbish or waste materials.
- .2 Do not dispose of waste, volatile materials, mineral spirits, oil, or paint thinner into waterways, storm, or sanitary sewers.
- .3 Remove materials on-site as Work progresses.

### **1.6 SCHEDULING**

- .1 Coordinate Work with other activities at site to ensure timely and orderly progress of Work.

## **PART 2 - PRODUCTS**

### **2.1 NOT USED**

- .1 Not Used.

## **PART 3 - EXECUTION**

### **3.1 APPLICATION**

- .1 Handle waste materials not reused, salvaged or recycled in accordance with appropriate regulations and codes.

### **3.2 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 – Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 – Cleaning.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.
  - .2 Source separate materials to be reused/recycled into specific sort areas.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 SECTION INCLUDES**

- .1 Administrative procedures preceding preliminary and final inspections of Work.

### **1.2 REFERENCES**

- .1 Canadian Construction Documents Committee (CCDC):
  - .1 CCDC 2-2008, Stipulated Price Contract.

### **1.3 ADMINISTRATIVE REQUIREMENTS**

- .1 Procedures for Acceptance of Work:
  - .1 Contractor's Inspection: Prior to making application for substantial performance of the Work:
    - .1 Conduct inspection of Work, identify in writing a comprehensive list of deficiencies and defects, and repair as required to conform to Contract Documents.
    - .2 Notify Consultant in writing of satisfactory completion of Contractor's inspection and submit verification that corrections have been made.
  - .2 Request in writing for Consultant to review Work and identify defects and deficiencies.
  - .3 Completion Tasks: submit written certificates that tasks have been performed as follows:
    - .1 Work: completed and inspected for compliance with Contract Documents.
    - .2 Defects: corrected and deficiencies completed.
    - .3 Equipment and Systems: tested, adjusted, and balanced and fully operational.
    - .4 Elevator has been tested and certified by authorities having jurisdiction and is fully operational.
    - .5 Fire alarm verification certificate issued to Consultant.
    - .6 Final Electrical Safety Authority (ESA) Inspection Certificate issued to Consultant.
    - .7 Certificates required by Utility companies: submitted.
    - .8 Operations and maintenance manuals have been submitted and reviewed by Consultant.
    - .9 Operation of Systems: demonstrated to Owner's personnel.
    - .10 Commissioning of mechanical systems: completed in accordance with 01 91 01 – Commissioning and except for warranty and seasonal verification activities specified within, submit four (4) copies of final Commissioning Report submitted to Consultant.
    - .11 Work: complete and ready for final review.
  - .4 Consultants Review (Stage 1):
    - .1 When completion tasks are done, make application for Certificate of Substantial Performance. Refer to CCDC 2, General Conditions Article GC Part 5, and Payment. Request in writing for a review of Work to be performed, Consultant, and Contractor for the purpose of obtaining Substantial Performance.
    - .2 The Consultant will prepare a written list of deficiencies which will be issued to the Contractor. The Contractor shall then proceed to correct the deficiencies and complete the Work.

- .3 Should the Work be deemed complete by the Consultant for the purpose of declaring the project Substantially Performed, the Consultant will issue a Certificate of Substantial Performance to the Contactor and Owner in accordance with the requirements of the lien statute of Place of Work. The Contractor shall then proceed to Stage 2 for Finishing Work.
- .4 Should Work be deemed incomplete according to Owner and Consultant, complete outstanding items and repeat the steps noted above for additional Stage 1 reviews. Refer also to Item 1.4 Number of Reviews.
- .5 Commencement of Lien and Warranty Periods: date of Owner's acceptance of submitted declaration of Substantial Performance to be date for commencement for warranty period and commencement of lien period unless required otherwise by lien statute of Place of Work.
- .6 Final Payment (Stage 2):
  - .1 Upon completion of the outstanding items noted in Stage 1, request in writing for a final review of Finishing Work to be performed by Owner, Consultant, and Contractor for the purpose of obtaining Total Performance.
  - .2 When the Consultant considers final deficiencies and defects corrected and requirements of Contract met, make application for final payment. Should the Work be deemed complete by the Consultant for the purpose of declaring the project Totally Performed, the Consultant will request from the Contractor complete with the required submittals as prescribed in Section 01 29 00 Payment Procedures, Final Payment.
  - .3 Refer to CCDC 2: when Work is deemed incomplete by Consultant. Complete outstanding items and request re-inspection.
  - .4 Should Work be deemed incomplete according to Owner and Consultant, complete outstanding items and repeat the steps noted above for additional Stage 2 Reviews. Refer also to Item 1.4 Number of Reviews.
- .7 Payment of Holdback: after issuance of Certificate of Substantial Performance of Work, submit application for payment of holdback amount in accordance with contractual agreement.

#### **1.4 NUMBER OF REVIEWS**

- .1 The Consultant and the Owner will perform final reviews as described above, under the headings of Stage 1 and Stage 2.
- .2 Should additional reviews be necessary in the opinion of the Consultant as noted in Stage 1 and / or Stage 2 reviews, such reviews will be performed by the Consultant and Owner and the Contractor shall pay all costs of time, transportation and miscellaneous expenses incurred by any and all members of the Consultant and Owner team.
- .3 The applicable Consultant rates shall be J.L. Richards & Associates Limited current per diem professional rates. The Owner shall be reimbursed at the Owner's established rates.

#### **1.5 SYSTEMS DEMONSTRATION**

- .1 Prior to final review, demonstrate operation of each system to Owner. Ten (10) days prior to demonstration, provide an agenda for demonstration and a written description of operating procedure and maintenance, including schematics and diagrams for operation and maintenance of building services equipment and systems being demonstrated.
- .2 Responsible personnel from Contractor, Subcontractors and equipment suppliers whose work is being demonstrated shall be present as required at these demonstrations.
- .3 Refer also to Section 01 91 01 - Commissioning.

## **1.6 FINANCIAL CLOSEOUT**

- .1 Execute transition of Performance and Labour and Materials Payment Bond, if any, to warranty period requirements.
- .2 Submit a final statement of accounting giving total adjusted Contract Price, previous payments, and monies remaining due.
- .3 Consultant will issue a final change order reflecting approved adjustments to Contract Price not previously made.

## **1.7 FINAL CLEANING**

- .1 Clean in accordance with Section 01 74 11 – Cleaning.
- .2 Remove surplus materials, excess materials, rubbish, tools and equipment.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 – Construction/Demolition Waste Management and Disposal.

## **PART 2 - PRODUCTS**

### **2.1 NOT USED**

- .1 Not Used.

## **PART 3 - EXECUTION**

### **3.1 NOT USED**

- .1 Not Used.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 SECTION INCLUDES:**

- .1 Record documents, samples, specifications.
- .2 Equipment and systems.
- .3 Product data, materials and finishes, and related information.
- .4 Operation and maintenance data.
- .5 Record Drawings.
- .6 Warranties and bonds.

### **1.2 ADMINISTRATIVE REQUIREMENTS**

- .1 Pre-warranty Meeting:
  - .1 Convene meeting one month prior to contract completion with Consultant and Owner, in accordance with Section 01 31 19 – Project Meetings to:
    - .1 Verify Project requirements.
    - .2 Review manufacturer's installation instructions and warranty requirements.
  - .2 Consultant to establish communication procedures for:
    - .1 Notifying construction warranty defects.
    - .2 Determine priorities for type of defects.
    - .3 Determine reasonable response time.
  - .3 Contact information for bonded and licensed company for warranty work action: provide name, telephone number and address of company authorized for construction warranty work action.
  - .4 Ensure contact is located within local service area of warranted construction, is continuously available, and is responsive to inquiries for warranty work action.

### **1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Two weeks prior to Substantial Performance of the Work, submit to the Consultant:
  - .1 Four (4) final copies and an electronic copy of operating and maintenance manuals.
  - .2 Four (4) copies and an electronic copy of Commissioning Report, except warranty and seasonal verification activities manuals.

- .3 Two weeks following Substantial Performance of the Work, provide to the Consultant and / or Owner as directed by Consultant:
  - .1 Spare parts, maintenance materials and special tools of same quality and manufacture as products provided in Work.
    - .1 Provide evidence, if requested, for type, source and quality of products supplied.
    - .2 Defective products will be rejected, regardless of previous inspections. Replace products at no cost to Owner.
  - .2 Record documents.
  - .3 Maintenance materials.
  - .4 Warranties.

#### **1.4 FORMAT**

- .1 Organize data as instructional manual.
- .2 Binders: black vinyl, hard covered, with labelling pocket on spine, 3 'D' ring, loose leaf 8 ½ x 11 inches with spine and face pockets.
- .3 When multiple binders are used correlate data into related consistent groupings.
  - .1 Identify contents of each binder on spine.
- .4 Cover: enclose title sheet labelled "Operating and Maintenance Data Manual", project name, date and list of contents.
- .5 Arrange content by systems, under Section numbers and sequence of Table of Contents.
- .6 Provide tabbed fly leaf for each separate product and system, with typed description of product and major component parts of equipment.
- .7 Text: manufacturer's printed data, or typewritten data.
- .8 Drawings: provide with reinforced punched binder tab.
  - .1 Bind in with text; fold larger drawings to size of text pages.

#### **1.5 CONTENTS - PROJECT RECORD DOCUMENTS**

- .1 Table of Contents for each volume (provide title of project):
  - .1 Date of submission; names.
  - .2 Addresses, and telephone numbers of Consultant and Contractor / Subcontractor with name of responsible parties.
  - .3 Schedule of products and systems, indexed to content of volume.
- .2 For each product or system:
  - .1 List names, addresses and telephone numbers of subcontractors 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 Drawings: supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams.
- .5 Typewritten Text: as required to supplement product data.
  - .1 Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions specified in Section 01 45 00 – Quality Control.
- .6 Operational information on equipment, cleaning and lubrication schedules, filters, overhaul and adjustment schedules and similar maintenance information; copy of building permit;
- .7 Testing and Inspection Reports:
  - .1 Copy of final inspection certificate by Electrical Safety Authority;
  - .2 Copy of fire alarm verification certificate;
  - .3 Copy of sprinkler test verification certificate;
  - .4 Copy of certificates issued by other utilities;
  - .5 Copies of field tests;
  - .6 Copies of all inspection and testing reports;
- .8 Maintenance instructions for finished surface and materials;
- .9 Copy of hardware and paint schedules;
- .10 Training: refer to Section 01 91 01 – Commissioning.

## **1.6 RECORD DOCUMENTS AND SAMPLES**

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

## **1.7 RECORDING INFORMATION ON PROJECT RECORD DOCUMENTS**

- .1 After award of Contract, the Owner will provide an electronic copy of the contract drawings and specifications (or project manual) for purpose of maintaining record drawings and specifications. The Contractor will be responsible for printing three (3) sets of whiteprint (blueprint or blackline) contract drawings and specifications. Accurately and neatly record deviations from Contract Documents caused by site conditions and changes ordered by Consultant and the Owner. Mark all copies as "Project Record Copy"
- .2 Use felt tip marking pens, maintaining separate colours for each major system, for recording information.
- .3 Record information concurrently with construction progress:
  - .1 Do not conceal Work until required information is recorded.
- .4 Contract Drawings and shop drawings: mark each item to record actual construction, including:
  - .1 Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
  - .2 Concealed components of mechanical and electrical services.
  - .3 Measured locations of internal utilities and appurtenances, referenced to visible and accessible features of construction.
  - .4 Field changes of dimension and detail.
  - .5 Supplemental Instructions.
  - .6 Changes made by change orders.
  - .7 Details not on original Contract Drawings.
  - .8 References to related shop drawings and modifications.
- .5 Specifications: mark each item to record actual construction, including:
  - .1 Manufacturer, trade name, and catalogue number of each product actually installed, particularly optional items and substitute items.
  - .2 Supplemental Instructions.
  - .3 Changes made by Addenda and change orders or change directives.
- .6 Other Documents: maintain manufacturer's certifications, inspection certifications, field test records, required by individual specifications sections.
- .7 At completion of project and prior to final review, neatly transfer notations to a second and third set of drawings and specifications. In addition, create an electronic copy of the record drawings and specifications complete with references to the notations and any specific details, in the .pdf format of the original electronic copy. Submit all final copies to Owner via the Consultant.

## **1.8 EQUIPMENT AND SYSTEMS**

- .1 For each item of equipment and each system include description of unit or system, and component parts.
  - .1 Give function, normal operation characteristics and limiting conditions.
  - .2 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.
  - .1 Include regulation, control, stopping, shut-down, and emergency instructions.
  - .2 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 co-ordination drawings, with installed colour coded piping diagrams.
- .12 Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.
- .13 Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.
- .14 Include test and balancing reports as specified in Section 01 91 01 - Commissioning.
- .15 Additional Requirements: as specified in individual specification sections.

## **1.9 MATERIALS AND FINISHES**

- .1 Building Products, Applied Materials and Finishes: include product data, with catalogue number, size, composition, and colour and texture designations.
  - .1 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.

## **1.10 MAINTENANCE MATERIALS**

- .1 Spare Parts:
  - .1 Provide spare parts, in quantities specified in individual specification sections.
  - .2 Provide items of same manufacture and quality as items in Work.

- .3 Deliver to location as directed; place and store.
- .4 Receive and catalogue items:
  - .1 Submit inventory listing to Consultant.
  - .2 Include approved listings in Maintenance Manual.
  - .3 Obtain receipt for delivered products and submit prior to final payment.
- .2 Extra Stock Materials:
  - .1 Provide maintenance and extra materials, in quantities specified in individual specification sections.
  - .2 Provide items of same manufacture and quality as items in Work.
  - .3 Deliver to location as directed; place and store.
  - .4 Receive and catalogue items:
    - .1 Submit inventory listing to Consultant.
    - .2 Include approved listings in Maintenance Manual.
  - .5 Obtain receipt for delivered products and submit prior to final payment.
- .3 Special Tools:
  - .1 Provide special tools, in quantities specified in individual specification section.
  - .2 Provide items with tags identifying their associated function and equipment.
  - .3 Deliver to location as directed; place and store.
  - .4 Receive and catalogue items:
    - .1 Submit inventory listing to Consultant.
    - .2 Include approved listings in Maintenance Manual.

#### **1.11 DELIVERY, STORAGE AND HANDLING**

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

#### **1.12 WARRANTIES AND BONDS**

- .1 Develop warranty management plan to contain information relevant to Warranties.
- .2 Submit warranty management plan, thirty (30) days before planned pre-warranty conference, to Consultant approval.
- .3 Warranty management plan to include required actions and documents to assure that Owner receives warranties to which it is entitled.
- .4 Provide plan in narrative form and contain sufficient detail to make it suitable for use by future maintenance and repair personnel.

- .5 Submit, warranty information made available during construction phase, to Consultant for approval prior to each monthly pay estimate.
- .6 Assemble approved information in binder, submit upon acceptance of work and organize binder as follows:
  - .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 applicable item of work.
  - .4 Verify that documents are in proper form, contain full information, and are notarized.
  - .5 Co-execute submittals when required.
  - .6 Retain warranties and bonds until time specified for submittal.
- .7 Except for items put into use with Owner's permission, leave date of beginning of time of warranty until Date of Substantial Performance is determined.
- .8 Conduct joint four (4) month and nine (9) month warranty inspection, measured from time of acceptance, by Consultant.
- .9 Include information contained in warranty management plan as follows:
  - .1 Roles and responsibilities of personnel associated with warranty process, including points of contact and telephone numbers within the organizations of Contractors, subcontractors, manufacturers or suppliers involved.
  - .2 Listing and status of delivery of Certificates of Warranty for extended warranty items, to include roofs, HVAC balancing, pumps, motors, transformers, and commissioned systems such as fire protection, alarm systems, sprinkler systems, and lightning protection systems,.
  - .3 Provide list for each warranted equipment, item, feature of construction or system indicating:
    - .1 Name of item.
    - .2 Model and serial numbers.
    - .3 Location where installed.
    - .4 Name and phone numbers of manufacturers or suppliers.
    - .5 Names, addresses and telephone numbers of sources of spare parts.
    - .6 Warranties and terms of warranty: include one-year overall warranty of construction. Indicate items that have extended warranties and show separate warranty expiration dates.
    - .7 Cross-reference to warranty certificates as applicable.
    - .8 Starting point and duration of warranty period.
    - .9 Summary of maintenance procedures required to continue warranty in force.
    - .10 Cross-reference to specific pertinent Operation and Maintenance manuals.
    - .11 Organization, names and phone numbers of persons to call for warranty service.
    - .12 Typical response time and repair time expected for various warranted equipment.
  - .4 Contractor's plans for attendance at four (4) and nine (9) month post-construction warranty inspections.
  - .5 Procedure and status of tagging of equipment covered by extended warranties.
  - .6 Post copies of instructions near selected pieces of equipment where operation is critical for warranty and/or safety reasons.

- .10 Respond in timely manner to oral or written notification of required construction warranty repair work.
- .11 Written verification to follow oral instructions.
  - .1 Failure to respond will be cause for the Consultant to proceed with action against Contractor.

### **1.13 WARRANTY TAGS**

- .1 Tag, at time of installation, each warranted item. Provide durable, oil and water resistant tag.
- .2 Attach tags with copper wire and spray with waterproof silicone coating.
- .3 Leave date of acceptance until project is accepted for occupancy.
- .4 Indicate following information on tag:
  - .1 Type of product/material.
  - .2 Model number.
  - .3 Serial number.
  - .4 Contract number.
  - .5 Warranty period.
  - .6 Inspector's signature.
  - .7 Construction Contractor.

## **PART 2- PRODUCTS**

### **2.1 NOT USED**

- .1 Not Used.

## **PART 3 - EXECUTION**

### **3.1 NOT USED**

- .1 Not Used.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 RELATED SECTIONS**

- .1 Section 01 11 00 – Summary of Work
- .2 Section 01 33 00 – Submittal Procedures
- .3 Section 01 43 00 – Quality Plan
- .4 Section 01 45 00 – Quality Control
- .5 Section 01 61 00 – Common Product Requirements
- .6 Section 01 77 00 – Closeout Procedures
- .7 Divisions 20 - 27 – Mechanical, Electrical and Communications

### **1.2 DEFINITIONS**

- .1 Commissioning Authority (CxA) – Owner's appointed representative – retained by the University of Guelph.
- .2 Consultant Team – consists of those professionals who are responsible for the design and performance objectives and are listed in Section 00 00 03 – Project and Consultant Identification.
- .3 Commissioning Team – consists of various participants involved in the commissioning process. The commissioning documentation and tasks of each team member will be coordinated through the CxA.

### **1.3 CONSULTANT TEAM**

- .1 The Consultant Team for the Project is responsible for developing a set of performance objectives and providing a design that meets those objectives. The Consultant Team will be required to assist with developing and witnessing the system tests. Consultants are to advise the Contractor as to which tests require witnessing.

### **1.4 COMMISSIONING TEAM**

- .1 Members of the team shall include the following as a minimum:
  - .1 Owner:
    - .1 Owner's Representative
    - .2 Owner's Facility Management Representative
    - .3 Owner's Commissioning Authority (CxA)
  - .2 Consultant Team:
    - .1 Architect
    - .2 Mechanical Consultant
    - .3 Electrical Consultant

- .3 Contractors
  - .1 General Contractor (GC/CM)
  - .2 Mechanical Sub-contractor
  - .3 Electrical Sub-contractor
  - .4 Testing and Balancing Agent
  - .5 Controls Sub-Contractor
  - .6 Other Sub-Contractors (as applicable)
- .4 Other key players in the commissioning process include:
  - .1 Manufacturer's Representatives (as applicable)
  - .2 Inspectors and Testing Agencies:
    - .1 Building Inspection
    - .2 Power Utility

## 1.5 DESCRIPTION

- .1 Commissioning is a systematic process of ensuring that all building systems installed in accordance with the drawings and specifications, manufacturer's requirements and good industry practice. Commissioning also ensures that equipment operates and performs, in and of itself as well as in the system, as was intended by the designers in response to the owner's requirements. Finally, commissioning ensures the owner has the documentation and training required to operate the equipment and systems in a safe, efficient and long lasting manner.
- .2 During the construction phase, commissioning will include the following specific activities:
  - .1 Review of shop drawings for commissionable mechanical and electrical equipment and systems at the same time as the design engineers. Comments from the CxA will be given to the design engineers to incorporate into their review as appropriate. Contractors will respond to the comments from the engineer of record.
  - .2 Integration of commissioning activities into the project schedule. The CxA will provide a list of milestone activities complete with expected durations and due dates for inclusion in construction schedule. Progress will be monitored against these dates during commissioning inspections.
  - .3 Verify equipment is installed in accordance with the manufacturer's recommendations and industry accepted standards including review of completed manufacturers' start-up sheets, supplemented where required with commissioning pre-functional checklists provided by the CxA. Contractor shall complete check sheets as required by the CxA.
  - .4 Verify equipment is set-up, adjusted and balanced to perform as specified. This will include review of Testing, Adjusting, and Balancing (TAB) procedures, review of TAB reports and spot checking measurements on site. The TAB contractor shall cooperate with the CxA providing information requested and tools and manpower for spot checking measurements as required by the CxA.
  - .5 Functional Performance Testing (FPT) of mechanical and electrical equipment and systems to ensure proper, complete and efficient operation under the range of conditions they are expected to encounter. Contractors shall provide manpower, tools and other services as required by the CxA to perform the FPT.
  - .6 Provide a review of the construction draws from a commissioning perspective and provide recommendations to the Prime Consultant and the University.

- .7 CxA will review O&M documentation provided to the owner to ensure it is complete and acceptable for ongoing operation and maintenance of the equipment. The review shall be sent to the consultant for incorporation with his comments. The Contractors shall provide changes as required by the Engineer.
- .8 The CxA will witness the Owner's operating personnel training to verify it was adequate and complete to ensure they fully understand the requirements of operating and maintaining the equipment. Contractors shall ensure training meets the approval of the CxA and provide additional training if requested.
- .3 Commissioning does not take away from, reduce responsibility of or in any way diminish the requirement for the consultant team and installing contractors to provide a complete, finished and fully functioning product.

## **1.6 OWNER RESPONSIBILITIES**

- .1 Responsibilities of the owner are as follows:
  - .1 Retain the services of the Commissioning Authority.
  - .2 Work with the CxA to define the design intent of the building and system by developing the Owner's project Requirements. Provide a copy of the document to the commissioning team.
  - .3 To provide operating personnel to attend training and instruction regarding specific components, equipment and systems.
  - .4 To observe on-site installation, start-up and testing equipment and systems.
  - .5 To provide assistance to resolve issues identified by the CxA including scheduling concerns.

## **1.7 CONSULTANT TEAM RESPONSIBILITIES**

- .1 Responsibilities of Consultant are as follows:
  - .1 Define the Basis of Design to meet the Owner's Project Requirements.
  - .2 Prepare the design documents outlining the project requirements.
  - .3 Review contractor's shop drawings submission to ensure that the equipment proposed comply with specifications requirements.
  - .4 Review contractor's submittals to ensure compliance with the specifications requirements.
  - .5 Monitor, check, inspect and report on the installation throughout the construction stages to ensure the equipment installation is as approved and the installation method, workmanship, procedures will follow the approved submission and method statement.
  - .6 Inspect the systems installation and issue deficiencies reports. Ensure deficiencies are corrected and certify installation of systems.
  - .7 Review operating and maintenance manuals, balancing and test reports and as-built for accuracy.
  - .8 Witness tests, note any deficiencies and provide progress report.
  - .9 Review contractor's progress draws against actual construction progress on site and incorporate CxA comments as part of the payment certification process.

## 1.8 COMMISSIONING AUTHORITY RESPONSIBILITIES

### .1 Construction Phase:

- .1 Coordinate and direct the commissioning activities in a logical, sequential and efficient manner using consistent protocols and forms, centralized documentation, clear and regular communication and consultations with all necessary parties, update timelines and schedules.
- .2 Develop and maintain the commissioning plan.
- .3 Review contractor's shop drawing submission for commissioning related issues.
- .4 Prepare commissioning plan based on the contractor's schedule and installation method statement. Provide all required pre-functional, start-up and functional performance checklists.
- .5 Monitor, check and inspect the installation throughout the construction stages.
- .6 Co-ordinate with the GC/CM to have commissioning activities integrated into the project schedule. Include durations and dates for key milestone commissioning activities to be completed.
- .7 Issue deficiencies reports noting any issues that may have an impact on the commissioning of the equipment or system. Maintain an ongoing commissioning issues log. Issues log is to include any concerns with meeting the milestone commissioning dates.
- .8 Attend construction site meetings as required to discuss commissioning related items and any impact on project schedule.
- .9 Set-up and chair commissioning meetings.
- .10 .Perform review of pre-functional checklists.
- .11 .Witness and validate tests and note deficiencies.
- .12 .Work with the commissioning team to expeditiously resolve any problems that may arise due to site conditions, or commissioning deficiencies.
- .13 .Prepare Systems Manual.
- .14 .Direct functional verification testing. Record all testing results. Contractor shall operate the equipment during functional performance testing.
- .15 .Direct integrated system testing as required.
- .16 .Assist the GC/CM in the co-ordination of owner training. Participate in training sessions as required to verify that information has been adequately provided to the owner.
- .17 Provide a review of the construction draws from a commissioning perspective and provide recommendations to the Prime Consultant and the University. The chart below will be utilized by the CxA to evaluate the construction draws. Refer also to Section 01 29 00.1 – Payment Procedures for further details.

Carry 1% of overall contract value for cx'ing paperwork only. Validation of the cx'ing process is tied to progress draws and in particular Schedule of Values using the following chart. For example, fans cannot invoice more than 75%, if the pre-functional verifications are not complete, or more than 95% if the equipment start-up checklists & execution and functional performance testing is not complete.

	Schedule of Values % Complete					
	10%	25%	75%	95%	97%	99%
	Cx'ing Tasks to be Completed by these Milestone Percentages					
	* Cx'ing Kick Off Meeting Held	* Shop Drawing Submittal Review Process Complete	* Pre-functional Verifications Complete	* Equipment Start-up Checklists & Execution Complete	* As-built Drawings and O&M Manuals Submitted	* All Items on the Cx'ing Issues Log have been Addressed
	* Contractors Name Their Cx Agent (Designated Representative)	* Project Schedule has Incorporated Cx'ing Tasks		* Functional Performance Testing Complete	* Owner Training Complete	

.2 Post-Construction Phase:

- .1 Prepare final report on commissioning, identifying any deficiencies that may be outstanding.
- .2 Direct deferred functional verification testing.
- .3 Review commissioning issues with the commissioning team prior to the end of warranty.

## 1.9 CONTRACTOR RESPONSIBILITIES

.1 .1 General Contractor:

- .1 Provide a designated representative to attend commissioning meetings.
- .2 Provide a copy of the project schedule to the CxA. Work with the CxA to coordinate commissioning activities and integrate them into the overall project schedule.
- .3 Coordinate the resolution of deficiencies identified through the commissioning process with the sub-trades.
- .4 Coordinate scheduling of owner training with the sub-trades.
- .5 Return to site approximately 10 months after the start of the warrantee period to review system operation and to address operational issues.
- .6 Include the CxA in the distribution of construction draws for their review.

.2 Mechanical Contractor:

- .1 Attend initial commissioning coordination meeting.
- .2 Provide a complete set of all submittals for mechanical equipment for the CxA.
- .3 Provide complete equipment and systems start-up including personnel and tools, as required for safe, proper and complete start-up of all mechanical equipment.
- .4 Perform pre-functional, start-up and complete required documentation as directed by CxA.
- .5 Correct all deficiencies found during pre-functional, start-up and TAB to ensure that all equipment and systems are fully functional and ready for functional performance testing.

- .6 Prepare O&M manuals and supplementary information on all equipment as directed by CxA and assemble in binders tabbed and indexed. Supplementary information may include, but is not limited to, such items as power/control field wiring diagrams, equipment maintenance schedule, vendor and maintenance contact lists. Submit to CxA when requested.
  - .7 Prepare preliminary schedule for O&M manuals submission, owner training, pipe and duct system testing, flushing and cleaning, equipment start-up, and TAB for use by the CxA. Update schedule throughout the construction period.
  - .8 Notify CxA a minimum of two weeks in advance of equipment and system start-up and/or pre-functional testing.
  - .9 Set-up and schedule vendors and contractors required to participate in the owner training sessions for all equipment and systems.
  - .10 Provide a complete set of as-built record drawings and schematics, include a copy to the CxA.
  - .11 Return to site with the GC/CM, owner and CxA approximately 10 months after the start of the warranty period to review system operation and to address operational issues.
  - .12 Provide a designated representative to attend commissioning meetings and coordinate the completion of commissioning deliverables according to this specification.
- .3 TAB Contractor(s)
- .1 Attend commissioning coordination meetings.
  - .2 Submit TAB procedures to CxA and consultant team for review and acceptance.
  - .3 Provide a preliminary TAB report showing that the system is complete and capable of being balanced. Provide an additional copy of the preliminary report labelled "For CxA".
  - .4 Attend TAB review meeting scheduled by the CxA. Be prepared to discuss procedures that shall be followed in TAB and findings of preliminary TAB.
  - .5 Submittal of final TAB report showing all flows, pressures, motor speeds, voltages and amperages etc., as required for a full and complete balancing report on all systems. Provide an additional copy of the TAB final report labelled "For CxA", and include as-built distribution systems schematics.
  - .6 Participate in verification of the TAB report, which includes of repeating selected measurement contained in the TAB report where required by the CxA for verification or diagnostic purposes.
  - .7 Provide a designated representative to attend commissioning meetings and coordinate the completion of commissioning deliverables according to this specification.
- .4 Building Controls and Automation System Contractor(s)
- .1 Attend initial commissioning coordination meeting.
  - .2 Attend Sequence of Operation and Graphics review meeting scheduled by the CxA. Be prepared to discuss all sequences including all changes; provide a schematic for each proposed graphic.
  - .3 Provide the following submittals to the CxA at time of FPT. (Note: The following shall be updated to as-built conditions).
    - .1 Hardware and software submittals and shop drawings.
    - .2 Narrative description of each control sequence for each piece of equipment or system controlled.
    - .3 Point-to-point and sensor calibration verification checklists.

- .4 As-built diagrams showing all control points, sensor locations, point names, actuators, controllers and, where necessary, points of access, superimposed on diagrams of the physical equipment.
- .5 Printout of panel layouts including all analog input, analog output, digital input, and digital output connections. Provide a separate list for each stand-alone control unit.
- .6 Printout of final control programming algorithms, include current values of all parameters for each system point.
- .7 Owners operation and maintenance manuals.
- .4 Provide complete training to operating personnel on hardware, operation and programming, and the application program for the system.
- .5 Demonstrate system performance to CxA. including all modes of system operation. (e.g. normal, abnormal, emergency).
- .6 Provide control system technician to operate systems as required by and under the direction of the CxA during system verification and functional performance testing.
- .7 Provide support and coordination with TAB contractor on all interfaces between their scopes of work. Provide all devices, such as portable operators' terminals, for TAB use in completing TAB procedures.
- .8 Provide any trend logs as may be required by the CxA.
- .9 Return to site with the GC/CM, owner and CxA approximately 10 months after the start of the warrantee period to review system operation and to address operational issues.
- .10 .Provide a designated representative to attend commissioning meetings and coordinate the completion of commissioning deliverables according to this specification.
- .5 Electrical Contractor
  - .1 Attend commissioning meetings scheduled by the CxA.
  - .2 Provide a complete set of all submittals for electrical equipment to the CxA
  - .3 Provide a copy of the electrical Coordination Study.
  - .4 Correct all deficiencies found during Pre-functional inspection, start-up, TAB and FPT to ensure all equipment and systems are fully functional and in complete and proper working order.
  - .5 Prior to occupancy, but following the completion of all changes, certify that all protection devices have been checked and reset to conform to the Coordination Study settings.
  - .6 Participate in the verification of all protective device settings.
  - .7 Prepare O&M manuals and supplementary information on all equipment as directed by CxA and assemble in binders tabbed and indexed. Supplementary information may include, but is not limited to, such items as power/control field wiring diagrams, equipment maintenance schedule, vendor and maintenance contact lists. Submit to CxA when requested.
  - .8 Provide electrical system technicians to assist during system verification and functional performance testing as required by the CxA.
  - .9 Provide a complete set of as-built record drawings and schematics with a copy to the CxA.
  - .10 .Return to site with the GC and CxA approximately 10 months after the start of the warrantee period to review system operation and to address operational issues.
  - .11 .Provide a designated representative to attend commissioning meetings and coordinate the completion of commissioning deliverables according to this specification.

## 1.10 EQUIPMENT/SYSTEMS TO BE COMMISSIONED

- .1 Mechanical Systems
  - .1 Fire Protection Systems
    - .1 Wall Hydrants
    - .2 Fire Dampers
    - .3 Fire Extinguisher Cabinets
    - .4 Automatic Sprinkler System
    - .5 Backflow Preventer
  - .2 Ventilation Systems
    - .1 Fans
    - .2 Motor Operated Dampers
    - .3 Roof Hoods
    - .4 Variable Air Volume Boxes
    - .5 Silencers
    - .6 Fan Powered Variable Air Volume Boxes
    - .7 Grilles, Registers, and Diffusers
    - .8 In-line Disposable Filters
    - .9 Airflow Measurement Systems
  - .3 Domestic Water System
    - .1 Pumps:
    - .2 Variable Frequency Drives
    - .3 Circulators:
    - .4 Piping
    - .5 Domestic Hot Water Heater
    - .6 Mixing Valve for DHWH
    - .7 Pressure Reducing Valves – listing location, number and type
    - .8 Control Valves
    - .9 Controls
    - .10 Meters - monitored
    - .11 Air Separators
    - .12 Backflow Preventer
  - .4 Heating System
    - .1 Energy Recovery Unit:
    - .2 Pumps
    - .3 Variable Frequency Drives
    - .4 Piping
    - .5 Air Separators
    - .6 Control Valves
    - .7 Air Handling Units
    - .8 Centrifugal Fans
    - .9 Silencers
    - .10 Thermostats
    - .11 Controls
    - .12 Meters - monitored
    - .13 Chemical Treatment
    - .14 Free Cooling Loop
    - .15 Backflow Preventer

- .5 Steam Systems
  - .1 Steam Strainers
  - .2 Expansion Joints for Steam & Condensate Lines
  - .3 Expansion Tanks
  - .4 Backflow Preventers
  - .5 Steam Meter - monitored
  - .6 Steam Traps
  - .7 Steam Pressure Reducing Valves - listing location, number and type
  - .8 Flash Tank
  - .9 Safety Relief Valves
  - .10 Condensate Receiver and Pumps
  - .11 Steam Heat Exchanges Skid Packages
  - .12 Heat Exchangers:
  - .13 Humidifiers
- .6 Hydronic System
  - .1 Radiant Panels
  - .2 Wall Fin Convectors:
  - .3 Radiant Unit Heaters
  - .4 Fan Coils
  - .5 Glycol Feeder
  - .6 Pumps
  - .7 Variable Frequency Drives
  - .8 Piping
  - .9 Control Valves
  - .10 Air Separators
  - .11 Backflow Preventer
- .7 Plumbing System
  - .1 Roof Drains
  - .2 Floor Drains
  - .3 Cleanouts
  - .4 Plumbing Fixtures
  - .5 Fixture Carriers
  - .6 Solids Interceptor
  - .7 Dual Flush Valves
  - .8 Mixing Valve for Hose Reels
  - .9 Pipe Filters
  - .10 Pot Feeder
  - .11 Primed Traps
  - .12 Backflow Preventer
- .8 Packaged Units
  - .1 Radiant Unit Heaters
  - .2 Horizontal Unit Heaters
  - .3 Fan Coil Units
  - .4 Glycol Feeder
  - .5 Packaged Dehumidifiers

- .2 Integrated Automation
  - .1 Central Building Automation System,
    - .1 Controllers
    - .2 Field Devices
    - .3 Sequences
    - .4 Network
    - .5 Operator Workstation
    - .6 Operator Interface
- .3 Electrical Systems
  - .1 Lighting
    - .1 Light Fixtures
    - .2 Emergency/Normal Power
    - .3 Addressable Ballasts'
    - .4 Daylight Sensors
    - .5 Occupancy Sensors
    - .6 Lighting Control System
    - .7 Sequences
    - .8 Schedules
    - .9 Interface
    - .10 Meters - monitored
  - .2 Power Distribution System
    - .1 Meters - monitored
    - .2 Transformers
    - .3 Electrical Switchboards and Panelboards
    - .4 Splitters (SPI & SPXI)
    - .5 Motor Control Centres
    - .6 Low Voltage Control Equipment
  - .3 Fire Alarm System
    - .1 Devices – set up in a listing
    - .2 Fire Panels
    - .3 Network
  - .4 Telecommunications Systems
    - .1 Devices
    - .2 Network
  - .5 7. Intercom (paging) Systems
    - .1 Devices
    - .2 Network
  - .6 Data System
    - .1 Devices
    - .2 Network
  - .7 Security System
    - .1 Devices
    - .2 Network

.4 Integrated Systems

- .1 Verification of integrated systems is to be included in the commissioning. This would include integrated black-out testing and integrated fire alarm testing as well as additional integrated systems as required.

**1.11 COORDINATION**

- .1 Management: Contractors shall cooperate fully with the CxA who will be the Owner's representative for commissioning during all commissioning activities. Contractors shall work together and with the other members of the commissioning team as required to fulfil their contracted responsibilities and meet the objectives of commissioning.
- .2 Scheduling: The GC/CM will work with the CxA to schedule the commissioning activities required of contractors and subcontractors. All parties will address scheduling problems and make necessary notifications in a timely manner in order to expedite the commissioning process.

The CxA will provide the initial schedule of milestone commissioning activities and proposed durations and dates at the commissioning scoping meeting. As construction progresses more detailed schedules may be developed by the GC/CM. The GC/CM is responsible for incorporating these activities into the project schedule and ensuring that work is complete on time to meet the milestone dates. The GC/CM shall be responsible for ensuring that the mechanical, electrical, and controls sub-contractors will return to the building approximately 10 months after the start of the warrantee period to review system operation and to address operational issues.

**PART 2- PRODUCTS**

**2.1 TEST EQUIPMENT**

- .1 All standard testing equipment required to perform start-up and pre-functional and required functional performance testing shall be provided by the division contractor for the equipment being tested.
- .2 Special test equipment, tools or instruments required by the contract documents shall be provided for commissioning and shall be left on site.
- .3 All testing equipment shall have had a certified calibration, traceable to a national standard, performed within the past year. If not otherwise noted, temperature sensors and digital thermometers shall have an accuracy of  $\pm 0.1^{\circ}\text{F}$ , pressure sensors shall have an accuracy of  $\pm 1.0\%$  for each range available on the instrument (not the full range of the meter). All equipment shall be re-calibrated when dropped or damaged.

**PART 3 - EXECUTION**

**3.1 MEETINGS**

- .1 Commissioning Meetings: Soon after construction commences, the CxA will conduct an initial commissioning scope meeting with the entire commissioning team in attendance. Commissioning requirements, procedures, responsibilities and schedule will be reviewed. Other commissioning meetings will be conducted as required throughout construction. These meetings will cover coordination, deficiency resolution and planning issues with particular Contractors and Subs.

### 3.2 SUBMITTALS

- .1 Mechanical and Electrical Contractors shall supply one (1) copy of all shop drawings marked "for CxA" to the CxA at the same time as provided to other designers for review, including all controls and shop drawings and narrative description of each control sequence for each piece of equipment or system controlled (Refer to section 01 33 00 – Submittal Procedures).
- .2 Contractors and Subs shall comply with specific requests for submittal documentation from the CxA in a timely fashion to ensure commissioning work continues as scheduled. At a minimum, the request will include the manufacturer's printed installation and start-up procedures, O&M data and manuals, final shop drawings, power and control field wiring drawings, sequences of operation, and results of required tests.
- .3 Final completion of the O&M manuals including all required submittals is the responsibility of the Contractor. The CxA will review and forward comments to the engineer of record for follow-up. Refer to Section 01 77 00 – Closeout Procedures.
- .4 TAB contractor shall supply an extra copy of the preliminary and the final TAB report marked "for CxA" for review. The CxA will review and forward comments to the engineer of record for follow-up.
- .5 Contractor shall provide an extra set of O&M manuals, as built drawings and field power wiring diagrams to the CxA. The CxA will review and forward comments to the engineer of record for follow-up. Refer to section 01 77 00 – Closeout Procedures.

### 3.3 START-UP AND PRE-FUNCTIONAL CHECKS

- .1 The installing contractor or sub-contractor shall be responsible for performing and documenting start-up based on manufacturer's requirements and/or good industry practice. They shall perform all required procedures and checks and document the results. Start-up documents as requested by the CxA shall be provided.
- .2 Controls and sensor point-to-point checks. Control system point-to-point checks and calibration checks for all sensors shall be included as part of pre-functional. The results shall be documented and provided to CxA.
- .3 Execution of Start-up and Pre-functional checklists
  - .1 Pre-functional and start-up checklists shall be developed and provided by CxA. Where appropriate manufacturers checklists and procedures shall be combined or accepted in lieu of CxAs checklists.
  - .2 The contractor, sub-contractor, manufacturer's rep or supplier shall perform pre-functional and start-up checks. They shall complete the checklist on each piece of equipment. Checklists shall be successfully completed prior to any functional performance testing (FPT).
  - .3 At his sole discretion the CxA shall observe, recheck or verify the pre-functional and start-up documentation of any or all equipment. The contractor shall cooperate with and provide support to the CxA as requested.
  - .4 Only individuals with direct knowledge of and who personally witnessed any pre-functional or start-up activity shall sign off the checklists.
  - .5 It will be the responsibility of the contractor to remedy all deficiencies found. Retesting by the contractor may be required to demonstrate corrections have been made.

- .4 Deficiencies, non-conformance and approval of pre-functional and start-up checklists.
  - .1 Dates for remedy of deficiencies shall be provided to the CxA with the initial pre-functional and start-up documents.
  - .2 The CxA will work with all parties as required to affect proper corrective measures, correct and retest deficiencies or uncompleted items. The GC/CM shall coordinate the correction of deficiencies.
  - .3 Items left incomplete or not properly corrected, causing delays or multiple call-backs for retest may result in back-charges to the party at fault.

### **3.4 TESTING, ADJUSTING AND BALANCING (TAB)**

- .1 A preliminary TAB balancing shall be done prior to final balancing. System deficiencies requiring correction prior to final TAB shall be documented.
- .2 All deficiencies shall be corrected by the contractor prior to final balancing.
- .3 Participate in repeating selected measurement as required by the CxA for verification or diagnostic purposes.

### **3.5 FUNCTIONAL PERFORMANCE TESTING (FPT)**

- .1 In general, functional performance testing is conducted after pre-functional and start-up checks have been satisfactorily completed, the control system is fully operational, and TAB is complete.
- .2 The installing contractor or sub-contractor, under the direction of the CxA, shall execute all FPT and shall maintain responsibility for all equipment tested.
- .3 In general, each system shall be operated through all modes of operation (seasonal, occupied, unoccupied, warm-up, cool-down, part-load, full-load). Proper responses to such modes and emergency conditions (e.g., power failure, freeze condition, no flow, equipment failure, etc.) shall be verified.
- .4 FPT verification may be achieved by manual testing (persons manipulate the equipment and observe performance) or by monitoring the performance and analyzing the results using the control system's trend log capabilities or by stand-alone data loggers. The CxA will determine which method is most appropriate.
- .5 The CxA will schedule FPTs through the GC/CM and affected Contractors and Subs.
- .6 Corrections of minor deficiencies identified during FPT may be made by the Contractor or Sub during the tests.
- .7 Where a deficiency cannot be corrected immediately, the contractor or sub-contractor shall provide a reasonable timeline for correction. The CxA shall document the deficiency and reschedule the FPT.
- .8 Where there is a dispute regarding whether a problem is a deficiency or who is responsible, the deficiency shall be documented and resolution attempted by parties in attendance. Final acceptance of proposed resolution lies with the Owner or designated representative.

- .9 The burden of responsibility to solve and correct deficiencies lies with the design consultants, manufacturers, vendors, GC/CM, contractors, and sub-contractors. The CxA may recommend solutions to problems in consultation with these parties. Ultimately, the GC/CM shall coordinate the successful resolution of deficiencies.
- .10 Cost of Retesting:
  - .1 If the contractor or sub-contractor is responsible for a deficiency then they shall carry the cost to rework the deficiency and complete the FPT.
  - .2 The CxA will direct the first retesting of the equipment at no charge.
  - .3 If corrections of deficiencies have been reported to be successfully completed but are determined during testing to be faulty or otherwise incomplete, the time for the CxA to direct second or subsequent retests will be charged back.

### 3.6 TRAINING OF OWNER PERSONNEL

- .1 The contractor supplying each piece of equipment shall be responsible for providing complete and satisfactory training on that piece of equipment. Training may be performed by the contractor, supplier, manufacturer or others as the contractor may decide best able to provide that training.
- .2 Owner personnel shall be provided with completed O&M Manuals at least ten (10) working days prior to training. In addition, one hardcopy and one electronic copy (searchable PDF file format) of the related maintenance booklet and wiring as-builts shall be provided to owner personnel for the purpose of training.
- .3 The GC shall be responsible for training coordination and scheduling and ultimately for ensuring that training is completed. The CxA shall be responsible for overseeing and approving the content and adequacy of training for all commissioned equipment.
- .4 Basic training for each piece of equipment shall include the following items at a minimum:
  - .1 General description of the system and its operation (Design Intent)
  - .2 Detailed itemization and identification of major components and access to same
  - .3 Detailed itemization and identification of operating controls and safeties including normal and abnormal sensor readings
  - .4 Review of the O&M manuals for identification of service requirements, procedures, wiring diagrams, parts identification, safety procedures, etc.
  - .5 Review of system drawings and schematics
  - .6 Review of control drawings and schematics
  - .7 Operational review for
    - .1 Start-up
    - .2 Normal operation
    - .3 Shut down
    - .4 Unoccupied operation
    - .5 Seasonal changeover
    - .6 Manual operation
    - .7 Controls set-up and programming
    - .8 Troubleshooting and alarms

- .8 Interactions with other systems
- .9 Adjustments and optimizing methods for energy conservation
- .10 Health and safety issues
- .11 Regular maintenance requirements including frequency, parts and equipment, and tools needed, replacement parts sources
- .12 Special maintenance needs
- .13 Tenant interaction issues
- .14 Discussion of environmentally responsible system features
- .15 Identification of contacts for service support and maintenance parts

### **3.7 DEFERRED TESTING**

- .1 If any check or test cannot be completed due to weather conditions, the building structure, required occupancy condition or other deficiency, execution of pre-functional checks and/or FPT may be delayed upon approval of the owner.

### **3.8 POST-OCCUPANCY REVIEW**

- .1 The CxA, GC/CM, mechanical, electrical, and controls sub-contractors shall return to the building approximately 10 months after the start of the warranty period to review system operation, owner concerns, unresolved deficiencies or warranty issues and to address any outstanding operational issues.
- .2 The exact date and time of this meeting is to be coordinated by the CxA.
- .3 CxA will provide site report to the consultants and owner for review, acceptance and formal issue to the appropriate parties.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 SUMMARY**

- .1 This Section includes the following:
  - .1 Demolition and removal of site improvements adjacent to a building or structure being demolished
  - .2 Removing below grade construction
  - .3 Disconnecting, capping or sealing, and removing site utilities

### **1.2 RELATED REQUIREMENTS**

- .1 Section 02 41 13 - Selective Site Demolition
- .2 Section 31 00 00.01 - Earthwork

### **1.3 REFERENCE STANDARDS**

- .1 Canadian Standards Association (CSA International)
  - .1 CSA S350-M1980 (R2003), Code of Practice for Safety in Demolition of Structures.
- .2 National Fire Protection Association (NFPA)
  - .1 NFPA 241 - 96, Standard for Safeguarding Construction, Alteration, and Demolition Operations
- .3 National Research Council Canada (NRC)
  - .1 National Building Code of Canada 2015 (NBC).
  - .2 National Fire Code of Canada 2015 (NFC).
- .2 Underwriters' Laboratories of Canada (ULC)
  - .1 CAN/ULC-S660-08, Standard for Nonmetallic Underground Piping for Flammable and Combustible Liquids
  - .2 ULC/ORD-C58.15-1992, Overfill Protection Devices for Flammable Liquid Storage Tanks
  - .3 ULC/ORD-C58.19-1992, Spill Containment Devices for Underground Flammable Liquid Storage Tanks
- .3 U.S. Environmental Protection Agency (EPA)/Office of Water
  - .1 EPA CFR 86.098-10, Emission standards for 1998 and later model year Otto-cycle heavy-duty engines and vehicles
  - .2 EPA CFR 86.098-11, Emission standards for 1998 and later model year diesel heavy-duty engines and vehicles
  - .3 EPA 832/R-92-005, Storm Water Management for Construction Activities: Developing Pollution Prevention Plans and Best Management Practices.

## 1.4 DEFINITIONS

- .1 Demolition: rapid destruction of building following removal of hazardous materials.
- .2 Waste Management Coordinator (WMC): Contractor representative responsible for supervising waste management activities as well as coordinating related, required submittal and reporting requirements.
- .3 Construction Waste Management Plan (CWM Plan): Written plan addressing opportunities for reduction, reuse, or recycling of materials prepared in accordance with Section 01 74 19 - Construction Waste Management and Disposal.
- .4 Construction Waste Management Report (CWM Report): Written report identifying actual materials that formed CWM Plan for reduction, reuse, or recycling of materials prepared in accordance with Section 01 74 19 - Construction Waste Management and Disposal

## 1.5 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination: Coordinate with the University of Guelph for the material ownership including but not limited to:
  - .1 Except for items or materials indicated to be reused, salvaged, reinstalled, or otherwise indicated to remain the University of Guelph 's property, demolished materials shall become the Contractor's property and shall be removed from Project site.
  - .2 Historic items, relics, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, antiques, and other items of interest or value to the University of Guelph that may be encountered during demolition remain the University of Guelph 's property.
- .2 Pre-Demolition Meetings:
  - .1 Convene pre-installation meeting 1 week prior to beginning demolition work and on-site installations, with the Contractor University of Guelph and J.L. Richards in accordance with Section 01 31 19 - Project Meetings.
- .3 Scheduling:
  - .1 Employ necessary means to meet project time lines without compromising specified minimum rates of material diversion.
  - .2 In event of unforeseen delay notify the University of Guelph in writing.

## 1.6 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Action Submittals: Provide the following submittals before starting any work of this Section:
  - .1 Shop Drawings: Submit drawings stamped and signed by professional engineer registered or licensed in the Province of Ontario as follows:
  - .2 Submit in accordance with Section 01 33 00 - Submittal Procedures and 01 74 19 - Construction Waste Management and Disposal.
  - .3 Schedule of Demolition Activities: Coordinate with Section 01 32 16.06 - Construction Progress Schedule.

- .2 Sustainable Design Submittals:
  - .1 Erosion and Sedimentation Control: submit erosion and sedimentation control plan in accordance with EPA 832/R92-005 and the City of Guelph Linear Infrastructure Standards.
  - .2 Construction Waste Management:
  - .3 Submit project Waste Management Plan highlighting recycling and salvage requirements.

## **1.7 QUALITY ASSURANCE**

- .1 Regulatory Requirements: Ensure Work is performed in compliance with CEPA, OPSS and City of Guelph regulations.
- .2 Comply with hauling and disposal regulations of the University of Guelph and the City of Guelph.
- .3 Standards: Comply with ANSI A10.6 and NFPA 241.

## **1.8 SITE CONDITIONS**

- .1 If material resembling spray or trowel-applied asbestos or other designated substance listed as hazardous is encountered, stop work, take preventative measures, and notify the University of Guelph and J.L. Richards immediately.
  - .1 Proceed only after receipt of written instructions have been received from J.L. Richards.
  - .2 Notify the University of Guelph and J.L. Richards before disrupting Building 046 access or services.
  - .3 Environmental protection:
    - .1 Ensure Work is done in accordance with Section 01 35 43 - Environmental Procedures.

## **1.9 EXISTING CONDITIONS**

- .1 Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.

## **PART 2 - PRODUCTS**

### **2.1 EQUIPMENT**

- .1 Equipment and heavy machinery:
- .2 Machinery shall be run only while in use, except where extreme temperatures prohibit shutting machinery down.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- .1 Survey existing conditions and correlate with requirements indicated to determine extent of demolition required.
- .2 Review Project Record Documents of existing construction provided by the University of Guelph.

- .3 The University of Guelph does not guarantee that existing conditions are the same as those indicated in Project Record Documents.
- .4 Inventory and record the condition of items being removed and salvaged.
- .5 When unanticipated mechanical, electrical, or structural elements are encountered, investigate and measure the nature and extent of the element.
- .6 Promptly submit a written report to Consultant.
- .7 Perform an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during demolition operations.

### 3.2 PREPARATION

- .1 Temporary Erosion and Sedimentation Control:
  - .1 Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to: the City of Guelph and civil drawings.
- .2 Protection of In-Place Conditions:
  - .1 Prevent movement, settlement, or damage to adjacent structures, utilities landscaping features and parts of building to remain in place. Provide bracing and shoring if required.
  - .2 Keep noise, dust, and inconvenience to occupants to minimum.
  - .3 Protect building systems, services and equipment.
  - .4 Provide temporary dust screens, covers, railings, supports and other protection as required.
  - .5 Do Work in accordance with Section 01 35 29 - Health and Safety Requirements.
- .3 Demolition/Removal:
  - .1 Demolish structures as indicated.
  - .2 Removal of pavements, curbs and gutters:
    - .1 Square up adjacent surfaces to remain in place by saw cutting or other method approved by J.L. Richards.
    - .2 Protect underlying and adjacent granular materials.
  - .3 At end of each day's work, leave Work in safe and stable condition.
  - .4 Protect interiors of parts not to be demolished from exterior elements at all times.
  - .5 Demolish to minimize dusting. Keep materials wetted as directed by J.L. Richards. Only dispose of material specified by selected alternative disposal option as directed by University of Guelph.
- .4 Remove the following materials and equipment, store, protect, and leave ready for reinstallation by other sections of Work:
  - .1 Parking Meters
  - .2 Pay and Display parking sign
- .5 Remove the following materials and equipment and store in the designated laydown area:
  - .1 Concrete sidewalk
  - .2 Concrete curb and gutter
  - .3 Asphalt pavement
  - .4 Native soil
  - .5 Bicycle lock-ups

### **3.3 SITE RESTORATION & REPAIRS**

- .1 Site Grading: Uniformly rough grade area of demolished construction to a smooth surface, free from irregular surface changes.
- .2 Provide a smooth transition between adjacent existing grades and new grades.
- .3 General: Promptly repair damage to adjacent construction caused by demolition operations.
- .4 Where repairs to existing surfaces are required, patch to produce surfaces suitable for new materials.
- .5 Restore exposed finishes of patched areas and extend restoration into adjoining construction in a manner that eliminates evidence of patching and refinishing.

### **3.4 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
- .3 Refer to demolition drawings and specifications for items to be salvaged for reuse.
- .4 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

## **PART 1 – GENERAL**

### **1.1 SUMMARY**

- .1 Section includes descriptions for demolishing, salvaging, recycling and removing site work items identified for removal in whole or in part, and for backfilling trenches and excavations resulting from site demolition activities.

### **1.2 RELATED REQUIREMENTS**

- .1 Section 02 41 00.08 Demolition for Minor Works.

### **1.3 REFERENCE STANDARDS**

- .1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).
- .2 Transport Canada (TC)
  - .1 Transportation of Dangerous Goods Act, 1992 (TDGA), c. 34.

### **1.4 DEFINITIONS**

- .1 Demolition: rapid destruction of building following removal of hazardous materials.
- .2 Waste Audit (WA): detailed inventory of materials in building. Indicates quantities of reuse, recycling and landfill.
  - .1 Involves quantifying by volume/weight amounts of materials and wastes generated during construction, demolition, deconstruction, or renovation project.
  - .2 Indicates quantities of reuse, recycling and landfill.
- .3 Waste Management Coordinator (WMC): contractor representative responsible for supervising waste management activities as well as coordinating related, required submittal and reporting requirements.

### **1.5 ADMINISTRATIVE REQUIREMENTS**

- .1 Site Meetings.
- .2 Convene pre-demolition meeting one week prior to beginning demolition work in accordance with Section 01 32 16.07 - Construction Progress Schedules - Bar (GANTT) Chart to:
  - .1 Verify project requirements.
  - .2 Review installation and site conditions.
  - .3 Co-ordination with other building subtrades.
  - .4 Review manufacturer's installation instructions and warranty requirements.
- .3 Arrange for site visit with the University of Guelph and J.L. Richards to examine existing site conditions adjacent to demolition work, prior to start of Work.

- .4 Ensure key personnel regularly attend project meetings as required.
- .5 Reporting Requirements: WMC to complete.
- .6 The contractor must provide written and verbal reports on status of waste diversion activity to J.L. Richards.
  - .1 Scheduling: meet project time lines without compromising specified minimum rates of material diversion.
  - .2 Notify the University of Guelph and J.L. Richards in writing when unforeseen delays occur.

## **1.6 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Shop Drawings:
  - .1 Submit drawings stamped and signed by professional engineer registered or licensed in the Province of Ontario, Canada.
  - .2 Submit for approval drawings, diagrams or details showing sequence of demolition work and supporting structures and underpinning, where required by authorities having jurisdiction.
- .3 Hazardous Materials:
  - .1 Provide description of Hazardous Materials and Notification of Filing with proper authorities prior to beginning of Work as required.
- .4 Waste Reduction Workplan:
  - .1 Prior to beginning of Work on site submit detailed Waste Reduction Workplan in accordance with Section 01 74 21 - Construction/Demolition Waste Management And Disposal and indicate:
    - .1 Descriptions of and anticipated quantities of materials to be salvaged reused, recycled and landfilled.
    - .2 Schedule of selective demolition.
    - .3 Number and location of dumpsters.
    - .4 Anticipated frequency of tippage.
    - .5 Name and address of haulers, and waste facilities.
- .5 Certificates:
  - .1 Submit copies of certified receipts from authorized disposal sites and reuse and recycling facilities for material removed from site upon request of the University of Guelph or J.L. Richards.

## **1.7 QUALITY ASSURANCE**

- .1 Regulatory Requirements: ensure Work is performed in compliance with CEPA, the City of Guelph, and all applicable Provincial regulations.

## **1.8 DELIVERY, STORAGE, AND HANDLING**

- .1 Store and manage hazardous materials in accordance with Section 01 35 43 - Environmental Procedures.

- .2 Storage and Protection.
  - .1 Protect in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.
  - .2 Protect existing items designated to remain and items designated for salvage. In event of damage to such items, immediately replace or make repairs to approval of the University of Guelph or J.L. Richards and at no cost to the University of Guelph or J.L. Richards.
  - .3 Remove and store materials to be salvaged in manner to prevent damage.
  - .4 Store and protect in accordance with requirements for maximum preservation of material.
  - .5 Handle salvaged materials as new materials.
- .3 Packaging Waste Management: remove for reuse by manufacturer of pallets, crates, padding, and packaging materials as specified in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

## **1.9 SITE CONDITIONS**

- .1 Site Environmental Requirements.
  - .1 Perform work in accordance with Section 01 35 43 - Environmental Procedures.
  - .2 Ensure that selective demolition work does not adversely affect adjacent watercourses, groundwater and wildlife, or contribute to excess air and noise pollution.
  - .3 Do not dispose of waste of volatile materials including but not limited to, mineral spirits, oil, petroleum based lubricants, or toxic cleaning solutions into watercourses, storm or sanitary sewers.
    - .1 Ensure proper disposal procedures are maintained throughout the project.
  - .4 Do not pump water containing suspended materials into watercourses, storm or sanitary sewers or onto adjacent properties.
  - .5 Control disposal or runoff of water containing suspended materials or other harmful substances in accordance with the City of Guelph as directed by the University of Guelph.
  - .6 Protect trees, plants and foliage on site and adjacent properties where indicated.

## **PART 2 - PRODUCTS**

### **2.1 EQUIPMENT**

- .1 Leave machinery running only while in use, except where extreme temperatures prohibit shutting

## **PART 3 - EXECUTION**

### **3.1 PREPARATION**

- .1 Inspect site with the University of Guelph and J.L. Richards and verify extent and location of items designated for removal, disposal, alternative disposal, recycling, salvage and items to remain.
- .2 Locate and protect utilities. Preserve active utilities traversing site in operating condition.
- .3 Notify and obtain approval of utility companies before starting demolition.

- .4 Disconnect and cap designated mechanical services.
  - .1 Water Lines: remove as indicated in drawings in accordance with the City of Guelph as directed by J.L. Richards and securely plug to form watertight seal.

### **3.2 REMOVAL OPERATIONS**

- .1 Remove items as indicated on drawings.
- .2 Do not disturb items designated to remain in place.
- .3 Removal of pavements, curbs and gutters:
  - .1 Square up adjacent surfaces to remain in place by saw cutting or other method approved by J.L. Richards.
  - .2 Protect underlying and adjacent granular materials.
  - .3 Prevent contamination with base course aggregates, when removing asphalt pavement for subsequent incorporation into hot mix asphalt concrete paving,
  - .4 Excavate at least 300 mm below pipe invert, when removing pipes under existing or future pavement area.
  - .5 Stockpile topsoil for final grading and landscaping:
- .4 Provide erosion control and seeding if not immediately used.
- .5 Disposal of Material:
  - .1 Dispose of materials not designated for salvage or reuse on site as instructed by the University of Guelph at the appropriate facilities .
  - .2 Trim disposal areas to approval of The University of Guelph.
- .6 Backfill:
  - .1 Backfill in areas as indicated and in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.

### **3.3 STOCKPILING**

- .1 Label stockpiles, indicating material type and quantity.
- .2 Designate appropriate security resources/measures to prevent vandalism, damage and theft.
- .3 Locate stockpiled materials convenient for use in new construction to eliminate double handling wherever possible.
- .4 Stockpile materials designated for alternate disposal in location which facilitates removal from site and examination by potential end markets, and which does not impede disassembly, processing, or hauling procedures.

### **3.4 REMOVAL FROM SITE**

- .1 Remove stockpiled material as directed by J.L. Richards, when it interferes with operations of project.
- .2 Remove stockpiles of like materials by alternate disposal option once collection of materials is complete.
- .3 Transport material designated for alternate disposal using approved haulers to appropriate facilities and in accordance with applicable regulations.

### **3.5 RESTORATION**

- .1 Restore areas and existing works outside areas of demolition to conditions that existed prior to beginning of Work.
- .2 Use soil treatments and procedures which are not harmful to health, are not injurious to plants, and do not endanger wildlife, adjacent water courses or ground water.

### **3.6 FIELD QUALITY CONTROL**

- .1 Verification requirements include:
  - .1 Materials and resources.
  - .2 Storage and collection of recyclables.
  - .3 Construction waste management.
  - .4 Resource reuse.
  - .5 Recycled content.
  - .6 Local/regional materials.

### **3.7 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
  - .1 Leave Work area clean at end of each day.
  - .2 Remove debris, trim surfaces and leave work site clean, upon completion of Work
  - .3 Use cleaning solutions and procedures which are not harmful to health, are not injurious to plants, and do not endanger wildlife, adjacent water courses or ground water.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
  - .1 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
  - .2 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

### **3.8 PROTECTION**

- .1 Repair damage to adjacent materials or property caused by selective site demolition.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 SUMMARY**

- .1 Section includes descriptions for demolishing, salvaging, recycling and removing of asphalt paving identified in whole or in part, and for backfilling trenches and excavations resulting from site demolition activities a required by scope of work.

### **1.2 RELATED REQUIREMENTS**

- .1 Section 02 41 13 - Selective Site Demolition
- .2 Section 02 41 00 - Demolition for Minor Works

### **1.3 REFERENCE STANDARDS**

- .1 U.S. Environmental Protection Agency (EPA) / Office of Water
- .2 EPA 832/R-92-005, Storm Water Management for Construction Activities: Developing Pollution Prevention Plans and Best Management Practices.

### **1.4 DEFINITIONS**

- .1 Demolish: Detach items from existing construction and legally dispose of them off site, unless indicated to be removed and salvaged or removed and reinstalled.
- .2 Existing to Remain: Existing items of construction that are not removed and that are not otherwise indicated as being removed, removed and salvaged, or removed and reinstalled
- .3 Draft Construction Waste Management Plan (Draft CWM Plan): Detailed inventory of materials in building indicating estimated quantities of reuse, recycling and landfill, prepared in accordance with Section 01 74 19 - Construction Waste Management and Disposal and as follows:
  - .1 Involves quantifying by volume/weight amounts of materials and wastes generated during construction, demolition, deconstruction, or renovation project.
- .4 Waste Management Coordinator (WMC): Contractor representative responsible for supervising waste management activities as well as coordinating related, required submittal and reporting requirements.
- .5 Construction Waste Management Plan (CWM Plan): Written plan addressing opportunities for reduction, reuse, or recycling of materials prepared in accordance with Section 01 74 21 - Construction Waste Management and Disposal.
- .6 Construction Waste Management Report (CWM Report): Written report identifying actual materials that formed CWM Plan for reduction, reuse, or recycling of materials prepared in accordance with Section 01 74 21 - Construction Waste Management and Disposal.

## **1.5 ADMINISTRATIVE REQUIREMENTS**

- .1 Coordination: Coordinate requirements for Waste Management and Disposal for materials being re used or recycled in accordance with Section 01 74 21 – Construction Demolition Waste Management and Disposal.
  - .1 Divert excess materials from landfill.
  - .2 Separate materials identified for recycling place in identified areas in accordance with Waste Management Plan.
  - .3 Label location of salvaged material's storage areas and provide barriers and security devices.
  - .4 Remove materials that cannot be salvaged for re use or recycling and dispose of in accordance with applicable codes at licensed facilities.
- .2 Pre-Construction Meeting: Arrange a pre construction meeting in accordance with Section 01 31 19 - Project Meetings; attended by the University of Guelph Contractor's key personnel and Consultant to discuss the following:
  - .1 Verify project requirements.
  - .2 Review site conditions.
  - .3 Coordination with other Subcontractors affected by work of this Section.
  - .4 Examine existing site conditions adjacent to demolition work, prior to start of Work.
  - .5 Waste reporting requirements.

## **1.6 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Action Submittals: Provide following submittals before starting work of this Section:
- .2 Shop Drawings: Submit shop drawings indicating diagrams or details showing sequence of demolition work.
- .3 Informational Submittals: Provide following submittals during course of work:
- .4 Certificates: Submit copies of certified weigh bills, bills of lading or receipts from authorized disposal sites and reuse and recycling facilities for material removed from site on a regular basis.

## **1.7 QUALITY ASSURANCE**

- .1 Regulatory Requirements: ensure Work is performed in compliance with CEPA, the City of Guelph and all applicable Provincial regulations.
- .2 Comply with hauling and disposal regulations of Authority Having Jurisdiction.

## **1.8 SITE CONDITIONS**

- .1 Protect existing site features to remain or identified for salvage or re use; make repairs and restore to a similar condition to existing where damage to these items occurs as directed by Consultant and at no cost to Owner:
  - .1 Remove and store salvaged materials to prevent contamination.
  - .2 Store and protect salvaged materials as required for maximum preservation of material.
  - .3 Handle salvaged materials same as new materials.

- .2 Perform pavement removal work to prevent adverse effects to adjacent watercourses, groundwater and wildlife, and to prevent excess air and noise pollution:
  - .1 Do not pump water containing suspended materials into watercourses, storm or sanitary sewers or onto adjacent properties.
  - .2 Control disposal or runoff of water containing suspended materials or other harmful substances in accordance with Authorities Having Jurisdiction.
- .3 Protect existing site features and structures, trees, plants and foliage on site and adjacent properties.

## **PART 2 - PRODUCTS**

### **2.1 EQUIPMENT**

- .1 Use cold milling, planning or grinding equipment with automatic grade controls capable of operating from stringline, and capable of removing part of pavement surface to depths or grades indicated.

## **PART 3 - EXECUTION**

### **3.1 PREPARATION**

- .1 Verify extent and location of asphalt identified for removal, disposal, alternative disposal, recycling, salvage and items to remain.
- .2 Locate and protect utilities, preserve active utilities traversing site in operating condition.
- .3 Temporary Erosion and Sedimentation Control:
  - .1 Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to sediment and erosion control drawings.
  - .2 Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.
  - .3 Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.
- .4 Prior to beginning removal operation, inspect and verify with J.L. Richards areas, depths and lines of asphalt pavement to be removed.
- .5 Protection: protect existing pavement not designated for removal, light units and structures from damage. In event of damage, immediately replace or make repairs to approval of The University of Guelph or J.L. Richards at no additional cost.

### **3.2 REMOVAL**

- .1 Remove existing asphalt pavement to lines and grades as indicated
- .2 Demolition of pavements, curbs and gutters:
  - .1 Square up adjacent surfaces to remain in place by saw cutting or other method acceptable to the consultant.
  - .2 Protect adjacent joints and load transfer devices.

- .3 Protect underlying and adjacent granular materials where they are exposed and identified to remain.
- .4 Prevent contamination with base course aggregates, when removing asphalt pavement for subsequent incorporation into hot mix asphalt concrete paving.
- .3 Use equipment and methods of removal and hauling which do not damage or disturb underlying pavement.
- .4 Prevent contamination of removed asphalt pavement by topsoil, underlying gravel or other materials.
- .5 Suppress dust generated by removal process.

### **3.3 FINISH TOLERANCES**

- .1 Finished surfaces in areas where asphalt pavement has been removed within +/-5 mm of grade specified but not uniformly high or low.

### **3.4 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
- .3 Sweep remaining asphalt pavement surfaces clean of debris resulting from removal operations using rotary power brooms and hand brooming as required.
- .4 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.
  - .2 Removed asphalt pavement which is to be recycled in hot mix asphalt concrete under this contract may be stockpiled at designated asphalt plant site.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 REFERENCES**

- .1 CSA International
  - .1 CSA W47.1-09 (R2014), Certification of companies for fusion welding of steel, Includes Update No. 3 (2011), Update No. 5 (2012), Update No. 6 (2013).
  - .2 CSA W59-03 (R2008), Welded Steel Construction (Metal Arc Welding), Includes Update No. 1 (2004).
  - .3 CSA S350-M1980, Code of Practice of Safety in Demolition of Structures.

### **1.2 QUALITY ASSURANCE**

- .1 Comply with the requirements of the Ontario Building Code, Ontario Occupational Health and Safety Act Canada and all other Standards and Regulations noted.
- .2 All Work performed and materials used shall be of the same standard of quality as that of the existing finished building as a minimum.
- .3 Any welding shall be performed by Welders certified in accordance with CSA W47.1, and shall conform to CSA W59.
- .4 Patch and extend work using only skilled mechanics capable of matching the existing quality or workmanship and as otherwise indicated. The quality of patched or extended Work to be performed as specified in the sections of the product and execution Specifications that follow these General Requirements.
- .5 Pre Installation Meetings: convene pre-installation meeting one (1) week prior to beginning work of this Section and on-site installation, with contractor's representative and Consultant in accordance with Section 01 31 19 - Project Meetings.

### **1.3 SECURITY**

- .1 Make provision to maintain building security in a manner acceptable to the Owner during construction and after normal working hours.

### **1.4 ENVIRONMENTAL REQUIREMENTS**

- .1 Suppress all dust and dirt. Prevent occurrence of unsanitary conditions, flooding or leaking.
- .2 Do not allow dirt, debris or discarded materials accumulate on site. Remove promptly each day.

### **1.5 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate and recycle waste materials in accordance with Section 01 74 21 – Construction Demolition Waste Management & Disposal.

## **PART 2 - PRODUCTS**

### **2.1 NOT USED**

- .1 Not used.

## **PART 3 - EXECUTION**

### **3.1 EXISTING CONDITIONS**

- .1 Examine areas to be selectively demolished or dismantled, and confirm that their condition is substantially the same as the date on which bids closed, and as indicated in the Contract Documents. Advise the Consultant of any conditions that vary from this.
- .2 Be familiar with structural system of the building, and the elements being demolished or dismantled.
- .3 Inspect site and verify with Consultant items designated for removal and items to remain. Protect existing items designated to remain and materials designated for salvage. In event of damage to such items, immediately replace or make repairs to approval of Consultant and at no cost to Owner.
- .4 Demolition of spray or trowel-applied asbestos can be hazardous to health. Should material resembling spray or trowel-applied asbestos be encountered in the course of demolition work stop work and notify the Consultant immediately. Do not proceed until written instructions have been received from the Consultant.
- .5 Demolition of applied asbestos materials can be hazardous to health. Should material resembling asbestos be encountered in the course of demolition work, stop work and notify the Consultant immediately. Do not proceed until written instructions have been received from the Consultant.

### **3.2 EXTENT OF DEMOLITION**

- .1 Drawings showing extent of selective demolition are intended to be schematic and do not indicate full extent of all selective demolition work. Examine all documents to determine complete scope of selective demolition, removals and re-instatement, repair and make good required to complete Work.

### **3.3 SAFETY**

- .1 Comply with all applicable legislation.

### **3.4 ALTERATIONS, CUTTING AND PROTECTION**

- .1 Extent:
  - .1 Perform cutting and removal work so as not to cut or remove more than is necessary and so as not to damage adjacent Work.
- .2 Responsibility and Assignment of Trades:
  - .1 Assign Work of moving, removal, cutting and patching and repair to trades under his/her supervision so as to cause the least damage to each type of Work encountered, and so as to return the building as much as possible to the appearance of new Work.
  - .2 Assigned only skilled tradesmen to perform patching and finishing Work.

- .3 Protection:
- .1 Protect remaining finishes, equipment and adjacent Work from damage caused by cutting, moving, removal and patching operations. Protect surfaces to remain as part of the finished Work.
  - .2 Prevent movement, settlement or damage of existing structures, services, walks, paving, trees, landscaping, adjacent grades and parts of existing building to remain.
  - .3 Provide bracing, shoring and underpinning as required. Make good damage caused by demolition.
  - .4 Take precautions to support affected structures and, if safety of building being demolished appears to be endangered, cease operations and notify Consultant.
  - .5 Prevent debris from blocking surface drainage system, elevators, mechanical and electrical systems which must remain in operation.
  - .6 Provide bracing, shoring, or needling as required to support portions of existing structure or building to remain, where demolition or dismantling, cutting out, or partial removal of any elements, as specified in other Sections degrades the structural integrity of the structure to a point where it will not support all imposed loads. All bracing, shoring, and needling shall be designed to cause no damage to existing surfaces upon which the bracing, shoring or needling bears.
  - .7 Shoring, bracing, or needling of structural items shall be designed by a Professional Engineer registered in the Province of Ontario, and drawings shall bear the seal of this Engineer. Submit drawings of shoring, bracing, or needling to the Consultant prior to installing.
  - .8 Maintain temporary supports in place until permanent structure is able to fully support all imposed loads.
  - .9 Make good damage to existing elements to remain caused by demolition.
  - .10 Prevent debris from blocking surface drainage system, and obstructing mechanical and electrical systems which must remain in operation.
  - .11 Protect salvaged elements from damage. Provide protective coverings and storage.
- .4 Debris:
- .1 Remove debris promptly from the site each day. Removed material, except that listed or marked by Consultant for retention, becomes the property of the Contractor. Load removed material directly on trucks for removal from site. Dispose of removed material legally. Do not burn on site. Do not allow debris to enter sewers. Refer to Section 01 74 21 – Construction Demolition Waste Management & Disposal.
  - .2 Do not let piled material endanger structure.
  - .3 Suppress dust. Prevent occurrence of unsanitary conditions, dirt or debris on the site and neighbouring property.
  - .4 As directed by Owner, deliver and store and/or dispose of, any salvaged items left over after completion of the Work.
- .5 Repair and make good any damage found subsequent to submission of inventory, which in the opinion of the Consultant is the result of the Work, and which is not documented in the inventory submitted to the Owner and Consultant to Owner. Repairs shall return damaged elements to their condition prior to start of work. Where work increases extent of existing damage, repair shall return element to match previous damaged condition. Refer to CCDC 2 – 2008, GC 9.1
- .6 Where repairs cannot, in the opinion of the Consultant, be expediently implemented the Consultant shall ascertain the value to be deducted from the amounts due the Contractor in the manner permitted under CCDC 2 – 2008, GC 2.4

### 3.5 DISMANTLING AND DEMOLITION

- .1 Do all work in a manner to prevent endangering safety of building or occupants.
- .2 Selectively dismantle parts of the building as required to suit installation of new work and remedial work. Salvage and reinstall elements unless otherwise indicated. Make good disturbed surfaces.
- .3 Remove existing equipment, services, and obstacles where required for refinishing or making good of existing surfaces, and replace as work progresses.
- .4 Do not disturb adjacent items designated to remain in place.
- .5 At end of each day's work, leave work in safe condition so that no part is in danger of toppling or falling. Protect interiors of parts not to be demolished from exterior elements at all times.
- .6 Demolish to minimize dusting. Keep materials wetted as directed by Consultant.
- .7 Do not throw or allow debris to fall uncontrolled from heights. Use chutes and other controls.
- .8 Temporarily re-route service lines entering building or on the building in accordance with authorities having jurisdiction, and to suit the Work of this Contract. Post warning signs on electrical lines and equipment that must remain energized during period of work.
- .9 Do not disrupt active or energized utilities designated to remain undisturbed, without Consultant's consent.

### 3.6 PATCHING, EXTENDING AND MATCHING

- .1 Patching:
  - .1 In areas where any portion of an existing finished surface is damaged, lifted, stained, peeling, cracked, or otherwise made or found to be imperfect, patch or replace imperfect surfaces with matching material.
  - .2 Do not incorporate salvaged material in new Work unless otherwise noted or approved by Consultant in writing.
  - .3 Provide adequate support or substrate for patching and finishing.
  - .4 For painted and/or coated imperfect surfaces, remove loose material, patch, sand, and repaint or recoat the patched portion to obtain a uniform colour and texture over the entire surface.
  - .5 Repaint or recoat entire surface where surrounding and/or adjacent surfaces cannot be matched.
- .2 Quality:
  - .1 In the sections of the Specifications which follow these general requirements, no concerted attempt has been made to describe each of the various existing products that must be used to patch, match, extend or replace existing Work. Obtain all such products in time to complete the Work on Schedule. Such products shall be provided in quality, which is in no way inferior to the existing products.
  - .2 The quality of the products that exist in the building, as apparent during pre-bid site visits, shall serve as the minimum specification requirement for strength, appearance and other characteristics.
- .3 Transitions:
  - .1 Where new Work abuts or finishes flush with existing Work, make the transition as smooth and workmanlike as possible. Perform patching Work to match existing adjacent Work in texture and appearance so as to make the patch or transition invisible to the eye at a distance of one (1) metre.
  - .2 In cases of extreme change of level such as 50mm or more, obtain instructions from Consultant as to method of making transition. Provide stepping, bulkheading, encasement, ramping, sloping or change of transition line, or any combination of these as directed in each case by Consultant.

- .4 Matching:
  - .1 Restore existing Work that is damaged during construction to a condition equal to its condition at the time of the start of such Work.
- .5 Overall requirement that the Work be complete:
  - .1 Where a product type of construction occurs in the existing building, and is not specified as a part of the new Work, provide such products or types of construction as needed to patch, extend or match the existing Work.
  - .2 These Specifications are not intended to describe existing products or standards of execution, nor will they enumerate products, which are not part of the new construction. The existing product is its own Specification.
  - .3 The presence of any product or type of construction in old Work shall cause its patching, extending or matching to be performed as necessary to make new Work complete and consistent, to identical standards of quality.

### **3.7 REPAIR**

- .1 Replace work damaged in the course of alterations, except at areas approved by Consultant in writing.
- .2 Where full removal of extensive amounts Work would be required to replace damaged portions, then filling, straightening and similar repair techniques, followed by full painting or other finishing, will be permitted.
- .3 If the repaired Work is not brought up to the standard for new Work, Consultant will direct that it be removed and replaced with new Work at no additional cost to the Owner.
- .4 Upon completion of work, remove debris, trim surfaces and leave work site clean.
- .5 Reinstall areas and existing works outside areas of demolition to conditions that existed prior to commencement of work.

### **3.8 CLEANING**

- .1 Clean in accordance with Section 01 74 11 – Cleaning.
- .2 Each Successive Trade:
  - .1 Clean Work area and make Work surfaces ready for the Work of the succeeding trades as each trade finishes its Work on each part of the alterations Work and related new Work.
  - .2 Clean or remedied immediately spillage, overspray, collections of dust or debris, damage to Owner-occupied spaces made by any responsible trade.
- .3 Each Area as it is Completed:
  - .1 Clean up all surfaces, remove equipment, salvage and debris and return in condition suitable for use by the Owner as quickly as possible as soon as Work in each area of the alterations is complete.
  - .2 Review final cleaning with Consultant prior to final acceptance.
  - .3 Reinstall areas and existing works outside areas of demolition to conditions that existed prior to commencement of work.

END OF SECTION

## **PART 1 GENERAL**

### **1.1 General and Related Work**

- .1 Read this section in conjunction with all other sections so as to comply with the requirements of Division 1 and the General Conditions of the Contract.
- .2 Related Work Specified Elsewhere

Division 13,	Section 02 83 11	Lead-Based Paint Abatement
Division 13,	Section 02 84 10	PCB Packaging and Disposal
Division 13,	Section 02 84 11	Mercury Packaging and Disposal
Division 13,	Section 02 87 00	Biohazard Remediation
- .3 The site conditions identify the location and condition of all known asbestos-containing materials (ACM) to be disturbed by the work of this section. The specification fulfils the requirements of the report required by Ontario Regulation 278/05.
- .4 Unless otherwise shown or specified it is the intent that work performed as per this section will result in the removal and disposal or decontamination of all ACM included in work of this section and all materials which have been contaminated by ACM either during or prior to work of this section.

### **1.2 Site Conditions**

- .1 The following reports are provided for reference. Pinchin relied solely on these reports for type of ACM present, locations and quantities of ACM, as required for the development of these specifications.
  - .1 “*Designated Substance Survey and Perchlorate Detection in Fume Hoods, OVC-Former VMI Building, University of Guelph-Physical Resource Dept.*” dated June 20, 2018. Prepared by Lex Scientific Solutions, File No. 01180066
  - .2 “*Spray-Applied Beam Insulation Inspection, OVC-Former VMI Building, University of Guelph-Physical Resource Dept.*” dated August 30, 2018. Prepared by Lex Scientific Solutions, File No. 01180066-B”

### **1.3 Outline of Work**

- .1 Refer to contract drawings for the extent of construction work and the Asbestos Work Areas.
- .2 Quantities provided in the specifications are approximate, it is the contractor’s responsibility to confirm all quantities provided and to verify all site conditions.
- .3 Coordinate the following items with the Contractor and the Consultant, which are to be included in the lump sum bid of the Abatement Contractor, including but not limited to: electrical isolations, GFI connection, water connections, hoarding walls, bin placement, hours of work, schedule, etc.
- .4 Within Wing C of the building, IT cables must be protected, cleaned and left in place during and after work. Coordinate with The Contractor and The Consultant to ensure this is completed properly.
- .5 Using Type 3 procedures, remove and dispose of the following within Corridors C201 and C202:

- .1 Sprayed fireproofing and overspray.
- .2 If sprayed prior to wall installation, remove top 6" of walls or partitions as required to access asbestos-containing sprayed fireproofing. Cut in clean straight line.
- .3 Asbestos-containing mechanical insulations.
- .4 Ceiling tiles, grid, supports and hangers.
- .5 Clean and protect non-asbestos mechanical insulations.
- .6 Column enclosures and check behind columns.
- .7 Check at base of all wall cavities for ACM debris.
- .8 All ductwork present, including flexible ducts, diffusers, VAV and mixing boxes, etc.
- .9 Exit signs.
- .10 Light fixtures, lamps and non-PCB ballasts.
  - .1 Package PCB ballasts as per Section 02 84 10.
- .11 All electrical services including but not limited to conduit, bx cable, junction boxes, telephone cord, computer cable, etc.
  - .1 NOTE: Within Wing C of the building, IT cables must be protected, cleaned and left in place during and after work. Coordinate with the Contractor and the Consultant to ensure this is completed properly.
- .12 Remove rigid ducts as required to clean the interior of all ductwork.
- .6 Using Type 3 procedures, remove and dispose of the following throughout the building:
  - .1 All ductwork present, including flexible ducts, diffusers, VAV and mixing boxes, etc.
  - .2 Ceiling tiles, grid, supports and hangers as necessary to access and remove ductwork.
    - .1 NOTE: Within Wing C of the building, IT cables must be protected, cleaned and left in place during and after work. Coordinate with the Contractor and the Consultant to ensure this is completed properly.
- .7 Using Type 3 procedures, remove and dispose of the following asbestos-containing materials:
  - .1 Parging cement present on pipe fittings in the following locations: Rooms 128, 130, 132, 133, 135, 138, 138A, 138B, 139, 139A, 140, 140A, Washroom 130, Washroom 117, 177A, 117B, 119, Sewage Room 120A, 123, 125A, 125B, 126, 126A, 126E, 127, Washroom 116, 116, 109, 109A, 109B, 102, 128, 124, 133A, Corridor 102, Corridor 103, 203, 204B, 206B, 206C, 209, 209A, 223, Corridor 201 and Penthouse Mechanical Room 222 (Approximately 411 fittings).
  - .2 Parging cement present on pipe fittings in inaccessible ceiling hatches in the following locations: Rooms 129, 132A, 132B, 132C, 117A, 117B, 121, 126D, Washroom 202, 201, Atrium 202, Corridor 100 and all stairwells (Unknown amount of fittings)
    - .1 Remove ceiling and fixtures as necessary to access these fittings.

- .3 Vinyl floor tiles and mastic present in the following locations:
  - .1 9"x9" Olive tiles with white streaks: Rooms 138A, 138B, 215, 215A, 215B, 215C, 215D, 216, 112, and C201 (approximately 256 square feet);
  - .2 9"x9" Brown tiles with white streaks: Rooms 123A, 221, Penthouse Mechanical Room 222 (bottom of stairs), 209, 209A, 210, 210A, 210B and 210C (approximately 612 square feet);
  - .3 9"x9" Grey tiles with white streaks: Rooms 128, 117A, 117B, 125B, 125A, 125, 126B, 126D, 214A, 214B, 215, 215A, 215B, 111, 203, 203A, 206A, 206B and 206C (approximately 2,223 square feet);
  - .4 Green/Blue tiles: Room 126 (approximately 270 square feet);
  - .5 9"x9" white tiles with green streaks: Rooms 132B and 126D (approximately 160 square feet);
  - .6 9"x9" teal tiles with white: Rooms 119 (approximately 96 square feet);
  - .7 9"x9" grey tiles with black: Rooms 123 and 124 (approximately 432 square feet);
  - .8 Black tiles with white streaks: Rooms 204B (approximately 40 square feet);
  - .9 9"x9" brown tiles with multicolour streaks: Rooms 203, 208, 210, 210A, 210B and 210C (approximately 912 square feet);
  - .10 9"x9" blue tiles with white streaks: Rooms 215, 215A, 215B, 215c, 215d, 216, 223, 204B, 213, 213A, 213B and 213C (approximately 839 square feet);
  - .11 9"x9" white tiles with brown streaks: Rooms 215C, 215D, 216, 219A, 219B, 220, 102, 203B, 207 and 207B (approximately 1,489 square feet);
  - .12 9"x9" red tiles with white streaks: Rooms 219, 219A, 219B, 219C, 128, 209, 209A and C201 (approximately 700 square feet);
  - .13 Army green tiles with white streaks: Rooms 213, 213A, 213B and 213C (approximately 170 square feet); and
  - .14 Black mastic adhesive below floor tiles: Found throughout the building except where there is terrazzo flooring and concrete flooring (approximately 18,000 square feet).
- .4 Presumed asbestos-containing gold antisweat mastic adhesive on the underside of sinks present in Rooms 209 and 209A (2 units).
- .5 Presumed asbestos-containing parge pipe and/or tank wrapping in the mechanical room 222 and Sewage Room 120A (approximately 6,000 square feet).
- .6 Presumed asbestos-containing transite board in Room 138 (approximately 70 square feet).
- .7 Presumed asbestos-containing fireproofing within two exterior column enclosures.

#### 1.4 Schedule

- .1 Coordinate all work with the Consultant.

- .1 A schedule is to be provided to the Consultant.
  - .1 The Contractor and the Consultant will provide advance notice to the University of Guelph – Physical Resources Dept. who will inform the school administration when work will be performed.
- .2 Perform the following work during Quiet Hours:
  - .1 Waste transfer.

## 1.5 Definitions

- .1 Asbestos: Any of the fibrous silicates defined in Regulation 278/05 including actinolite, amosite, anthophyllite, chrysotile, crocidolite and tremolite.
- .2 Asbestos Abatement Consultant: Owner's Representative providing inspection and air monitoring.
- .3 Asbestos Abatement Contractor: Contractor or sub-contractor performing work of this section.
- .4 Asbestos-Containing Material(s) (ACM): Material(s) identified under Site Conditions including debris, fallen material and settled dust.
- .5 Asbestos Work Area: Area where work takes place which will, or may, disturb ACM.
- .6 Authorized Visitors: Prime Contractor, Building Owner or Representatives, Asbestos Abatement Consultant, and persons representing regulatory agencies.
- .7 Competent Worker: A worker who is qualified because of knowledge, training and experience to perform the work, is familiar with Regulation 278/05 and the Occupational Health and Safety Act, and has knowledge of the potential or actual danger to health and safety in the work.
- .8 DOP Testing (or HEPA Integrity Test): Testing performed on HEPA Filtered Negative Pressure Machines and HEPA vacuums using DOP or equivalent. Testing shall ensure that total penetration from the unit does not exceed 0.03%, or 99.97% efficient of airborne particulate removal. DOP Testing must be in compliance with ASME N510-1989 (1995) and must be performed using a Temporary Mixing Chamber with installed baffles to allow uniform mixing of challenge aerosol.
- .9 Fitting: Section of pipe other than straight uninterrupted sections including elbows, valves, tees, hangers, nipples, union or ends.
- .10 Friable Material: means a material when dry can be crumbled, pulverized or powdered by hand pressure or is crumbled, pulverized or powdered.
- .11 HEPA Filter: High Efficiency Particulate Arresting filter that is at least 99.97 percent efficient in collecting a 0.3 micrometre aerosol.
- .12 Polyethylene: Either polyethylene sheeting or rip-proof polyethylene sheeting (as specified) with tape along edges, around penetrating objects, over cuts and tears, and elsewhere as required to provide a continuous polyethylene membrane to protect underlying surfaces from damage, and to prevent escape of asbestos fibres through sheeting into Occupied Areas.
- .13 PCM: Phase Contrast Microscopy

- .14 Personnel: All contractors' employees, sub-contractors employees, supervisors.
- .15 Occupied Area: Any area of the building outside the Asbestos Work Area.
- .16 Remove: Remove means remove and dispose of (as applicable type of waste) unless followed by other instruction (e.g. remove and turn over to Owner).
- .17 TEM: Transmission Electron Microscopy

## **1.6 Submittals**

- .1 Submit prior to starting work:
  - .1 Schedule.
  - .2 Workplace Safety and Insurance Board Clearance Certificate.
  - .3 Insurance certificates.
  - .4 Copy of Company Health and Safety Policy and applicable Programs.
  - .5 Ministry of Labour Notice of Project form.
  - .6 Copy of Certificate of Approval for transportation of asbestos waste and location of landfill.
  - .7 Pre-removal survey of damage in all areas where asbestos abatement will take place or waste will be transported.
- .2 Submit the following information regarding personnel prior to starting work:
  - .1 Resumes of the supervisory personnel.
  - .2 Proof in the form of a certificate that supervisory personnel have been certified as supervisors under the Ministry of Training, Colleges and Universities course 253S.
  - .3 Proof in the form of a certificate that workers have been certified under the Ministry of Training, Colleges and Universities course 253W.
  - .4 WHMIS training certificates for all personnel.
  - .5 Certificate proving that each worker or supervisor on site has been fit tested for the respirator appropriate for the work being performed.
- .3 Submit the following information regarding HEPA filtered devices prior to construction of enclosure or asbestos abatement:
  - .1 Performance data on HEPA filtered vacuums including DOP tests no more than 3 months old.
  - .2 Performance data on negative air units including DOP tests which must be no more than 3 months old if the unit is vented outdoors or which must be performed on site immediately prior to initial usage and when HEPA filters are changed or the unit is vented indoors.
  - .3 DOP tests to be performed by an independent testing company.
    - .1 DOP testing company is required to submit a detailed technical report of testing protocol, including Introduction, Methodology, Results, Conclusions, and Recommendations, including results of the Air-Aerosol Mixing Uniformity test as per ASME N510-1989 (1995).

- .2 DOP testing company must also provide calibration certificates from an independent calibration firm or from the manufacturer of the testing equipment for both the aerosol photometer and the pressure gauge on the aerosol generator dated within 1 calendar year from the on-site testing date.
- .3 DOP testing company must also provide the National Sanitation Foundation (NSF) certification name and number of the on-site technician performing the testing.
- .4 Submit the following prior to isolating the work area:
  - .1 Written statement that the Ground Fault Interrupter Panels use CSA approved parts and have been inspected by the Electrical Safety Authority.
  - .2 Material Safety Data Sheets for chemicals or material used in the course of the Asbestos Abatement Project.
- .5 Submit the following upon completion of the work.
  - .1 Manifests, waybills, bills of lading etc. as applicable for each type of waste.

#### **1.7 Regulations**

- .1 Comply with Federal, provincial, and local requirements, provided that in any case of conflict among those requirements or with these Specifications the more stringent requirements shall apply. Work shall be performed under regulations in effect at the time work is performed. Regulations include but are not limited to the following:
- .2 Ministry of Labour Occupational Health and Safety Act Regulations for Construction Projects including Revised Statutes of Ontario 1990, Chapter 0.1 and Ontario Regulation 278/05.
- .3 Ministry of Transportation Regulations for the transport of asbestos waste, including the Transportation of Dangerous Goods Act.
- .4 Ministry of Environment Regulations for the disposal of asbestos waste, including R.R.O. 1990, Reg. 347 as amended.

#### **1.8 Supervision**

- .1 Provide on-site, a supervisor, with authority to oversee all aspects of the work, including but not limited to, health and safety, methods, scheduling, labour and equipment requirements.
- .2 The supervisor must be on site at all times during work at risk of disturbing ACM. Failure to comply with this requirement may result in a stoppage of work, at no cost to the Owner.
- .3 Provide a minimum of one supervisor for every 10 workers.
- .4 Replace supervisory personnel, with approved replacements, within 3 working days of a written request from the Asbestos Abatement Consultant. Asbestos Abatement Consultant reserves the right to request replacement of supervisory personnel without explanation.

- .5 Do not replace supervisory personnel without written approval from the Asbestos Abatement Consultant.

#### **1.9 Quality Assurance**

- .1 Ensure the removal and handling of ACM or asbestos contaminated materials is performed by persons experienced in the methods, procedures and industry practices of asbestos abatement.
- .2 Complete work so that at no time airborne asbestos, visible solid residue, or water runoff contaminates areas outside Asbestos Work Area. Asbestos Abatement Consultant is empowered to order a shutdown of work when a leak has occurred or is likely to occur. Cost of additional work by Asbestos Abatement Contractor and/or Asbestos Abatement Consultant to rectify unsatisfactory conditions shall be charged to the Asbestos Abatement Contractor.
- .3 Perform all work involving other trades such as electrical, mechanical, carpentry, glazing etc. using licensed persons experienced and qualified for the work required.
- .4 The Asbestos Abatement Consultant will not be responsible for and will not have control or charge of construction means, methods, techniques, sequences or procedures, or for safety precautions and programs required for the Work in accordance with the applicable construction safety legislation, other regulations or general construction practice. The Asbestos Abatement Consultant will not be responsible for or have control or charge over the acts or omissions of the Asbestos Abatement Contractor, his Subcontractors or their agents, employees or other persons performing any of the Work.

#### **1.10 Notification**

- .1 Before commencing work, notify orally and in writing, an inspector at the office of the Ontario Ministry of Labour nearest the project site.
- .2 Notify Sanitary Landfill site as per Ontario Regulation 347 as amended.
- .3 Inform all sub trades of the presence of ACM identified in the contract documents.
- .4 Notify the Owner or Owners Representative, the Joint Occupational Health and Safety Committee and the Ontario Ministry of Labour, as required by Regulation 278/05, if friable materials not identified in the contract documents are discovered during the course of the work. Stop work in these areas immediately.

#### **1.11 Insurance**

- .1 Maintain a Commercial General Liability Policy with an insurance company acceptable to Pinchin Ltd. and The University of Guelph – Physical Resources Dept. The intent of this policy is to hold Pinchin Ltd. and The University of Guelph – Physical Resources Dept. harmless as it relates to claims for Bodily Injury or Property Damage or both, relating to the contract. Commercial General Liability insurance shall be provided on an “occurrence” basis to cover injury or damage (whether detected or not during the policy period) which happens during the policy period.
- .2 Maintain an Automobile or Fleet Policy, and Non-owned Automobile Policy with an insurance company acceptable to Pinchin Ltd. and The University of Guelph – Physical Resources Dept. The intent of these policies is to hold Pinchin Ltd. and The University

of Guelph – Physical Resources Dept. harmless as it relates to claims for Bodily Injury or Property Damage or both, relating to the contract.

- .3 Maintain a Pollution Liability Policy (or asbestos liability policy or specific coverage under the CGL for asbestos abatement) with an insurance company acceptable to Pinchin Ltd. and The University of Guelph – Physical Resources Dept. The intent of this policy is to hold Pinchin Ltd. and The University of Guelph – Physical Resources Dept. harmless as it relates to claims for Bodily Injury or Property Damage or both, relating to the contract. Pollution Liability shall be provided on an “occurrence” basis to cover injury or damage (whether detected or not during the policy period) which happens during the policy period. Without limiting the generality of the foregoing, the policy shall insure the operations of asbestos abatement and shall not contain any environmental and/or health hazard exclusions relating to remediation operations including asbestos abatement.
- .4 Forward all certificates to Pinchin Ltd. and The University of Guelph – Physical Resources Dept. before work is commenced, showing Pinchin Ltd. and The University of Guelph – Physical Resources Dept. as additional insured as their interest may appear.
- .5 The University of Guelph – Physical Resources Dept. may request a certified true copy of the policies.
- .6 The limits will not be less than:

.1	Commercial General Liability	\$5,000,000.00
.2	Automobile	\$2,000,000.00
.3	Pollution Policy (Asbestos Liability)	\$5,000,000.00

#### **1.12 Personal Protection**

- .1 Protect all personnel at all times when possibility of disturbance of ACM exists.
- .2 Provide the following respiratory protection to all personnel:
  - .1 Full Face Powered Air Purifying Respirators with P100 high efficiency (HEPA) cartridge filters during projects when performing wet abatement of sprayed fireproofing or texture coat containing chrysotile asbestos, or wet abatement of other non-surfacing asbestos-containing material specified in this section.
  - .2 Non-powered half-face respirators with P100 high efficiency (HEPA) cartridge filters for dismantling of Type 3 enclosures, using Type 2 Procedures.
- .3 Respirators shall be:
  - .1 Certified by the National Institute of Occupational Safety and Health (NIOSH) or other testing agency acceptable to the Ministry of Labour.
  - .2 Fitted so that there is an effective seal between the respirator and the worker’s face. Ensure that no person required to enter an Asbestos Work Area has facial hair which affects the seal between respirator and face.
  - .3 Assigned to a worker for their exclusive use.
  - .4 Maintained in accordance with manufacturer’s specifications.
  - .5 Cleaned, disinfected and inspected by a competent person after use on each shift, or more often if required.

- .6 Repaired or have damaged or deteriorated parts replaced.
- .7 Stored in a clean and sanitary location.
- .8 Provided with new filters as necessary, according to manufacturer's instructions.
- .9 Worn by personnel who have been fit checked by qualitative or quantitative fit-testing. Instruction must be provided by a competent person as defined by the Occupational Health and Safety Act.
- .4 Provide protective clothing, to all personnel which:
  - .1 Is made of a material that does not readily retain nor permit penetration of asbestos fibres.
  - .2 Consists of head covering and full body covering that fits snugly at the ankles, wrists and neck.
  - .3 Is replaced or repaired if torn or ripped.
  - .4 Is disposed of as ACM.
- .5 Wear hard hats, safety shoes and other personal protective equipment required by applicable construction safety regulations.
- .6 Provide site specific instruction to workers before allowing entry to Asbestos Work Area. Instruction shall include training on entry and exit from Asbestos Work Areas. Instruction must be provided by a competent person as defined by the Occupational Health and Safety Act.
- .7 Provide soap, shampoo and towels for use by all personnel when leaving the Asbestos Work Area.
- .8 Prohibit smoking, eating, drinking, chewing in the Asbestos Work Area and Decontamination Facilities.

#### **1.13 Asbestos Abatement Work Area Entry Procedures**

- .1 Use the following procedure to enter contaminated Asbestos Work Area:
  - .1 Remove street clothes in Clean Change Room.
  - .2 Put on respirator with new or tested filters, and protective clothing in Clean Change Room or clean side of Shower Room.
  - .3 Store all street clothes, uncontaminated footwear, towels, etc. in the Clean Change Room.

#### **1.14 Asbestos Abatement Work Area Exit Procedures**

- .1 Use the following procedure to exit contaminated Asbestos Work Area:
  - .1 Remove gross contamination from protective clothing using HEPA vacuum or by wet wiping.
  - .2 Proceed to Equipment and Access Room and remove all contaminated clothing and equipment except respirator.
  - .3 Store contaminated footwear, hard hats, etc. in Equipment and Access Room.
  - .4 Proceed naked to shower while still wearing respirator.

- .5 Shower, cleaning outside of respirator with soap and water. Thoroughly wet body, head and hair, remove respirator and wash body, head and hair. Wet clean inside of respirator face piece.
- .6 Remove filters for testing or dispose of in container provided for this purpose. Remove after leaving the Shower but prior to entering the Clean Change Room.
- .7 Proceed to the Clean Change Room, dry off and dress in street clothing.
- .8 Maintain and disinfect respirator.

#### **1.15 Authorized Visitor Protection**

- .1 Provide clean protective clothing and equipment, and approved respirators to Authorized Visitors.
- .2 Ensure Authorized Visitors have received required training prior to granting entry into Asbestos Work Area.

#### **1.16 Air Monitoring**

- .1 Air monitoring will be performed following the National Institute for Occupational Safety and Health method 7400, Asbestos and other fibres by PCM (Phase Contrast Microscopy).
- .2 Co-operate with the Asbestos Abatement Consultant in collection of air samples. Asbestos Abatement Contractor to exercise care with Asbestos Abatement Consultant's equipment. The Owner reserves the right to back-charge the Asbestos Abatement Contractor for further collection of samples damaged by tampering or abuse. In addition, the Asbestos Abatement Contractor will be responsible for the cost of testing equipment repairs resulting from the actions of the Asbestos Abatement Contractor's forces.
- .3 PCM samples will be collected from within the Asbestos Work Area, after the site has passed a visual inspection and an acceptable coat of post removal sealant has been applied. These airborne fibre levels *must not exceed* 0.01 fibre/mL, after forced air monitoring and PCM analysis (Air Monitoring Clearance Inspection). If these results show fibre levels in excess of 0.01 fibre/mL:
  - .1 Maintain Asbestos Work Area isolation.
  - .2 Re-clean entire Asbestos Work Area.
  - .3 Apply another acceptable coat of post removal sealant to exposed surfaces throughout the Work area.
  - .4 Repeat above measures until visually inspected and air monitoring results are at a level equal to that specified.
  - .5 Alternate to items 2-4 above, the Asbestos Abatement Contractor can pay for analysis of samples by Transmission Electron Microscopy (TEM). Laboratory performing TEM analysis is to be NVLAP accredited.
- .4 Cost of additional inspection and sampling performed as a result of elevated fibre levels may be charged to the Asbestos Abatement Contractor at the Owner's discretion.

#### **1.17 Inspection**

- .1 From commencement of work until completion of clean-up operations, the Asbestos Abatement Consultant will be present periodically on site both inside and outside the Asbestos Work Area.
- .2 The following Milestone Inspections will take place, at the Owner's cost:
  - .1 Milestone Inspection A - Clean Site Preparation
    - .1 Inspection of preparations and set-up prior to contaminated work in the Asbestos Work Area.
  - .1 Milestone Inspection B - Contaminated Perimeter Preparation
    - .1 Inspection of preparations at perimeter of Asbestos Work Area.
  - .2 Milestone Inspection C - Before Bulk Removal
    - .1 Inspection of Asbestos Work Area prior to start of major ACM removal.
  - .3 Milestone Inspection D - Visual Clearance
    - .1 Inspection of Asbestos Work Area after removal of all asbestos, but prior to application of lock-down agent.
  - .4 Milestone Inspection E - Air Monitoring Clearance
    - .1 Inspection and air monitoring after the application of lock-down agent, but prior to removal of Polyethylene from within the Asbestos Work Area.
  - .5 Milestone Inspection F - Dismantling Inspection
    - .1 Inspection after removal of Polyethylene prior to dismantling perimeter seal and decontamination facility.
- .3 Do not proceed with next phase of Work until written approval of each milestone is received from the Asbestos Abatement Consultant.
- .4 In addition to the Milestone Inspections, inspection of the Asbestos Work Area may be performed to confirm the Asbestos Abatement Contractor's compliance with the requirements of the contract documents and governing authorities. Any deviations from these requirements that have not been approved in writing, may result in a stoppage of work, at no additional cost to the Owner.
- .5 The Asbestos Abatement Consultant is empowered by the Owner to inspect for final cleanliness at completion. Additional labour or materials expended by the Asbestos Abatement Contractor to provide satisfactory performance to the level specified shall be at no additional cost.
- .6 Inspection and air monitoring performed as a result of Asbestos Abatement Contractor's failure to perform satisfactorily regarding quality, safety, or schedule may be charged to the Asbestos Abatement Contractor at the Owner's discretion.

#### **1.18 Differential Pressure Monitoring**

- .1 Install differential pressure monitor at a location chosen by the Asbestos Abatement Consultant.
- .2 Replace damaged or non-functional equipment at the request of the Asbestos Abatement Consultant.

- .3 Co-operate with the Asbestos Abatement Consultant in collection of pressure monitoring data.
- .4 Maintain specified differential pressure at monitoring location. Negative air pressure is to be -0.02 inches of water, relative to the area outside the enclosed area
- .5 Record data at start and end of shift and maintain records on file.
- .6 Stop contaminated work and take corrective action if pressure differential drops below the specified level. Notify Asbestos Abatement Consultant immediately.

## **PART 2 PRODUCTS AND FACILITIES**

### **2.1 Materials and Equipment**

- .1 All materials and equipment brought to work site must be in good condition and free of asbestos, asbestos debris, and fibrous materials.
- .2 Airless Sprayer: AC powered pressure washer that allows wetting agent to mix with water, uses no air or compressed air, and has a nozzle to regulate power and pressure.
- .3 Amended Water: Water with wetting agent added for purpose of reducing surface tension to allow thorough wetting of ACM.
- .4 Asbestos Waste Container: An impermeable container acceptable to disposal site and Ministry of the Environment comprised of one of the following:
  - .1 A 6 mil (0.15 mm) labelled yellow sealed polyethylene bag, inside a second clear 6 mil (0.15 mm) sealed polyethylene bag.
  - .2 A 6 mil (0.15 mm) sealed polyethylene bag, positioned inside or outside a rigid sealed container of sufficient strength to prevent perforation of the container during filling, transportation and disposal.
  - .3 Labelled containers as required by the Ontario Ministry of the Environment Reg. 347 as amended and Regulation 278/05.
- .5 Differential Pressure Monitor: a high precision instrument for measuring and controlling pressure differences in the low range, between the Asbestos Work Area and occupied area. Acceptable Product: Magnehelic gauge (Cat. No. 2000-00) manufactured by Dwyer Instruments Inc. or equivalent. Calibrate regularly to manufacturer's instructions.
- .6 Discharge Ducting: Polyethylene Tubing. Reinforced with wire. Diameter equal to negative pressure machine discharge. Not to be longer than required, or so long that negative pressure is compromised.
- .7 Ground Fault Panel: Electrical panel as follows:
  - .1 Ground fault circuit interrupters of sufficient capacity to power temporary electrical equipment and lights in Asbestos Work Area.
  - .2 Interrupters to have a 5 mA ground fault protection.
  - .3 Necessary accessories including main switch disconnect, ground fault interrupter lights, test switch to ensure unit is working, and reset switch.
  - .4 Openings sealed to prevent moisture or dust penetration.
  - .5 Inspected by the Electrical Safety Authority.

- .6 Panel uses CSA approved parts and been constructed, inspected and installed by a licensed electrician.
- .8 HEPA Filtered Negative Pressure Machine: Portable air handling system which extracts air directly from the Asbestos Work Area and discharges the air to the exterior of the building. Equipped as follows:
  - .1 Prefilter and HEPA filter. Air must pass HEPA filter before discharge.
  - .2 Pressure differential gauge to monitor filter loading.
  - .3 Auto shut off and warning system for HEPA filter failure.
  - .4 Separate hold down clamps to retain HEPA filter in place during change of prefilter.
- .9 HEPA Vacuum: High Efficiency Particulate Arresting (HEPA) filtered vacuum equipment with a filter system capable of collecting and retaining 0.3 micron spherical particles greater than 0.3 microns at 99.97% efficiency.
- .10 Hose: Leak-proof, minimum bursting strength of 200 PSI or greater if required, abrasion resistant covering, reinforcing, and machined-brass couplings. Maintained and tested. Hose to be temperature resistant if it is to carry domestic hot water.
- .11 OSB: Oriented Strand Board.
- .12 Polyethylene Sheeting: 6 mil (0.15 mm) minimum thickness unless otherwise specified in sheet size to minimize joints. New materials only.
- .13 Post Removal Sealant (or Lockdown): Sealant that when applied to surfaces serves the function of trapping residual asbestos fibres or other dust. Product must have flame spread and smoke development ratings both less than 50. Product shall leave no stain when dry. Post Removal Sealant shall be compatible with replacement insulation or fireproofing where required and capable of withstanding service temperature of substrate. Apply to manufacturer's instructions.
- .14 Protective Clothing: Disposable full body coveralls complete with hoods manufactured of a material which does not permit penetration of asbestos fibres. Coveralls to fit snugly at ankles, wrists and neck. Acceptable materials: Dupont Tyvek or Kimberly Clark Kleenguard.
- .15 Rip-Proof Polyethylene Sheeting: Minimum requirements 8 mil (0.20 mm) fabric made up from 5 mil (0.13 mm) weave and 2 layers of 1.5 mil (0.05 mm) poly laminate or approved equal. In sheet size to minimize on-site seams and overlaps. New materials only.
- .16 Shower Hose: Water lines for supply of hot & cold water to shower facilities to be rated for use at 200 PSI (1380 kPa) or twice the working pressure whichever is greater. Supply lines to be continuous and free of fittings, joints or couplings.
- .17 Sprayer: Garden type portable manual sprayer or water hose with spray attachment if suitable.
- .18 Tape: Duct tape or tape suitable for sealing polyethylene to surfaces under both dry and wet conditions in the presence of Amended Water.

- .19 Wetting Agent: Non-sudsing surfactant added to water to reduce surface tension and increase wetting ability.

## 2.2 Hoarding Walls

- .1 Type A Hoarding Wall: 38 mm x 89 mm wood or metal studs at 400 mm o/c with continuous sill and top plate, covered with one layer of rip-proof polyethylene sheeting on each side of wall.
- .2 Type F Hoarding Wall: Upper perimeter hoarding wall - 38 mm x 89 mm wood or metal studs at 400 mm o/c with continuous sill and top plate, covered with 2 layers of polyethylene sheeting on Asbestos Work Area side. Anchor wall to underside of structure and extend down to top of ceiling or top of wall/hoarding wall below. Install wall under contaminated conditions.
- .3 Windows: Install sufficient transparent windows in hoarding walls to allow observation of entire work area from outside the enclosure where existing solid walls do not make up the perimeter.

## 2.3 Decontamination Facilities

- .1 Workers' Decontamination Facility: A decontamination facility comprised of three linked rooms, Contaminated Change Room, a Shower Room, and a Clean Change Room.
  - .1 Rooms, Occupied Areas and Asbestos Work Areas, shall be separated by curtained doorways at each door.
- .2 Contaminated Change Room: Room between Shower Room and Asbestos Work Area.
  - .1 Locate on contaminated side of Shower Room.
  - .2 Install asbestos waste container for asbestos contaminated protective clothing.
  - .3 Install storage facilities for any personal protective equipment to be reused in Asbestos Work Area including boots, hard hats, etc., but excluding respirators.
  - .4 Install hooks and shelves as required for personal protective equipment.
  - .5 Minimum size of generally 2 m x 2 m. Increase size accordingly to accommodate number of workers.
- .3 Shower Room: Room between Clean Change Room and Contaminated Change Room.
  - .1 Install one walk through shower unit for every six workers.
  - .2 Install constant supply of hot and cold water, controllable at each shower. Water supply must be sufficient to provide water at a minimum temperature of 40 degrees Celsius (maximum 50 degrees) in a volume required for all workers to properly decontaminate.
    - .1 Install individual hot and cold shut-off valves on water supply located on clean side of Shower Room. Connect shower to these valves.
    - .2 Install individual controls inside the shower to regulate water flow and temperature.
  - .3 Install rigid piping or Shower Hose with watertight connections for supply and drains.
  - .4 Install a sealed drip pan under and around the showers, 150 mm deep.

- .5 Install sump pumps, sufficient for volume of waste shower water from showers and drip pan. Direct waste shower water to sanitary drains.
- .6 Install ground fault protected power switch on clean side of shower for sump pumps, or timed for shut off.
- .7 Provide adequate quantity of soap, shampoo, clean towels
- .8 Install an Asbestos Waste Container for disposal of used respirator filters, on the contaminated side of the Shower Room.
- .4 Clean Change Room: A room between the Shower Room and Occupied Areas.
  - .1 Install hooks and shelves on clean side of shower in clean Change Room for storage of respirators.
  - .2 Install lockers or hangers for workers' street clothes and personal belongings.
  - .3 Install vented wood door in wood frame at doorway to Occupied Area. Door must have locking passage set. Provide two keys to Asbestos Abatement Consultant and one to Owner.
  - .4 Install hose bib on domestic cold water pipe for connection on clean side of Asbestos Work Area.
  - .5 Install electric hot water heater/tank for showers in decontamination facility.
  - .6 Provide ground fault protected power supply to hot water tanks, sump pump, battery chargers.
  - .7 Install a fire extinguisher, mount to wall.
  - .8 Minimum size of generally 2m x 2m. Increase size accordingly to accommodate number of workers.
- .5 Waste and Equipment Decontamination Facility: Waste and Equipment Decontamination Facility comprised of three linked rooms: a Container Cleaning Room, a Holding Room and a Transfer Room.
  - .1 Purpose of Waste and Equipment Decontamination Facility is to provide a means to decontaminate asbestos waste containers, scaffolding, vacuums, and other tools and equipment and materials required in the Asbestos Work Area.
  - .2 Rooms, Occupied Areas and Asbestos Work Areas, shall be separated by curtained doorways at each door.
- .6 Container Cleaning Room: Room between Asbestos Work Area and Holding Room of sufficient size to allow proper washing of equipment and waste containers or double bagging of asbestos waste. All wash water shall be treated as asbestos contaminated waste.
- .7 Holding Room: Room between Container Cleaning Room and Transfer Room, of sufficient size to accommodate at least two asbestos waste containers and two workers double bagging waste, or for largest item of equipment used.
  - .1 Install a fire extinguisher mounted to wall.
- .8 Transfer Room: Room between Holding Room and Occupied Area, acting as an air lock for the transfer of waste.

- .1 Install vented wood door in wood frame at doorway to Occupied Area. Door must have locking passage set. Provide two keys to Asbestos Abatement Consultant and one to Owner.
- .9 Construction of Decontamination Facilities
  - .1 Install floor protection as follows:
    - .1 Install one layer of rip-proof polyethylene sheeting over two layers of 6 mil polyethylene sheeting beneath entire decontamination facility.
    - .2 Turn 600 mm of polyethylene up the sides of the decontamination facility and overlap with the polyethylene sheeting covering the walls.
    - .3 Install plywood with taped and caulked joints between layers of 6 mil polyethylene where required to protect surfaces from water damage (e.g. carpet).
  - .2 Install walls as follows:
    - .1 Around all rooms, between all rooms, at entrance to Asbestos Work Area and at entrance to Occupied Area.
    - .2 Install 38 x 89 mm wood framing at 610 mm o/c with continuous top and sill plates.
    - .3 Install one layer rip-proof polyethylene sheeting on interior walls of Decontamination Facility.
    - .4 Install one layer rip-proof polyethylene sheeting both sides on interior dividing walls of Decontamination Facility.
    - .5 Install one layer rip-proof polyethylene sheeting over one layer of 6 mil polyethylene sheeting on walls exposed to the Asbestos Work Area.
    - .6 Install one layer rip-proof polyethylene sheeting over one layer of 6 mil polyethylene sheeting on walls exposed to the Occupied Area.
  - .3 Install roof as follows:
    - .1 Install joists. Size of joists is to be determined by clear span. Consult Ontario building Code (Table A-1). For clear spans up to 2850 mm use SPF Select 38 x 140 mm wood joist at 400 mm o/c with continuous 38 x 140 mm wood headers, and install strapping beneath joists.
    - .2 At the Contaminated Change Room and where roof is exposed to the Asbestos Work Area, install 19 mm plywood or OSB over joists. Caulk and tape joints and install one layer rip-proof polyethylene sheeting over 2 layers of 6 mil polyethylene sheeting.
    - .3 Where roof is not exposed to the Asbestos Work Area, install one layer rip-proof polyethylene sheeting over joists.
    - .4 Turn 600 mm of polyethylene down the sides over polyethylene on the perimeter walls.
    - .5 At underside of joists in all rooms, install one layer of polyethylene sheeting.
    - .6 Minimum interior clear height 2000 mm to underside of joist.
- .10 Curtained Doorways

- .1 Construct as follows:
  - .1 Install two flap doors, full width and height of door opening at all doors between chambers, facilities and Asbestos Work Area.
  - .2 Construct each flap door of two layers of polyethylene sheeting with all edges reinforced with tape. Use wood strapping to securely fasten flap doors to head and alternate jambs.
  - .3 Install weights attached to bottom edge of each door flap.
  - .4 Provide direction arrows on flaps to indicate opening.

## **2.4 Signage**

- .1 Work Area Signs: Post signs in both official languages at access points to the Asbestos Work Area and on hoarding walls as follows:
  - .1 CAUTION.
  - .2 Asbestos Dust Hazard Area.
  - .3 Unauthorized Entry Prohibited.
  - .4 Wear Assigned Protective Equipment.
  - .5 Breathing Asbestos Dust May Cause Serious Bodily Harm.
- .2 Vehicles, Bins and Asbestos Waste Containers: Post signs on both sides of every vehicle used for the transportation of asbestos waste and on every asbestos waste container. Signs must display thereon in large, easily legible letters that contrast in colour with the background the word “CAUTION” in letters not less than ten centimetres in height and the words:
  - .1 CONTAINS ASBESTOS FIBRES
  - .2 Avoid Creating Dust and Spillage
  - .3 Asbestos May be Harmful to Your Health
  - .4 Wear Approved Protective Equipment.
- .3 Place placards in accordance with Transportation of Dangerous Goods Act.

## **PART 3 EXECUTION**

### **3.1 Clean Site Preparation**

- .1 Perform pre-removal damage survey and submit to Asbestos Abatement Consultant.
- .2 Moving of equipment, tools, supplies, and stored materials that can be performed without disturbing ACM will be performed by others.
- .3 Remove visible dust and friable material from all surfaces in the work area including those to be worked on, using HEPA Vacuums or wet wiping using Type 2 Procedures as required by O. Reg. 278/05.
- .4 Maintain emergency and fire exits from Asbestos Work Area, or establish alternative exits satisfactory to Provincial Fire Marshall and local authorities having jurisdiction. Maintain extra routes from occupied areas. Place emergency exit signs at locations to clearly mark exit route. Seal emergency exit doors so as not to impede use of door during emergency evacuation.

- .5 Remove surface mounted fixtures specified to be reused or turned over to Owner.
- .6 Install Hoarding Walls between Asbestos Work Area and Occupied Area.
- .7 Install Worker Decontamination facility.
- .8 Install Waste Decontamination facility.
- .9 Install signage in clearly visible locations and in sufficient numbers to adequately warn of an asbestos dust hazard.
- .10 Post Ministry of Labour Notice of Project.
- .11 Install one layer of rip-proof polyethylene sheeting over two layers of 6 mil polyethylene sheeting so as to protect all equipment and finishes in the Asbestos Work Area that may be damaged. Items to remain include but are not limited to:
  - .1 Millwork.
  - .2 Doors.
  - .3 Bulkheads.
  - .4 Toilet Partitions.
  - .5 Plumbing fixtures.
  - .6 Electrical Equipment.
  - .7 Mechanical Equipment.
  - .8 Kitchen Equipment.
  - .9 Protect pneumatic control lines located in Asbestos Work Area. Notify Asbestos Abatement Consultant if lines are or become damaged.
- .12 Seal openings (excepting electrical trenches) in floor using tape, caulking, polyethylene, etc. Openings in floor are to be sealed independently prior to installation of polyethylene sheeting on floor. Include floors of duct and service shafts.
  - .1 Large openings in floor to be covered. Construction to comply with loading requirements of Ontario building Code and secured in place. Surround with guard rails as per the Occupational Health and Safety Act. Install one layer of rip proof polyethylene over two layers of 6 mil polyethylene over cover. Mark as opening to below. No personnel are to walk or stand on covered opening unless constructed to support live and dead load.
- .13 Seal openings in walls below ceiling level using polyethylene, tape, caulking, etc. including but not limited to windows, doors, vents, diffusers, etc.
- .14 Seal openings in ceiling, using polyethylene, tape, caulking, etc. including diffusers, grills, etc.
- .15 Establish negative pressure in Asbestos Work Areas as follows:
  - .1 Install HEPA Filtered Negative Pressure Machines sufficient to maintain pressure differential of -0.02 inches of water between contaminated Asbestos Work Area and Occupied Areas.
  - .2 Arrange HEPA Filtered Negative Pressure Machines to maximize differential pressure in Asbestos Work Area.

- .3 Install weighted flaps in perimeter Hoarding Walls as necessary to provide make-up air.
- .4 Operate HEPA Filtered Negative Pressure Machines continuously from first disturbance of ACM until completion of dismantling.
- .5 Replace prefilters frequently to maintain specified flow rate.
- .6 Replace HEPA filters as required to maintain flow rate and integrity of unit.
- .7 Discharge HEPA filtered negative pressure machines as follows:
  - .1 To building exterior.
    - .1 Direct discharge away from building access points.
  - .2 Use polyethylene discharge ducting or metal reinforced polyethylene discharge ducting in locations where the ducting must be protected from damage or collapse.
  - .3 Install and make airtight all negative air discharge ducting.
  - .4 Discharge ducting is not to be longer than required, and to be straight, so that the length of the ducting does not reduce the flow from negative pressure machines.
- .8 DOP test all HEPA Filtered Negative Pressure Machines.
- .16 Provide one Ground Fault Panel for each 5,000 square feet (500 square metres) of Asbestos Work Area.
  - .1 Ground Fault Interrupter Panel to use CSA approved equipment and be inspected by the Electrical Safety Authority.
  - .2 Ensure safe installation by licensed electricians.
  - .3 Connect to building power at electrical panel outside Asbestos Work Area.
  - .4 Cable to be completely jacketed with no defects. Tag/mark cable as Live.
  - .5 All electrical equipment used during work shall be supplied power from a Ground Fault Panel.
- .17 Install temporary lighting in all work areas at levels that will provide for a safe and efficient use of the work area.
- .18 Isolate, at panel, and disconnect existing power supply to Asbestos Work Area. Power supply to remaining areas of building must not be disrupted during work of this section.
  - .1 Lock-out/tag-out power at electrical panels.
  - .2 Mark/tag any items within or passing through the Asbestos Work Area that are to remain live including but not limited to cable, conduit, wire, fixtures, equipment panels, etc.
- .19 Install hose bib on domestic cold water pipe for connection of hoses for wetting.
  - .1 Install hoses with watertight connections and airless sprayers to wet asbestos-containing materials.
- .20 Shut down HVAC systems serving the Asbestos Work Area.
  - .1 Leave induction units at building exterior walls on lowest supply setting when temperatures are below 0°C so windows and exterior walls do not ice.

- .2 Disable any exhaust/return systems at induction units, washrooms, etc.
- .3 Seal and protect induction units with one layer of 6 mil polyethylene sheeting.
- .21 Perform clean demolition of non-asbestos materials as specified.
- .22 Install one layer of rip-proof polyethylene sheeting over two layers of 6 mil polyethylene sheeting, on floor surfaces in Asbestos Work Area.
  - .1 Install additional layers of rip-proof polyethylene and/or plywood to protect carpeted floor surfaces.
  - .2 Extend floor protection a minimum of 300 mm up all vertical surfaces in the Asbestos Work Area.
- .23 On walls within and forming the perimeter of the Asbestos Work Area install two layers of 6 mil polyethylene sheeting.
  - .1 At junction of floor and wall surface overlap floor polyethylene with wall polyethylene by a minimum of 300 mm at each layer. One layer of wall polyethylene must always overlap the top layer of floor polyethylene.
- .24 Notify Asbestos Abatement Consultant at least 24 hours prior to the need for Milestone Inspection A (Clean Site Preparation). Obtain written approval for this Milestone Inspection before proceeding.

### **3.2 Contaminated Perimeter Preparation**

- .1 Perform the following using Type 3 procedures including using the required personal protective equipment specified.
  - .1 Perform preparation work at perimeter during Quiet Hours after shutting down HVAC systems affecting the Asbestos Work Area, or during normal hours if complete HVAC system is isolated.
  - .2 Remove ceiling including grids, support and channels, or other obstructions around perimeter of Asbestos Work Area. Remove ceilings in sections equal to the work that can be performed in one shift.
  - .3 To complete:
    - .1 Remove top course of block at masonry walls if ACM is present above wall. HEPA vacuum to remove any debris on top of wall and in cavity. Immediately install one layer of rip-proof polyethylene over one layer of 6 mil polyethylene sheeting extending from below ceiling to top of wall, and over top to cover cavity. Do not allow asbestos-containing material to fall down block cavities.
    - .2 Remove drywall from walls/partitions from deck to 12” below at perimeter stud walls. HEPA vacuum to remove any debris. Immediately install one layer of rip-proof polyethylene over one layer of 6 mil polyethylene sheeting extending from below ceiling to top of wall, and over top to cover cavity. . Remove top plate from deck. Do not allow asbestos-containing material to fall down wall cavities.
    - .3 Install a layer of 6 mil polyethylene on all drywall at upper perimeter, above ceiling after cleaning of overspray or dust from wall.

- .4 Carefully wet asbestos-containing sprayed fireproofing and remove, from deck and beams along the upper perimeter of the Asbestos Work Area, a line of asbestos 300 mm wide to allow for installation of upper perimeter seal.
- .5 Install Type F Hoarding Wall at upper perimeter of Asbestos Work Area from top of perimeter wall to deck.
- .4 Seal any remaining holes in existing perimeter walls, columns, deck, etc. exposed by removal of tile at perimeter of Asbestos Work Area.
- .5 Notify Asbestos Abatement Consultant at least 24 hours prior to the need for Milestone Inspection B (Contaminated Perimeter Preparation). Obtain written approval for this Milestone Inspection before proceeding.

### **3.3 Contaminated Site Preparation**

- .1 Perform the following using Type 3 procedures including using the required personal protective equipment specified.
  - .1 Perform preparation work at perimeter during Quiet Hours after shutting down HVAC systems affecting the Asbestos Work Area, or during normal hours if complete HVAC system is isolated.
  - .2 Remove lenses from light fixtures.
  - .3 Remove lamps from light fixtures. Lamps are to be recycled. Do not dispose of fluorescent lamps.
  - .4 Remove light fixtures and associated electrical supply cable back to the junction box.
  - .5 Remove heat shields from light fixtures.
  - .6 Remove PCB ballasts and handle as per Section 02 84 10.
  - .7 Remove non-PCB ballasts.
  - .8 Remove ceiling mounted items specified to be turned over to Owner and remove associated electrical supply cable back to the junction box.
  - .9 Remove remaining ceiling mounted items specified to be removed, and associated electrical supply cable back to the junction box.
  - .10 Remove remaining ceiling tiles, grid and hangers.
  - .11 Cut hangers as close to deck as possible.
  - .12 Reinstall temporary lighting previously supported by ceiling system.
  - .13 Temporarily support all existing electrical and mechanical services and items supported by the ceiling systems, that are not scheduled to be removed.
  - .14 Clean and protect electrical systems in the Asbestos Work Area with polyethylene and tape. Include all communication, coaxial, triaxial, fire and public address systems, wiring, conduit, speakers, heat and smoke detectors, alarms, exit lights, junction boxes, etc.
    - .1 Mark/tag any items within or passing through the Asbestos Work Area that are to remain live.
  - .15 Clean and seal holes or penetrations in deck, ducts, etc. when exposed by ceiling removal.

- .16 Remove column enclosures to the extent specified.
  - .1 Caulk joint and any cracks in the slab at base of column with 2 hour fire rated caulking.
  - .2 Install layers of polyethylene sheeting to match floor adjacent.
- .17 Remove and dispose of all ductwork present in worksite, including diffusers, flex ducting, rigid ducting, etc.; as specified to be removed. Ductwork to be cleaned, lockdown applied and once cleanliness visually inspected by Consultant, can be removed from site and sent to facility for recycling.
- .18 Notify Asbestos Abatement Consultant at least 24 hours prior to the need for Milestone Inspection C (Before Bulk Removal). Obtain written approval of Milestone Inspection before proceeding.

### **3.4 Maintenance Of Contaminated Asbestos Work Area**

- .1 Inspect Asbestos Work Area perimeter Hoarding Walls and Upper Perimeter Seals at the beginning and end of each working period and once on each day work does not take place. Inspection must be performed by competent person.
- .2 Inspect HEPA filtered negative pressure machines including discharge ducting at the beginning and end of each working period. Inspection must be performed by competent person.
- .3 Perform Differential Pressure Monitoring on a frequent basis and record pressure at start and end of shift at a minimum.
- .4 Inspect polyethylene sheeting and ensure it is effectively sealed and taped. Repair damage and remedy defects immediately.
- .5 Inspect electrical panels and ensure locks and tags are on panels prior to entering the Asbestos Work Area.
- .6 Maintain Asbestos Work Area in tidy condition.
- .7 Remove waste and debris frequently.
- .8 Remove standing water on polyethylene/floor at the end of every shift.
- .9 Turn off water supply to hoses and reduce pressure in hose, prior to leaving the Asbestos Work Area at end of shift.
- .10 Turn off water supply to showers, at the end of every shift.
- .11 Ensure shower pans are pumped out at the end of every use and shift.

### **3.5 Wet Removal**

- .1 Do not use compressed air to clean or remove dust or debris.
- .2 Remove and dispose of remaining non-asbestos items before, during or after wet removal.
- .3 Spray asbestos-containing sprayed or trowelled material with Amended Water using airless spray equipment prior to removal. Saturate ACM to prevent release of airborne fibres during removal.

- .4 Remove asbestos-containing sprayed or trowelled material specified to be removed, clean substrate.
  - .1 Fully saturated ACM may be scraped directly into waste containers or may be allowed to fall to floor.
  - .2 ACM cannot be allowed to fall from one level to the next.
- .5 Spray asbestos-containing pipe insulations with Amended Water using airless spray equipment.
- .6 Remove pipe insulations specified to be removed and clean substrate. Maintain exposed surfaces of insulation or lagging in a wet condition.
  - .1 Full saturation of insulation will not be required if material is immediately bagged and not allowed to fall to floor.
  - .2 ACM cannot be allowed to fall from one level to the next.
- .7 Remove obstructions as required to remove the ACM.
  - .1 Notify asbestos abatement consultant if item is not specified to be removed and inhibits removal of ACM.
  - .2 Do not demolish any existing walls etc. that form the perimeter of the Asbestos Work Area without prior written permission from Asbestos Abatement Consultant.
- .8 All dislodged ACM shall be maintained in wet state until placed in asbestos waste containers for disposal.
- .9 As work progresses, and at regular intervals, place waste in asbestos waste containers and remove from the Asbestos Work Area.
- .10 After completion of gross asbestos removal work, perform the following:
  - .1 Wet clean surfaces from which ACM has been removed with stiff bristle brushes, vacuums, wet-sponges etc. to remove all visible residue and asbestos-containing materials.
  - .2 Wet clean surfaces which ACM has fallen on using stiff bristle brushes, vacuums, wet-sponges etc. to remove all visible residue and asbestos-containing materials
  - .3 Wet clean other surfaces in the Asbestos Work Area, including the decontamination facilities, scaffolding, equipment, polyethylene sheeting on floor and walls surfaces etc., ducts and similar items not covered with polyethylene sheeting.
  - .4 Remove wash water as contaminated waste.
  - .5 Remove waste.
  - .6 Level of cleanliness must be acceptable to Asbestos Abatement Consultant.
  - .7 Remove and dispose of the pre-filters from all negative air units as asbestos-contaminated waste.
- .11 Remove induction unit covers and:
  - .1 Clean entire induction unit with HEPA vacuum using Type 2 Procedures.

- .2 Turn induction unit covers over to Owner.
- .3 Cover induction units with one layer of 6 mil polyethylene sheeting.
- .12 Notify Asbestos Abatement Consultant at least 24 hours prior to the need for Milestone Inspection D (Visual Clearance). Obtain written approval for this Milestone Inspection before proceeding.

### **3.6 Waste and Material Handling**

- .1 Waste bins must be placed on grade or in receiving.
- .2 All bins must be covered and locked when waste transfer is not being performed.
- .3 Ensure redundant non-ACM, rubble, debris, etc. which was not cleaned and which was removed during contaminated work are treated, packaged, transported and disposed of as asbestos waste.
- .4 Fluorescent lamps contain mercury and are to be recycled. Do not dispose of fluorescent lamps.
- .5 Clean, wash and apply Post Removal Sealant to metal waste prior to removal from Asbestos Work Area.
  - .1 Recycle metals or dispose of metals as clean waste.
- .6 Clean, wash and apply Post Removal Sealant to non-porous materials prior to disposal as clean waste.
  - .1 Obtain prior written approval from the Asbestos Abatement Consultant for each individual type of material.
- .7 Clean and wash equipment prior to removal from Asbestos Work Area if removed prior to completion.
- .8 Place all equipment, tools and unused materials that cannot be cleaned in Asbestos Waste Containers.
- .9 As work progresses, and at regular intervals, transport the sealed and labelled asbestos waste containers from the Asbestos Work Area to waste bin.
- .10 Place items in bins according to waste classification. Place asbestos waste, metals, non-asbestos waste, etc. in separate bins.
- .11 Removal of waste containers and decontaminated equipment and materials from the Asbestos Work Area shall be performed using the Waste and Equipment Decontamination Facility as follows:
  - .1 Prior to entering the Waste and Equipment Decontamination Facility Container Cleaning Room, the first worker (fully protected inside the Asbestos Work Area) shall remove any visible contamination from the surface of the item or waste container being removed from the Asbestos Work Area.
  - .2 The first worker then carries the item into the Container Cleaning Room and wet sponges the item prior to passing the item through the curtained doorway to a second worker in the Holding Room. (The second worker shall be fully protected

- with respirator and disposable clothing and may only leave the decontamination facility via the Asbestos Work Area.)
- .3 The second worker in the Holding Room double bags or wraps and seals the item. Without entering the Transfer Room, the second worker passes the item through the curtained doorway into the Transfer Room.
  - .4 A third worker enters the Transfer Room from the clean area. (The third worker must never enter the Holding Room.) The third worker removes the item from the Transfer Room and transports it to the disposal bin.
  - .12 Transport waste and materials via the predetermined routes and exits. Arrange waste transfer route with Owner. Use a closed, covered cart to transport through Occupied Areas.
  - .13 Limit transportation of waste and materials through Occupied Areas of the building to Quiet Hours.
  - .14 Provide workers transporting waste with means to access full personal protective equipment and all tools required to properly clean up spilled ACM in the case of a rupture of an Asbestos Waste Container.
  - .15 Bin loading area and waste routes shall be kept clean at all times. Use Type 2 asbestos abatement procedures if appropriate or requested by Owner's Representative.
  - .16 Pick-up and drop off of garbage bin shall be at pre-approved times, and must not interfere with the Owners operations.
  - .17 Transport asbestos contaminated waste to landfill licensed by Ontario Ministry of the Environment.
  - .18 Co-operate with Ministry of the Environment inspectors and immediately carry out instructions for remedial work at dump to maintain environment, at no additional cost to the Owner.

### **3.7 Application Of Post Removal Sealant**

- .1 Wet Removal
  - .1 Obtain Asbestos Abatement Consultant's written permission to proceed.
  - .2 Apply one coat of Post Removal Sealant with an airless sprayer, in accordance with Manufacturer's Instructions, to cover all surfaces on all items in the Asbestos Work Area, including but not limited to polyethylene, ACM substrate, structural steel, and surfaces scheduled for demolition.
    - .1 Do not apply post removal sealant to materials that will be damaged by its application.
  - .3 Notify Asbestos Abatement Consultant at least 24 hours prior to the need for Milestone Inspection E (Air Monitoring Clearance). Obtain written approval of this Milestone Inspection before proceeding.

### **3.8 Air Clearance Monitoring**

- .1 Site must be dry prior to Air Clearance Monitoring.
- .2 The number of Air Clearance Monitoring samples will be as follows:

- .1 2 samples for less than 10 square metres.
- .2 3 samples for 10 to 500 square metres.
- .3 5 samples for more than 500 square metres.
- .3 Prior to air clearance monitoring, install clean 20-inch fans for air circulation during Air Clearance Monitoring.
  - .1 At least one fan per 10,000 cubic feet of space in Asbestos Work Area.
  - .2 Install in centre of Asbestos Work Area and space evenly.
  - .3 The fan exhaust shall be directed upwards or toward the ceiling.
  - .4 The fans shall be operated on the lowest speed setting.
- .4 Restrict access to Asbestos Work Area and operate negative air units for a 12 hour period prior to Milestone Inspection E.
- .5 The HEPA filtered negative pressure machines shall be in operation during clearance air monitoring.
- .6 In the presence of the Asbestos Abatement Consultant, immediately prior to air clearance monitoring, use a leaf blower to dislodge loose fibre.
  - .1 Direct leaf blower against walls, ceilings, floors, and other surfaces.
  - .2 Perform this for at least five minutes per 1,000 sq. ft. of Asbestos Work Area.
- .7 PCM samples will be collected as per Air Monitoring Section.

### **3.9 Asbestos Work Area Dismantling**

- .1 Use Type 2 worker precautions during dismantling.
- .2 Operate negative air units during dismantling.
- .3 Polyethylene, tape, cleaning material, etc. to be treated as asbestos waste.
- .4 Wash remaining equipment and tools used in contaminated Asbestos Work Area to remove all asbestos contamination, or place in Asbestos Waste Containers prior to being removed from Asbestos Work Area.
- .5 Clean Asbestos Work Area, Equipment and Access area, washing/Showering Room.
- .6 Remove upper seals, and seals over tops of walls, on deck, at columns, etc. within the Asbestos Work Area.
- .7 Remove top layer of polyethylene sheeting from surfaces protected by two or more layers of polyethylene sheeting. The bottom layer of polyethylene will remain until all re-fireproofing is complete. Remove outer layer as follows:
  - .1 Remove asbestos contaminated Polyethylene by carefully rolling away from walls to centre of Asbestos Work Area.
  - .2 Cut the lower layer of polyethylene sheeting to expose the baseboards, window sills, cabinets, shelves and other horizontal surfaces that may be contaminated by fallen ACM.
  - .3 Remove visible fibres or residue found during removal of polyethylene using a HEPA vacuum.

- .4 Remove polyethylene protection and hoarding walls where hoarding walls separate occupied areas from work area. Hoarding walls to remain are identified on asbestos demolition drawings.
- .8 Remove top layer of polyethylene on walls, finishes, and equipment.
- .9 Remove remaining polyethylene sheeting.
- .10 Remove water hoses and shut off at source.
- .11 Remove Signs, Hoarding Walls, Decontamination Facilities, Equipment Enclosures, Tunnels, Platforms.
- .12 Seal vacuum hoses and fittings, flexible ductwork and all tools used in contaminated work site in 6 mil polyethylene bags prior to removal from Work Area.
- .13 Remove temporary lights.
- .14 Remove negative air unit prefilters. Dispose of as asbestos contaminated waste.
- .15 Remove HEPA filtered negative pressure machines and discharge ducting.
- .16 Immediately upon shutting down negative air units, seal air inlet grill and exhaust vent with polyethylene and tape.
- .17 Notify Asbestos Abatement Consultant at least 24 hours prior to the need for Milestone Inspection F (Dismantling Inspection). Obtain written approval of this Milestone Inspection before proceeding.

### **3.10 Re-Establishment of Items**

- .1 Upon completion of work:
  - .1 Remove and disconnect Ground fault Panel, tags and locks from electrical panels and re-energize equipment and items.
  - .2 Remove hose bibs installed and repair pipe.
  - .3 Reinstall ducts removed to perform cleaning of ducts or to access ACM.
  - .4 Clean, mop and vacuum Asbestos Work Area and area beneath any Decontamination Facilities.
  - .5 Enable building air handling systems.

END OF SECTION

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## **Part 1 General**

### **1.1 SUMMARY**

- .1 Comply with requirements of this Section when performing following Work:
  - .1 Manual demolition of lead-painted plaster walls or building components by striking wall with sledgehammer or similar tool.

### **1.2 RELATED REQUIREMENTS**

- .1 Division 13, Section 02 82 12 Asbestos Abatement - Type 3
- .2 Division 13, Section 02 84 10 PCB Packaging and Disposal
- .3 Division 13, Section 02 84 11 Mercury Packaging and Disposal
- .4 Division 13, Section 02 87 00 Biohazard Remediation

### **1.3 SITE CONDITIONS**

- .1 The following reports are provided for reference. Pinchin relied solely on these reports for the development of these specifications.
  - .1 “*Designated Substance Survey and Perchlorate Detection in Fume Hoods, OVC-Former VMI Building, University of Guelph-Physical Resource Dept.*” dated June 20, 2018. Prepared by Lex Scientific Solutions, File No. 01180066
  - .2 “*Spray-Applied Beam Insulation Inspection, OVC-Former VMI Building, University of Guelph-Physical Resource Dept.*” dated August 30, 2018. Prepared by Lex Scientific Solutions, File No. 01180066-B”

### **1.4 REFERENCE STANDARDS**

- .1 Department of Justice Canada
  - .1 Canadian Environmental Protection Act, 1999 (CEPA).
- .2 Health Canada
  - .1 Workplace Hazardous Materials Information System (WHMIS), Material Safety Data Sheets (MSDS).
- .3 Human Resources and Social Development Canada (HRSDC)
  - .1 Canada Labour Code Part II, - SOR 86-304 - Occupational Health and Safety Regulations.
- .4 Transport Canada (TC)
  - .1 Transportation of Dangerous Goods Act, 1992 (TDGA).
- .5 U.S. Environmental Protection Agency (EPA)
  - .1 EPA 747-R-95-007-[1995], Sampling House Dust for Lead.
- .6 U.S. Department of Health and Human Services/Centers for Disease Control and Prevention/National Institute for Occupational Safety and Health (NIOSH)

- .1 NIOSH 94-113 - NIOSH Manual of Analytical Methods (NMAM), 4th Edition (1994).
- .7 U.S. Department of Labour - Occupational Safety and Health Administration (OSHA) - Toxic and Hazardous Substances
  - .1 Lead in Construction Regulation - 29 CFR 1926.62-[1993].
- .8 Underwriters' Laboratories of Canada (ULC)

## 1.5 DEFINITIONS

- .1 HEPA vacuum: High Efficiency Particulate Air filtered vacuum equipment with filter system capable of collecting and retaining fibres greater than 0.3 microns in any direction at 99.97% efficiency.
- .2 Authorized Visitors: Pinchin Ltd., University of Guelph – Physical Resources Dept. and representatives of regulatory agencies.
- .3 Occupied Area: areas of building or work site that is outside Work Area.
- .4 Sprayer: garden reservoir type sprayer or airless spray equipment capable of producing mist or fine spray. Must be appropriate capacity for scope of work.
- .5 Airlock: ingress or egress system, without permitting air movement between contaminated area and uncontaminated area. Consisting of two curtained doorways at least 2 m apart.
- .6 Curtained doorway: arrangement of closures to allow ingress and egress from one room to another. Typically constructed as follows:
  - .1 Place two overlapping polyethylene sheets over existing or temporarily framed doorway, securing each along top of doorway, securing vertical edge of one sheet along one vertical side of doorway, and secure other sheet along opposite vertical side of doorway.
  - .2 Reinforce free edges of polyethylene with duct tape and add weight to bottom edge to ensure proper closing.
  - .3 Overlap each polyethylene sheet at openings 1.5 m on each side.
- .7 Action level: employee exposure, without regard to usage of respirators, to an airborne concentration of lead of 50 micrograms per cubic metre of air calculated as 8 hour time-weighted average (TWA). Intermediate precautions for lead abatement are based on airborne lead concentrations greater than 0.05 milligrams per cubic metre of air within Work Area.
- .8 Competent person: Individuals capable of identifying existing lead hazards in workplace and taking corrective measures to eliminate them.
- .9 Lead in Dust: wipe sampling on vertical and/or horizontal surfaces, dust and debris is considered to be lead contaminated if it contains more than 40 micrograms of lead in dust per square foot.

## 1.6 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 02 82 12.

- .2 Provide proof satisfactory to Pinchin Ltd. and the University of Guelph – Physical Resources Dept. that suitable arrangements have been made to dispose of lead based paint waste in accordance with requirements of authority having jurisdiction.
- .3 Provide proof of Contractor's General and Environmental Liability Insurance.
- .4 Quality Control:
  - .1 Provide Pinchin Ltd. and the University of Guelph – Physical Resources Dept. necessary permits for transportation and disposal of lead based paint waste and proof that it has been received and properly disposed.
  - .2 Provide proof satisfactory to Pinchin Ltd. and the University of Guelph – Physical Resources Dept. that employees have had instruction on hazards of lead exposure, respirator use, dress, entry and exit from Work Area, and aspects of work procedures and protective measures.
  - .3 Provide proof that supervisory personnel have attended lead abatement course, of not less than two days duration, approved by Pinchin Ltd. and the University of Guelph – Physical Resources Dept. Minimum of one supervisor for every ten workers.
- .5 Product data:
  - .1 Provide documentation including test results, fire and flammability data, and Material Safety Data Sheets (MSDS) for chemicals or materials.

## 1.7 QUALITY ASSURANCE

- .1 Regulatory Requirements: comply with Federal, Provincial/Territorial and local requirements pertaining to lead paint, in case of conflict among those requirements or with these specifications more stringent requirement applies. Comply with regulations in effect at time work is performed.
- .2 Health and Safety:
  - .1 Safety Requirements: worker and visitor protection.
    - .1 Protective equipment and clothing to be worn by workers and visitors in Work Area includes:
      - .1 Respirator NIOSH approved and equipped with filter cartridges with assigned protection factor of 50, acceptable to Authority having jurisdiction. Suitable for type of lead and level of lead dust exposure in Lead Work Area. Provide sufficient filters so workers can install new filters following disposal of used filters and before re-entering contaminated areas.
      - .2 Disposable type protective clothing that does not readily retain or permit skin contamination, consisting of full body covering including head covering with snug fitting cuffs at wrists, ankles, and neck.
    - .2 Requirements for workers:
      - .1 Remove street clothes in clean change room and put on respirator with new filters or reusable filters, clean coveralls and head covers before entering Equipment and Access Rooms or Work Area. Store street clothes, uncontaminated footwear,

- towels, and similar uncontaminated articles in clean change room.
- .2 Remove gross contamination from clothing before leaving work area. Place contaminated work suits in receptacles for disposal with other lead - contaminated materials. Leave reusable items except respirator in Equipment and Access Room. When not in use in Work Area, store work footwear in Equipment and Access Room. Upon completion of lead abatement, dispose of footwear as contaminated waste or clean thoroughly inside and out using soap and water before removing from Work Area or from Equipment and Access Room.
  - .3 Enter unloading room from outside dressed in clean coveralls to remove waste containers and equipment from Holding Room of Container and Equipment Decontamination Enclosure system. Workers not to use this system as means to leave or enter work area.
  - .3 Eating, drinking, chewing, and smoking are not permitted in Work Area.
  - .4 Ensure workers are fully protected with respirators and protective clothing during preparation of system of enclosures prior to commencing actual lead abatement.
  - .5 Ensure workers wash hands and face when leaving Work Area. Facilities for washing are located [as indicated on drawings].
  - .6 Provide and post in Clean Change Room and in Equipment and Access Room the procedures described in this Section, in both official languages.
  - .7 Ensure no person required to enter Work Area has facial hair that affects seal between respirator and face.
  - .8 Visitor Protection:
    - .1 Provide protective clothing and approved respirators to Authorized Visitors to Work Areas.
    - .2 Instruct Authorized Visitors in use of protective clothing, respirators and procedures.
    - .3 Instruct Authorized Visitors in proper procedures to be followed in entering into and exiting from Work Area.

## **1.8 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate waste materials for recycling or reuse.
- .2 Handle and dispose of hazardous materials in accordance with CEPA, TDGA, Regional and Municipal regulations.
- .3 Disposal of lead waste generated by removal activities must comply with Provincial and Municipal regulations. Dispose of lead waste in sealed double thickness 6 ml bags or leak proof drums. Label containers with appropriate warning labels.
- .4 Provide manifests describing and listing waste created. Transport containers by approved means to licensed landfill for burial.

## **1.9 EXISTING CONDITIONS**

- .1 Reports and information pertaining to lead based paint to be handled, removed, or otherwise disturbed and disposed of during this Project are bound into this specification.
- .2 Notify Pinchin Ltd. and the University of Guelph – Physical Resources Dept. of lead based paint discovered during Work and not apparent from drawings, specifications, or report pertaining to Work. Do not disturb such material until instructed by Pinchin Ltd. and the University of Guelph – Physical Resources Dept.

## **1.10 SCHEDULING**

- .1 Not later than two days before beginning Work on this Project notify the following in writing, where appropriate:
  - .1 Appropriate Regional or Zone Director of Medical Services Branch, Health Canada.
  - .2 Provincial Ministry of Labour.
  - .3 Disposal Authority.
- .2 Inform sub trades of presence of lead-containing materials identified in Existing Conditions.
- .3 Provide Pinchin Ltd. and the University of Guelph – Physical Resources Dept. copy of notifications prior to start of Work.
- .4 Coordinate all work with the Consultant.
  - .1 A schedule is to be provided to the Consultant.
    - .1 The Contractor and the Consultant will provide advance notice to the University of Guelph – Physical Resources Dept. who will inform the school administration when work will be performed.
- .5 Perform the following work during Quiet Hours:
  - .1 Waste transfer.

## **Part 2 Products**

### **2.1 MATERIALS**

- .1 Polyethylene: 0.15 mm unless otherwise specified; in sheet size to minimize joints.
- .2 FR polyethylene: 0.15 mm woven fibre reinforced fabric bonded both sides with polyethylene.
- .3 Tape: fibreglass - reinforced duct tape suitable for sealing polyethylene under dry conditions and wet conditions using amended water.
- .4 Slow - drying sealer: non-staining, clear, water - dispersible type that remains tacky on surface for at least 8 hours and designed for trapping residual lead paint residue.
- .5 Lead waste containers: metal type acceptable to dump operator with tightly fitting covers and 0.15 mm sealable polyethylene liners.

- .1 Label containers with pre-printed bilingual cautionary Warning Lead clearly visible when ready for removal to disposal site.

### **Part 3 Execution**

#### **3.1 SUPERVISION**

- .1 Approved Supervisor must remain within Lead Work Area during disturbance, removal, or other handling of lead based paints.

#### **3.2 PREPARATION**

- .1 Remove and wrap items to be salvaged or reused, and transport and store in area specified by The University of Guelph – Physical Resources Dept.
- .2 Work Area:
  - .1 Shut off and isolate HVAC system to prevent dust dispersal into other building areas. Conduct smoke tests to ensure duct work is airtight.
  - .2 Pre-clean fixed casework, and equipment within work areas, using HEPA vacuum and cover with polyethylene sheeting sealed with tape.
  - .3 Clean work areas using HEPA vacuum. If not practicable, use wet cleaning method. Do not use methods that raise dust, such as dry sweeping, or vacuuming using other than HEPA vacuum.
  - .4 Seal off openings, corridors, doorways, windows, skylights, ducts, grilles, and diffusers, with polyethylene sheeting sealed with tape.
  - .5 Cover floor surfaces in work area from wall to wall with FR polyethylene drop sheets to protect existing floor during removal.
  - .6 Build airlocks at entrances and exits from work areas to ensure work areas are always closed off by one curtained doorway when workers enter or exit.
  - .7 At point of access to work areas install warning signs in both official languages in upper case "Helvetica Medium" letters reading as follows where number in parentheses indicates font size to be used:
    - .1 CAUTION LEAD HAZARD AREA (25 mm).
    - .2 NO UNAUTHORIZED ENTRY (19 mm).
    - .3 WEAR ASSIGNED PROTECTIVE EQUIPMENT AND RESPIRATOR (19 mm).
    - .4 BREATHING LEAD CONTAMINATED DUST CAUSES SERIOUS BODILY HARM (7 mm).
  - .8 Maintain emergency and fire exits from work areas, or establish alternative exits satisfactory to Authority having jurisdiction.
  - .9 Where water application is required for wetting lead containing materials, provide temporary water supply by use of appropriately sized hoses for application of water as required.
  - .10 Provide electrical power and shut off for operation of powered tools and equipment. Provide 24 volt safety lighting and ground fault interrupter circuits on power source for electrical tools, in accordance with applicable CSA Standard. Ensure safe installation of electrical lines and equipment.

- .3 Worker Decontamination Enclosure System:
  - .1 Worker Decontamination Enclosure System includes Equipment and Access Room and Clean Room, as follows:
    - .1 Equipment and Access Room: construct between exit and work areas, with two curtained doorways, one to the rest of suite, and one to work area. Install waste receptor and storage facilities for workers' shoes and protective clothing to be re-worn in work areas. Build large enough to accommodate specified facilities, equipment needed, and at least one worker allowing sufficient space to change comfortably.
    - .2 Clean Room: construct with curtained doorway to outside of enclosures. Provide lockers or hangers and hooks for workers' street clothes and personal belongings. Provide storage for clean protective clothing and respiratory equipment. Install mirror to permit workers to fit respiratory equipment properly.
- .4 Construction of Decontamination Enclosures:
  - .1 Construct framing for enclosures or use existing rooms. Line enclosure with polyethylene sheeting and seal with tape, apply two layers of FR polyethylene on floor.
  - .2 Construct curtain doorways between enclosures so when people move through or waste containers and equipment are moved through doorway, one of two closures comprising doorway always remains closed.
- .5 Maintenance of Enclosures:
  - .1 Maintain enclosures in clean condition.
  - .2 Ensure barriers and polyethylene linings are effectively sealed and taped. Repair damaged barriers and remedy defects immediately.
  - .3 Visually inspect enclosures at beginning of each work day.

### 3.3 LEAD - BASE PAINT ABATEMENT

- .1 Removal of lead based paint to be performed by manual demolition of lead-painted walls and ceilings and building components by striking a wall with sledgehammer or similar tool.
- .2 Remove lead based paint in small sections and pack as it is being removed in sealable 0.15 mm plastic bags and place in labelled containers for transport.
- .3 Seal filled containers. Clean external surfaces thoroughly by wet sponging. Remove from immediate working area to Staging Area. Clean external surfaces thoroughly again by wet sponging before moving containers to decontamination Washroom. Wash containers thoroughly in decontamination Washroom, and store in Holding Room pending removal to Unloading Room and outside. Ensure containers are removed from Holding Room by workers who have entered from uncontaminated areas dressed in clean coveralls.
- .4 After completion of stripping work, wire brush and wet sponge surface from which lead based paint has been removed to remove visible material. During this work keep surfaces wet.
- .5 After wire brushing and wet sponging to remove visible lead based paint, and after encapsulating lead containing material impossible to remove, wet clean work area

including equipment and access room, and equipment used in process. After inspection by Pinchin Ltd., apply continuous coat of slow drying sealer to surfaces. Do not disturb work for 8 hours with no entry, activity, ventilation or disturbance during this period.

- .6 After enclosing lead painted surfaces, wet clean work area and equipment and access room. During settling period no entry, activity, or ventilation will be permitted.

### **3.4 INSPECTION**

- .1 Perform inspection to confirm compliance with specification and governing authority requirements. Deviations from these requirements not approved in writing by Pinchin Ltd. will result in work stoppage, at no cost to Owner.
- .2 Pinchin Ltd. will inspect work for:
  - .1 Adherence to specific procedures and materials.
  - .2 Final cleanliness and completion.
  - .3 No additional costs will be allowed by Contractor for additional labour or materials required to provide specified performance level.
- .3 When lead dust leakage from Work Area occurs Pinchin Ltd. may order Work shutdown.
  - .1 No additional costs will be allowed by Contractor for additional labour or materials required to provide specified performance level.

### **3.5 FINAL CLEANUP**

- .1 Remove polyethylene sheet by rolling it away from walls to centre of work area. Vacuum visible lead containing particles observed during cleanup, immediately, using HEPA vacuum equipment.
- .2 Place polyethylene seals, tape, cleaning material, clothing, and other contaminated waste in plastic bags and sealed labelled waste containers for transport.
- .3 Clean-up Work Areas, Equipment and Access Room, and other contaminated enclosures.
- .4 Clean-up sealed waste containers and equipment used in Work and remove from work areas, via Container and Equipment Decontamination Enclosure System, at appropriate time in cleaning sequence.
- .5 Conduct final check to ensure no dust or debris remains on surfaces as result of dismantling operations.

### **3.6 RE-ESTABLISHMENT OF OBJECTS AND SYSTEMS**

- .1 Repair or replace objects damaged in course of work to their original state or better, as directed by The University of Guelph – Physical Resources Dept.

## **END OF SECTION**

## **PART 1 GENERAL**

### **1.1 General and Related Work**

- .1 Read this section in conjunction with all other sections so as to comply with the requirements of Division 1 and the General Conditions of the Contract.
- .2 Related Work Specified Elsewhere
  - Division 13, Section 02 82 12 Asbestos Abatement – Type 3
  - Division 13, Section 02 83 11 Lead-Based Paint Abatement
  - Division 13, Section 02 84 11 Mercury Packaging and Disposal
  - Division 13, Section 02 87 00 Biohazard Remediation
- .3 Perform the following work practices for the handling, packaging, and transfer of materials containing polychlorinated biphenyls (PCB).
- .4 Unless otherwise shown or specified it is the intent that work performed as per this section will result in the removal and disposal or decontamination of all PCB-containing materials and all materials which have been contaminated by PCBs either during or prior to work of this section.

### **1.2 Site Conditions**

- .1 The following reports are provided for reference. Pinchin relied solely on these reports for the development of these specifications.
  - .1 “*Designated Substance Survey and Perchlorate Detection in Fume Hoods, OVC-Former VMI Building, University of Guelph-Physical Resource Dept.*” dated June 20, 2018. Prepared by Lex Scientific Solutions, File No. 01180066
  - .2 “*Spray-Applied Beam Insulation Inspection, OVC-Former VMI Building, University of Guelph-Physical Resource Dept.*” dated August 30, 2018. Prepared by Lex Scientific Solutions, File No. 01180066-B”

### **1.3 Outline of Work**

- .1 Identify ballasts as either non-PCB or PCB containing.
- .2 Remove and dispose of non-PCB ballasts, or recycle.
- .3 Remove and package PCB-containing ballasts (approximately 578 units).
- .4 Transport packaged PCB waste to a MOE (Ministry of the Environment) approved incineration facility and destroy. Contractor to assume all costs incurred including destruction, transport, permits, approvals and record keeping.

### **1.4 Schedule**

- .1 Coordinate all work with the Consultant.
  - .1 A schedule is to be provided to the Consultant.
    - .1 The Contractor and the Consultant will provide advance notice to the University of Guelph – Physical Resources Dept. who will inform the school administration when work will be performed.
- .2 Perform the following work during Quiet Hours:

- .1 Waste transfer.

## 1.5 Definitions

- .1 Competent Worker: A worker who is qualified because of knowledge, training and experience to perform the work, is familiar with the Occupational Health and Safety Act and Environmental Protection Act, has knowledge of the potential or actual danger to health and safety in the work.
- .2 Polyethylene: Either polyethylene sheeting with tape along edges, around penetrating objects, over cuts and tears, and elsewhere as required to provide a continuous polyethylene membrane to protect underlying surfaces from damage.
- .3 PCBs: Monochlorinated or Polychlorinated Biphenyls (or any mixture of both).
- .4 PCB Equipment: Equipment designed or manufactured to operate with PCB liquid or to which PCB liquid was added or drums and other containers used for the storage of PCB liquid.
- .5 PCB Liquid: means liquid containing PCBs at a concentration of more than fifty milligrams per kilogram, or 50 parts per million.
- .6 PCB Material: means material containing PCBs at a concentration of more than fifty milligrams per kilogram or 50 parts per million, whether the material is liquid or not.
- .7 PCB Waste: PCB Equipment, PCB Material, PCB Liquids and materials or items contaminated with PCBs.
- .8 Personnel: All contractors' employees, sub-contractors employees, supervisors.
- .9 Work Area: Area of building from which PCB-containing items are being removed.

## 1.6 Submittals

- .1 Prior to starting work, the Contractor performing work of this section shall submit:
  - .1 Workplace Safety and Insurance Board Clearance Certificate.
  - .2 Insurance certificates.
  - .3 Company Health and Safety Policy.
  - .4 Certificate of Approval for transportation of PCB waste and location of destruction facility.
- .2 Prior to starting work, submit the following information regarding personnel:
  - .1 WHMIS training certificates for all personnel.
  - .2 Material Safety Data Sheets for chemicals or material used in the course of the Asbestos Abatement Project.
- .3 Submit the following upon completion of the work.
  - .1 Manifests, waybills, certificate of destruction/recycling etc. as applicable for each type of waste.

## **1.7 Regulations**

- .1 Perform work in accordance with current applicable environmental and occupational health regulations and codes including but not limited to:
  - .1 PCB Regulations SOR/2008-273
  - .2 Regulations Respecting Mobile System for the Destruction and Treatment of Chlorobiphenyls that are Operated by or under Contract with Federal Institutions (SOR/90-5; amended SOR/93-231 and SOR/2000-105).
  - .3 Regulations Respecting the Import and Export of Hazardous Wastes (SOR/92-637; Amended 94-459; SOR 94-684; SOR/2000-103).
  - .4 Waste Management – PCBs, R.R.O. Regulation 362/90.
  - .5 Mobile PCB Destruction Facilities, R.R.O. Regulation 352/90.
  - .6 Regulation 347, General Waste, as amended.

## **1.8 Supervision**

- .1 Provide on site, a supervisor, with authority to oversee aspects of the work, including but not limited to, health and safety, methods, scheduling, labour and equipment requirements.
- .2 A minimum of one supervisor for every 10 workers is required.
- .3 Replace supervisory personnel, with approved replacements, within 3 working days of a written request.

## **1.9 Quality Assurance**

- .1 Ensure the removal and handling of PCBs is performed by persons experienced in the methods, procedures and industry practices.
- .2 Complete work so that at no time do PCBs contaminate the building or environment.

## **1.10 Insurance**

- .1 Maintain a Comprehensive General Liability Policy with an insurance company acceptable to Pinchin Ltd. and The University of Guelph – Physical Resources Dept. The intent of this policy is to hold Pinchin Ltd. and The University of Guelph – Physical Resources Dept. harmless as it relates to claims for Bodily Injury or Property Damage or both, relating to the contract. Commercial General Liability insurance shall be provided on an “occurrence” basis to cover injury or damage (whether detected or not during the policy period) which happens during the policy period, even though a claim may not be presented for many years.
- .2 Maintain an Automobile or Fleet Policy, and Non-owned Automobile Policy with an insurance company acceptable to Pinchin Ltd. and The University of Guelph – Physical Resources Dept. The intent of these policies is to hold Pinchin Ltd. and The University of Guelph – Physical Resources Dept. harmless as it relates to claims for Bodily Injury or Property Damage or both, relating to the contract.
- .3 Maintain a Pollution Liability Policy (or asbestos liability policy or specific coverage under the CGL for asbestos abatement) with an insurance company acceptable to Pinchin Ltd. and The University of Guelph – Physical Resources Dept. The intent of this policy

is to hold Pinchin Ltd. and The University of Guelph – Physical Resources Dept. harmless as it relates to claims for Bodily Injury or Property Damage or both, relating to the contract. Pollution Liability shall be provided on an “occurrence” basis to cover injury or damage (whether detected or not during the policy period) which happens during the policy period, even though a claim may not be presented for many years. Without limiting the generality of the foregoing, the policy shall insure the operations of the work and shall not contain any environmental and/or health hazard exclusions relating to remediation operations.

- .4 All certificates must be forwarded to Pinchin Ltd. and The University of Guelph – Physical Resources Dept. before work is commenced, showing THE OWNER as additional insured as their interest may appear.
- .5 The University of Guelph – Physical Resources Dept. may request a certified true copy of the policies if he deems it necessary.
- .6 The limits will not be less than:

.1	Commercial General Liability	\$5,000,000.00
.2	Automobile	\$2,000,000.00
.3	Pollution Policy	\$5,000,000.00
- .7 The University of Guelph – Physical Resources Dept. reserves the right to ask for higher limits of liability if the exposure so warrants. It is recommended that the policies in question be written with the same company.

#### **1.11 Instruction and Training**

- .1 Instruction and training must be provided to all workers and supervisors. Instruction and training includes the following:
  - .1 Hazards of PCBs.
  - .2 Use, care and disposal of protective equipment (including but not limited to respirators and filters) and clothing that would be used and worn during work, including:
    - .1 Limitations of equipment.
    - .2 Inspection and maintenance of equipment.
    - .3 Proper fitting of equipment.
    - .4 Disinfecting and cleaning of equipment.
  - .3 Personal hygiene to be observed when performing the work.
  - .4 The measures and procedures prescribed by this section.
  - .5 Instruction and training must be provided by a competent, qualified person.

#### **1.12 Personal Protection**

- .1 During work involving PCBs, personnel are to wear the following personal protective equipment:
  - .1 Gloves.
  - .2 Aprons.

- .3 Protective coveralls.
- .4 Protective eyewear.
- .2 Protective clothing shall be replaced or repaired if torn or ripped.
- .3 Prior to leaving the Work Area, personnel shall decontaminate their clothing or protective clothing by using a HEPA Vacuum, or by damp wiping.
- .4 Dispose of protective clothing not to be reused as PCB waste.
- .5 Provide soap, towels and facilities for washing of hands and face, which shall be used by all personnel when leaving the Work Area.
- .6 Prohibit smoking, eating, drinking, chewing in the Work Area.
- .7 Use hard hats, safety shoes and other personal protective equipment required by applicable construction safety regulations.
- .8 PCB liquids do not constitute an inhalation hazard when handled at room temperature. In the event of a fire or other heating of PCB Equipment, Material, Waste or Liquid, immediately vacate the area. Air purifying filter respirators DO NOT provide protection against PCB vapours.
- .9 In the event of PCB ingestion, obtain medical assistance immediately.

## **PART 2 PRODUCTS**

### **2.1 Materials**

- .1 Apron: Full body neoprene apron.
- .2 Containment Drums: new, not used double bung 45 gallon No. 16 gauge cold rolled steel drums with removable steel lid, PCB resistant gasket, and 12 gauge compression type ring closure with 5/8" bolt and forged lug. Drums shall be newly painted inside and out with bright white rust-resistant enamel.
- .3 Drum liners: clear polyethylene bag, 36" x 60", 6 mil thick. Open one 36" end.
- .4 Face Shield: Full face shield to attach to hard hat to prevent splashes from Askarel Type Liquid from hitting skin.
- .5 Gloves: Elbow length, of PCB resistant material (neoprene) and in good condition.
- .6 Label: Number 4 Severe Hazard Label, completed as Health 3, Fire 1, Environment 4, and Reactivity 1. Available from Environment Canada Environmental Protection Service, 7th Floor, 25 St. Clair East, Toronto (966-5840).
- .7 Polyethylene Sheeting: 6 mil (0.15 mm) minimum thickness unless otherwise specified, in sheet size to minimize joints. New materials only.
- .8 Protective Coveralls: Disposable full body coveralls to prevent splashes to clothing, complete with hoods. Coveralls to fit snugly at ankles, wrists and neck. Acceptable materials: Tyvek. Tyvek material does not provide protection against PCB liquid if it soaks through.
- .9 Vermiculite: pre-packed, Industrial grade 3, containing no asbestos.

## **PART 3 EXECUTION**

### **3.1 PCB Packaging**

- .1 Wear personal protection at all times when disturbing PCB Equipment, Liquids, Material and Waste.
- .2 Do not contaminate building surfaces with PCB-containing oil, tar etc.
- .3 Install polyethylene sheeting to protect surfaces and finishes.
- .4 Notify Owner's Representative of any PCB spills immediately.
  - .1 Any spills of PCBs are to be cleaned to the satisfaction of the Owner's Representative at the contractors cost. This includes removal and replacement of building materials as required.
- .5 Place PCB waste including: ballasts on polyethylene sheeting immediately after removal.
- .6 Do not drop PCB Equipment, Waste or Materials.
- .7 Avoid rough handling of PCB Equipment and Materials. Do not throw into drum.
- .8 Remove ballasts as specified.
  - .1 Remove bx cable for lights back to junction box.
  - .2 Pour 2" layer of vermiculite or absorbent in Containment Drum. Place polyethylene liner into Containment Drum. No further fill is required.
  - .3 Place ballasts on end in Containment Drum.
- .9 When full:
  - .1 Seal liner bag with duct tape.
  - .2 Seal drum with lid, gasket and compression ring.
  - .3 Affix specified and completed label.
  - .4 Do not leave liner bags or drums open overnight.
- .10 As filled drums accumulate, transfer to temporary storage area.
- .11 Temporary storage facility to be a fully enclosed block wall room within the building complete with appropriate warning signs.
- .12 Remove contaminated material, including gloves, aprons, rags, hoses, solvents, protective coveralls, polyethylene, etc. and package as per the above.

### **3.2 Transportation and Reporting**

- .1 Transport materials following Transportation of Dangerous Goods Act.
  - .1 Transport PCBs to approved incineration site for destruction and ensure materials are destroyed.
- .2 The facility used to process the PCBs shall be approved by the Ministry of the Environment, and shall have valid Certificates of Approval to carry out the work outlined herein.

- .1 The facility must issue a Certificate of Destruction identifying types and quantities of PCBs generated from the project.
- .3 A typed and signed transfer document for each transfer of PCBs, is to be submitted to Owner's representative, giving following:
  - .1 Number of drums.
  - .2 Contents including ballast type, capacitor type, oil type, transformer type and approximate quantities.
  - .3 Approximate net weight of contents.
  - .4 Dates removal begun and completed (for each lot).
  - .5 Date drums transferred.
- .4 Submit certificate(s) of destruction, certificate of recycling (as applicable) and waste manifests from **all** transfer points. Submit the above for waste **regardless** of single transport or as blended waste.

### **3.3 Fire and Explosion Response**

- .1 PCB liquids are relatively non-flammable. However, if exposed to flame or hot surfaces, a higher vapour concentration will result. At high temperatures PCBs may decompose and chemically rearrange to produce highly toxic gases, vapours, and soot.
- .2 In the event of a fire involving PCBs, immediately stop work and report to the local Fire Marshall and Fire Department . Report specifically the presence of PCBs. The necessity to rapidly report the fire overrides any decontamination procedures.
- .3 Cause all workers to evacuate the site. When leaving, shut down all water in use. Only personnel trained in use of, and wearing SCBA apparatus, will be allowed to re-enter site.
- .4 Do not return to site until Owner's Representative and Ontario Ministry of the Environment representatives have declared the area for re-entry.

### **3.4 Re-Establishment of Items**

- .1 Upon completion of work:
  - .1 Remove tags and locks from electrical panels and re-energize equipment and items.
  - .2 Clean, mop and vacuum the Work Area.

END OF SECTION

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## **PART 1 GENERAL**

### **1.1 General and Related Work**

- .1 Read this section in conjunction with all other sections so as to comply with the requirements of Division 1 and the General Conditions of the Contract.
- .2 Related Work Specified Elsewhere
  - Division 13, Section 02 82 12 Asbestos Abatement – Type 3
  - Division 13, Section 02 83 11 Lead-Based Paint Abatement
  - Division 13, Section 02 84 10 PCB Packaging and Disposal
  - Division 13, Section 02 87 00 Biohazard Remediation
- .3 Perform the following work practices for the handling, packaging, and transfer of Mercury Materials and Waste.
- .4 Unless otherwise shown or specified it is the intent that work performed as per this section will result in the removal and disposal or decontamination of all mercury-containing materials and all materials which have been contaminated by mercury either during or prior to work of this section.

### **1.2 Site Conditions**

- .1 The following reports are provided for reference. Pinchin relied solely on these reports for the development of these specifications.
  - .1 “*Designated Substance Survey and Perchlorate Detection in Fume Hoods, OVC-Former VMI Building, University of Guelph-Physical Resource Dept.*” dated June 20, 2018. Prepared by Lex Scientific Solutions, File No. 01180066
  - .2 “*Spray-Applied Beam Insulation Inspection, OVC-Former VMI Building, University of Guelph-Physical Resource Dept.*” dated August 30, 2018. Prepared by Lex Scientific Solutions, File No. 01180066-B”

### **1.3 Outline of Work**

- .1 Remove fluorescent light bulbs (approximately 1,137 units).
- .2 Package and recycle all mercury, mercury contaminated materials and mercury waste.

### **1.4 Schedule**

- .1 Coordinate all work with the Consultant.
  - .1 A schedule is to be provided to the Consultant.
    - .1 The Contractor and the Consultant will provide advance notice to the University of Guelph – Physical Resources Dept. who will inform the school administration when work will be performed.
- .2 Perform the following work during Quiet Hours:
  - .1 Waste transfer.

### **1.5 Definitions**

- .1 Competent Worker: A worker who is qualified because of knowledge, training and experience to perform the work, is familiar with the Occupational Health and Safety Act and Environmental Protection Act, has knowledge of the potential or actual danger to health and safety in the work.
- .2 Mercury Waste: Equipment, materials or items containing mercury or contaminated with mercury.
- .3 Polyethylene: Either polyethylene sheeting with tape along edges, around penetrating objects, over cuts and tears, and elsewhere as required providing a continuous polyethylene membrane to protect underlying surfaces from damage.
- .4 Personnel: All contractors' employees, sub-contractors employees, supervisors.
- .5 Work Area: Area of building from which mercury containing items are being removed.

#### **1.6 Submittals**

- .1 Prior to starting work, the Contractor performing work of this section shall submit:
  - .1 Workplace Safety and Insurance Board Clearance Certificate.
  - .2 Insurance certificates.
  - .3 Company Health and Safety Policy.
  - .4 Certificate of Approval for transportation of mercury waste and location of recycling facility.
- .2 Prior to starting work, submit the following information regarding personnel:
  - .1 WHMIS training certificates for all personnel.
  - .2 Material Safety Data Sheets for chemicals or material used in the course of the Asbestos Abatement Project.
- .3 Submit the following upon completion of the work.
  - .1 Manifests, waybills, certificate of destruction/recycling etc. as applicable for each type of waste.

#### **1.7 Regulations**

- .1 Perform work in accordance with current applicable environmental and occupational health regulations and codes including but not limited to:
  - .1 Regulation 347, General Waste, as amended.
  - .2 R.R.O. Regulation Mercury R.R.O. 1990, Regulation 844, Amended to O. Reg. 110/04, Designated Substance — Mercury.

#### **1.8 Supervision**

- .1 Provide on site, a supervisor, with authority to oversee aspects of the work, including but not limited to, health and safety, methods, scheduling, labour and equipment requirements.
- .2 A minimum of one supervisor for every 10 workers is required.
- .3 Replace supervisory personnel, with approved replacements, within 3 working days of a written request.

## **1.9 Quality Assurance**

- .1 Ensure the removal and handling of Mercury is performed by persons experienced in the methods, procedures and industry practices.
- .2 Complete work so that at no time does mercury contaminate the building or environment.

## **1.10 Insurance**

- .1 Maintain a Comprehensive General Liability Policy with an insurance company acceptable to Pinchin Ltd. and The University of Guelph – Physical Resources Dept. The intent of this policy is to hold Pinchin Ltd. and The University of Guelph – Physical Resources Dept. harmless as it relates to claims for Bodily Injury or Property Damage or both, relating to the contract. Commercial General Liability insurance shall be provided on an “occurrence” basis to cover injury or damage (whether detected or not during the policy period) which happens during the policy period, even though a claim may not be presented for many years.
- .2 Maintain an Automobile or Fleet Policy, and Non-owned Automobile Policy with an insurance company acceptable to Pinchin Ltd. and The University of Guelph – Physical Resources Dept. The intent of these policies is to hold Pinchin Ltd. and The University of Guelph – Physical Resources Dept. harmless as it relates to claims for Bodily Injury or Property Damage or both, relating to the contract.
- .3 Maintain a Pollution Liability Policy or specific coverage under the CGL for Mercury, with an insurance company acceptable to Pinchin Ltd. and The University of Guelph – Physical Resources Dept. The intent of this policy is to hold Pinchin Ltd. and The University of Guelph – Physical Resources Dept. harmless as it relates to claims for Bodily Injury or Property Damage or both, relating to the contract. Pollution Liability shall be provided on an “occurrence” basis to cover injury or damage (whether detected or not during the policy period) which happens during the policy period, even though a claim may not be presented for many years. Without limiting the generality of the foregoing, the policy shall insure the operations of the work and shall not contain any environmental and/or health hazard exclusions relating to remediation operations.
- .4 All certificates must be forwarded to Pinchin Ltd. and The University of Guelph – Physical Resources Dept. before work is commenced, showing The University of Guelph – Physical Resources Dept. as additional insured as their interest may appear.
- .5 The University of Guelph – Physical Resources Dept. may request a certified true copy of the policies if he deems it necessary.
- .6 The limits will not be less than:

.1	Commercial General Liability	\$5,000,000.00
.2	Automobile	\$2,000,000.00
.3	Pollution Policy	\$5,000,000.00
- .7 The University of Guelph – Physical Resources Dept. reserves the right to ask for higher limits of liability if the exposure so warrants. It is recommended that the policies in question be written with the same company.

## **1.11 Instruction and Training**

- .1 Instruction and training must be provided to all workers and supervisors. Instruction and training includes the following:
  - .1 Hazards of Mercury.
  - .2 Use, care and disposal of protective equipment (including but not limited to respirators and filters) and clothing that would be used and worn during work, including:
    - .1 Limitations of equipment.
    - .2 Inspection and maintenance of equipment.
    - .3 Proper fitting of equipment.
    - .4 Disinfecting and cleaning of equipment.
  - .3 Personal hygiene to be observed when performing the work.
  - .4 The measures and procedures prescribed by this section.
  - .5 Instruction and training must be provided by a competent, qualified person.

#### **1.12 Personal Protection**

- .1 During work involving mercury, personnel are to wear the following additional personal protective equipment:
  - .1 Non-powered half-face respirators with mercury vapour cartridges with life span indicators in the cartridge.
  - .2 Protective coveralls.
  - .3 Protective eyewear/face shield.
  - .4 Chemical resistant gloves and apron.
- .2 Respiratory protection shall be certified by the National Institute of Occupational Safety and Health (NIOSH) or other testing agency acceptable to the Ministry of Labour.
- .3 Respirators shall be:
  - .1 Fitted so that there is an effective seal between the respirator and the worker's face. Ensure that no person required to enter the Work Area has facial hair which affects the seal between respirator and face.
  - .2 Assigned to a worker for his exclusive use.
  - .3 Maintained in accordance with manufacturer's specifications.
  - .4 Cleaned, disinfected and inspected by a competent person after use on each shift, or more often if required.
  - .5 Repaired or have damaged or deteriorated parts replaced.
  - .6 Stored in a clean and sanitary location.
- .4 Replace filters as necessary.
- .5 Personnel must have respirators fit checked by qualitative or quantitative fit-testing. Instruction must be provided by a competent person as defined by the Occupational Health and Safety Act.
- .6 Personnel shall wear and use the respirator provided.

- .7 Protective clothing shall be replaced or repaired if torn or ripped.
- .8 Prior to leaving the Work Area, personnel shall decontaminate their clothing or protective clothing by using a HEPA Vacuum, or by damp wiping.
- .9 Dispose of protective clothing not to be reused as Mercury waste.
- .10 Provide soap, towels and facilities for washing of hands and face, which shall be used by all personnel when leaving the Asbestos Work Area.
- .11 Prohibit smoking, eating, drinking, chewing in the Work Area.
- .12 Use hard hats, safety shoes and other personal protective equipment required by applicable construction safety regulations.

## **PART 2 PRODUCTS**

### **2.1 Materials**

- .1 Containment Drums: new, not used double bung 45 gallon No. 16 gauge cold rolled steel drums with removable steel lid, chemical resistant gasket, and 12 gauge compression type ring closure with 5/8" bolt and forged lug. Drums shall be newly painted inside and out with bright white rust-resistant enamel.
- .2 Drum liners: clear polyethylene bag, 36" x 60", 6 mils thick. Open one 36" end.
- .3 Mercury Sponge: A plated metal-wool pad for the pick-up of mercury spills.
- .4 Mercury Vacuum: Nilfisk VT Mercury Vacuum or equal. Vacuum used to collect liquid mercury and granular mercury compounds with an internal HEPA filter and an activated carbon adsorbent filter to purify exhaust air of mercury vapours.
- .5 Neutralizing Agent: Mercon X or similar. Mercury neutralizing solution such as 20% sodium sulphide or sodium thiosulphate.
- .6 Pipe and Drain Neutralizing Agent: MerconGel or similar solution that is designed to prevent the release of mercury vapour from traps, collection systems, pipes, drains and stand pipes.
- .7 Polyethylene Sheeting: 6 mil (0.15 mm) minimum thickness unless otherwise specified, in sheet size to minimize joints. New materials only.
- .8 Protective Coveralls: Disposable full body coveralls to prevent splashes to clothing, complete with hoods. Coveralls to fit snugly at ankles, wrists and neck. Acceptable materials: Tyvek.
- .9 Vermiculite: pre-packed, Industrial grade 3, containing no asbestos.

## **PART 3 EXECUTION**

### **3.1 Mercury Packaging**

- .1 Wear personal protection at all times when disturbing lamps, equipment and items that contain mercury.
- .2 Do not drop mercury-containing materials.
- .3 Do not contaminate building surfaces with mercury.

- .4 Protect work area by installing polyethylene drop sheets or sealed polyethylene sheeting below, and at surrounding work area.
- .5 Package lamps in cardboard boxes designed for lamps of that size. Do not break lamps.

### **3.2 Spill Containment**

- .1 For large mercury spills:
  - .1 Evacuate area. Only personnel using the specified PPE are to be in spill area.
  - .2 Deactivate air handling systems.
  - .3 Open windows or provide ventilation to area.
  - .4 Deactivate heat systems if they are adjacent and may aid in vaporization of mercury.
  - .5 Contact Owner's Representative immediately.
  - .6 If spill cannot be cleaned up immediately, apply neutralizing agent over mercury spill area.
  - .7 Collect mercury droplets together with a dust pan, squeegee or mercury vacuum.
  - .8 Clean-up bulk mercury using aspirator bulb or mercury vacuum. Clean remainder with a mercury sponge. Place mercury in closed container (plastic or glass).
  - .9 Porous surfaces are to be cleaned with Neutralizing Agent after clean-up of bulk mercury.
  - .10 If mercury spills into soil, carpet, through cracks, into drains etc. further removal of surface materials at contractor cost will be required. Do not proceed without approval from Owner's Representative.
  - .11 Place all cleaning materials including drop sheets or polyethylene sheeting in containment drums.

### **3.3 Transportation and Reporting**

- .1 Transport materials following Transportation of Dangerous Goods Act.
  - .1 Transport Mercury Materials and Waste to approved site for recycling, including mercury vapour in lamps, and ensure materials are recycled.
- .2 The facility used to process and recycle the mercury shall be approved by the Ministry of the Environment, or local jurisdictional authority, and shall have valid Certificates of Approval to carry out the work outlined herein.
  - .1 The facility must issue a Certificate of Recycling identifying types and quantities of materials generated from the project. The facility must also provide a Certificate of Recycling for the mercury generated from the project. Any mercury contaminated materials not recycled are to be identified by a manifest.
- .3 A typed and signed transfer document for each transfer of mercury is to be submitted to Owner's representative, giving following:
  - .1 Number of drums or boxes.
  - .2 Contents and approximate quantities.

- .3 Approximate net weight of contents.
- .4 Dates removal begun and completed (for each lot).
- .5 Date transferred.
- .4 Submit certificate(s) of certificate of recycling and waste manifests from **all** transfer points. Submit the above for waste **regardless** of single transport or as blended waste.

### 3.4 Re-Establishment of Items

- .1 Upon completion of work:
  - .1 Clean, mop and vacuum the Work Area.

END OF SECTION

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**Part 1 General**

**1.1 SUMMARY**

- .1 Comply with requirements of this Section when performing following Work:
  - .1 Removal and disposal of digester tanks with presumed biohazard on the interior of each tank.

**1.2 RELATED REQUIREMENTS**

- .1 Division 13, Section 02 82 12 Asbestos Abatement - Type 3
- .2 Division 13, Section 02 83 12 Lead-Based Paint Abatement
- .3 Division 13, Section 02 84 10 PCB Packaging and Disposal
- .4 Division 13, Section 02 84 11 Mercury Packaging and Disposal

**1.3 SITE CONDITIONS**

- .1 The following reports are provided for reference. Pinchin relied solely on these reports for the development of these specifications.
  - .1 “*Designated Substance Survey and Perchlorate Detection in Fume Hoods, OVC-Former VMI Building, University of Guelph-Physical Resource Dept.*” dated June 20, 2018. Prepared by Lex Scientific Solutions, File No. 01180066
  - .2 “*Spray-Applied Beam Insulation Inspection, OVC-Former VMI Building, University of Guelph-Physical Resource Dept.*” dated August 30, 2018. Prepared by Lex Scientific Solutions, File No. 01180066-B”

**1.4 REFERENCE STANDARDS**

- .1 Environmental Abatement Council of Ontario (EACO)
  - .1 EACO Mould Abatement Guidelines, Edition 3 (2015).

**1.5 OUTLINE OF WORK**

- .1 Provide a separate price for the work outlined in this Section. Refer to Section 01 24 03 of the specification tender package for details.
- .2 Refer to contract drawings for the extent of construction work.
- .3 Quantities provided in the specifications are approximate, it is the contractor’s responsibility to confirm all quantities provided and to verify all site conditions.
- .4 Coordinate the following items with the Contractor and the Consultant, which are to be included in the lump sum bid of the Abatement Contractor, including but not limited to: electrical isolations, GFI connection, water connections, hoarding walls, bin placement, hours of work, schedule, etc.
- .5 Remove and dispose of the following items utilizing procedures outlined in Appendix B and Appendix D of the attached EACO Mould Abatement Guidelines, Edition 3 (2015):
  - .1 Three digester tanks within Sewage Room 120A.

**1.6 SCHEDULE**

- .1 Coordinate all work with the Consultant.
  - .1 A schedule is to be provided to the Consultant.
    - .1 The Contractor and the Consultant will provide advance notice to the University of Guelph – Physical Resources Dept. who will inform the school administration when work will be performed.
- .2 Perform the following work during Quiet Hours:
  - .1 Waste transfer.

**END OF SECTION**

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## **PART 1 - GENERAL**

### **1.1 STANDARDS**

Standards listed below govern minimum quality of work required under this section:

- .1 American Concrete Institute:
  - .1 ACI 301-15, "Specifications for Structural Concrete".
  - .2 ACI 303R-12, "Guide to Cast-in-Place Architectural Concrete Practice".
  - .3 SP-4 8<sup>th</sup> edition, "Formwork for Concrete".
  - .4 SP-66-04, "ACI Detailing Manual 2004".
- .2 ASTM International:
  - .1 ASTM A1064/A1064M-17, "Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed for Concrete".
  - .2 ASTM A 1064/A 1064M-17, "Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete".
  - .3 ASTM C33M-18, "Standard Specification for Concrete Aggregates".
  - .4 ASTM C 260/C 260M-10a (2016), "Standard Specification for Air-Entraining Admixtures for Concrete".
  - .5 ASTM C 309-11, "Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete".
  - .6 ASTM C 494/C 494M-17, "Standard Specification for Chemical Admixtures for Concrete".
  - .7 ASTM C 1017/C 1017M-13 e1, "Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete".
  - .8 ASTM D 1751-04(2013) e1, "Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Non extruding and Resilient Bituminous Types)".
  - .9 ASTM E 1155M-14, "Standard Test Method for Determining FF Floor Flatness and FL Floor Levelness Numbers (Metric)".
- .3 Canadian General Standards Board (CGSB):
  - .1 CAN/CGSB 19.24-M90 (Withdrawn), "Multicomponent. Chemical-Curing Sealing Compound".
  - .2 CAN/CGSB-25.20-95 Withdrawn, "Surface Sealer for Floors".
  - .3 CAN/CGSB-51.34-M86 (Withdrawn), "Vapour Barrier, Polyethylene Sheet for Use in Building Construction".
- .4 CSA International:
  - .1 CAN/CSA A23.1-14, "Concrete Materials and Methods of Concrete Construction".
  - .2 CAN/CSA A23.2-14, "Methods of Test for Concrete".
  - .3 CAN/CSA-A23.3-14, "Design of Concrete Structures".
  - .4 CAN/CSA A283-06(R2016), "Qualification Code for Concrete Testing Laboratories".
  - .5 CAN/CSA A3000-13 "Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005)".
  - .6 CAN/CSA G30.18-09(R2104), "Carbon Steel Bars for Concrete Reinforcement".
  - .7 CAN/CSA O86-14, "Engineering Design in Wood".
  - .8 CAN/CSA O121-17, "Douglas Fir Plywood".

- .9 CAN/CSA O151-17, "Canadian Softwood Plywood".
- .10 CAN/CSA O153-13(R2017), "Poplar Plywood".
- .11 CAN/CSA O325-16, "Construction Sheathing".
- .12 CAN/CSA S269.1-16, "Falsework and Formwork".
- .13 CAN/CSA W186-M1990 (R2016), "Welding of Reinforcing Bars in Reinforced Concrete Construction".
- .5 Health Canada/Workplace Hazardous Materials Information System (WHMIS):
  - .1 Material Safety Data Sheets.
- .6 Reinforcing Steel Institute of Canada (RSIC):
  - .1 RSIC "Reinforcing Steel Manual of Standard Practice".

## 1.2 PERFORMANCE BASED SPECIFICATION

- .1 The concrete materials supplied for this project will be provided by the Performance Based Specification. For each concrete element to be constructed the following criteria will be provided:
  - Structural criteria including strength at age.
  - Class of exposure of concrete.
  - Any permeability requirements.
  - Specific aggregate size to limit shrinkage and improve placement performance.
  - Flatness and durability of finish.

## 1.3 QUALITY PLAN

- .1 Develop and implement a Quality Plan that verifies the concrete work meets the project specifications. The Quality Plan shall be of sufficient detail to demonstrate the performance requirements of the project have been met. The completed steps of the Quality Plan shall be communicated to the Consultant in a manner and frequency to facilitate the Owner's Quality Assurance Plan process.
- .2 The Quality Plan shall describe, as a minimum, the following plans and procedures:
  - .1 Identify the personnel responsible for implementation and oversight of the quality control plan for this section in an organization chart. Describe the roles and responsibilities of each person listed.
  - .2 Provide samples of Contractor's quality control inspection and data logging forms to be used on the project. The quality control forms shall, as a minimum, include the following:
    - .1 Shop Drawing Review and Sign Off.
    - .2 Formwork Inspection.
    - .3 Reinforcing Inspection.
    - .4 Inspection of Concrete Accessories, Inserts, and Openings.
    - .5 Concrete Placement Log.
    - .6 Curing Log.
    - .7 Concrete Cylinder Log.
    - .8 Waterproofing Log and Inspection.
    - .9 Final Concrete Inspection.

- .3 Quality plan shall include procedural steps for review of shop drawings by the Contractor prior to submission to the Consultant.
  - .4 Describe quality control procedural steps related to:
    - .1 Formwork and Falsework.
    - .2 Reinforcing.
    - .3 Concrete Placement, Testing, Finishing and Curing.
    - .4 Hot and Cold Weather Work, including: methods of preparation, curing, heating, insulation, and temperature monitoring.
    - .5 Coordinating with the Owner's Quality Assurance Plan. Indicate anticipated timeframes for scheduling of general conformance reviews by Consultant.
    - .6 Coordination of Material Testing.
    - .7 Review of installation of proprietary systems by manufacturer's representative.
    - .8 Defective Concrete, including: identification, documentation, submission of proposed repair procedures, and follow-up inspection.
  - .5 Risk Management: list and describe any anticipated project specific risks associated with this section and outline proposed means of mitigation.
- 
- .3 The Quality Plan shall be prepared taking into account the specific requirements of this project. Generic quality plans that, in the Consultant's opinion, fail to address the specific requirements of this project will be returned 'Revise and Resubmit'.
  - .4 Submit Quality Plan in accordance with Section 01 33 00 – Submittal Procedures Division 1. Acceptance of the Quality Plan by the Consultant shall be considered a prerequisite for concrete placement. Failure of the Contractor to coordinate the timely submission of a complete Quality Plan, which ultimately results in the delay of the start of concrete work, shall not be at the risk of the Owner or Consultant for back charge.

#### **1.4 EXAMINATION**

- .1 Prior to construction of forms and/or placement of concrete, carefully examine all Contract Documents and shop drawings which affect this work. Report any discrepancies to the Consultant for their direction.

#### **1.5 SOIL INSPECTION**

- .1 Contractor is to appoint a Soils Consultant to test compaction of backfill material and to verify bearing capacity of foundation subgrade. Notify Soils Consultant a minimum of two (2) business days prior to placement of concrete or compacted backfill. Do not place concrete or compacted backfill until underlying subgrade material has been inspected and accepted.
- .2 Soils Consultant will be paid from cash allowance carried in Division 1. Supply all necessary cooperation.

#### **1.6 STORAGE AND HANDLING**

- .1 Deliver, store, and handle all materials in accordance with the Quality Plan. Ensure all concrete materials are handled in accordance with CSA A23.1.

## **1.7 FALSEWORK AND FORMWORK DESIGN AND REVIEW**

- .1 Design, construct, and dismantle falsework and formwork in accordance with the requirements of CAN/CSA A23.1, CSA S269.1, CSA 269.3, and ACI Standard SP4 unless more stringent tolerances are specified.

## **1.8 REINFORCING STEEL ACTION AND INFORMATION SUBMITTALS**

- .1 Submit reinforcing steel shop drawings in accordance with Division 1.
- .2 Prepare reinforcing steel shop drawings that conform to the construction drawings with respect to placement, quantity and size of reinforcing steel bars. Reinforcing steel shop drawings shall be reviewed and accepted in accordance with the Quality Plan prior to forwarding on to the Consultant.
- .3 Forwarded shop drawings shall be in a single, complete set in order that all details may be read in conjunction with plans, elevations and all other dependent details. Quantity and format of shop drawings are to be in accordance with Division 1. Reproduction of Contract Documents will not be acceptable as Shop Drawings.
- .4 All materials, finishes and loadings shall be clearly illustrated. Submittals shall clearly define any abbreviations.
- .5 Where shop drawings are re-submitted, clearly illustrate all revisions from previous submissions using revision marks and "bubbles".
- .6 All details and sections to be to a scale of not less than 1:25.
- .7 Provide elevation drawings of all walls, cross referenced to plan drawings. Provide drawings for each differing section of steel arrangement. Do not indicate various areas on one detail.
- .8 Indicate placement of reinforcement at all openings, depressions, spandrels and sleeves. Show bar supports, hangers, inserts, water stops, anchor bolts, etc.
- .9 Shop drawings shall correspond to each detail on drawing. Each wall, slab, etc. to be separately listed. Bar lists shall be reviewed only for general conformity, quantities are not checked in detail.
- .10 Detail to requirements of CAN/CSA-A23.1 and RSIO "Reinforcing Steel Manual of Standard Practice". Ensure adjustments are made in detailing of reinforcing steel for splices and development lengths. Splice lengths are to be based on bar position within section (e.g. top bars) and reinforcement coating.
- .11 The construction drawings show reinforcing steel placement for the project that shows the intent of reinforcing of concrete elements. These drawings can accomplish this description through the use of nomenclature such as similar and typical, indicating similar arrangements of reinforcing steel within concrete elements but potential variation of formed dimensions and lengths to accommodate the intended final construction.
- .12 The reinforcing steel shop drawings shall be of sufficient detail to allow for a clear understanding of the fabrication limits, quantity and placement of all reinforcing steel on the project. Fabrication of reinforcing steel prior to acceptance through the Quality Plan shall not be at the risk of the Consultant for back charge if fabricated reinforcement is not suitable for the project due to modifications in the shop drawings.

## **1.9 CONCRETE MATERIALS ACTION AND INFORMATION SUBMITTALS**

- .1 Submit in accordance with Division 1.
  - .1 Concrete mix designs.
  - .2 Product and material samples as requested.
  - .3 Proposed curing methods.

## **1.10 COORDINATION OF QUALITY PLAN WITH WORK ON SITE**

- .1 Pre-construction Meeting: convene pre-construction meeting one week prior to beginning concrete work.
  - .1 Ensure key personnel, site supervisor, Consultant, specialty Contractor – finishing, forming, all attend.
- .2 Prior to placement of concrete ensure all inspection processes and assembled documentation has been carried out to conform to the Quality Plan.
- .3 Notify the Consultant at least 1 business day in advance of the proposed placement of concrete. Upon notification the Consultant may elect to review the contents of the Quality Plan to assess if the work is proceeding in general conformance with the contract documents. The Consultant may elect to review the work on site and prepare appropriate record of observations for the Owner.

## **1.11 PROPRIETARY PRODUCTS**

- .1 All proprietary products to be applied/installed in strict accordance with the manufacturer's published recommendations.

## **PART 2 - PRODUCTS**

### **2.1 FORMWORK AND FALSE WORK**

- .1 For non-exposed concrete or concrete without special architectural features, use wood and wood product formwork materials to CSA-0121, CSA-086, CSA 0437 Series, and CSA-0153. Materials to bear grade marks, or to be accompanied by certificates, test reports, or other proof of conformity.
- .2 For exposed concrete or concrete with special architectural features, use formwork materials to stricter requirements of CSA-A23.1/ A23.2 and ACI-303.
  - .1 Form liner to be new factory coated high density overlaid Douglas fir plywood to CSA 0121.
- .3 Apply non-reactive form release agent prior to placing reinforcing.

### **2.2 FORM TIES**

- .1 Unexposed Concrete Surfaces - snap ties, coil ties or she-bolts to suit application.
- .2 Exposed or Architectural Concrete - Plastic cone type snap ties or coil ties which break off or are removable 38 mm inside concrete surface. Non-shrink, non-metallic grout to be installed after removal of tie and plastic cone.

- .3 Waterproof Structures - plastic cone type snap ties or coil ties which break off or are removable 50 mm inside concrete surface complete with fused water stop plastic washer to each wire strut in centre of tie to break surface continuity and prevent water seepage. Fill cone holes with waterproof expanding grout. Standard of Acceptance: products by National Concrete Accessories.

## 2.3 REINFORCEMENT

- .1 Reinforcing Bars - to CSA G30.18, Grade 400 deformed billet steel. Provide Grade 400W where welding of reinforcing is required.
- .2 Slab Bolsters and High Chairs - to suit application. For exposed concrete, chairs and bolsters to be plastic tipped or stainless steel.
- .3 Mechanical splices subject to approval of Consultant. Standard of Acceptance: BAR LOCK by Dayton Superior, LENTON Couplers by ERICO.
- .4 Form Saver Inserts – integral threaded cast-in inserts, to develop 125% of Yield Strength of reinforcing steel. Standard of Acceptance: products by Dayton Superior, LENTON Form Savers by ERICO.

## 2.4 CONCRETE

- .1 All constituent materials shall conform to the requirements of CAN/CSA-A23.1.
- .2 Concrete mix design shall comply with requirements of CAN/CSA-A23.1 based on Alternative No. 1 in Table 5. Ready-mix concrete to be proportioned mixed and delivered in accordance with CAN/CSA-A23.1.
- .3 Submit acceptable recent records of tests to justify use of desired supplier. Recent records to include compressive strength, air content and air-void system tests. Where doubt exists as to quality of concrete provided by a proposed supplier, Consultant may, at their discretion, order Contractor to arrange for an alternative, acceptable source of supply at no extra cost or delay to Owner.
- .4 Pump mix designs shall not be modified from normal concrete mix designs by the changing cement content or quantities of coarse and fine aggregate. Specifically fine aggregate contents shall not be increased, nor coarse aggregate contents reduced to accommodate pumping.
- .5 Admixtures other than air entraining and water reducing agents are not permitted unless approved by Consultant. Calcium chloride shall not be used.
- .6 Use 20 mm aggregate unless otherwise noted

- .7 Minimum compressive strength and class of concrete to be used:

Use	Compressive Strength	Exposure	Water/Cement Ratio
Unshrinkable Concrete Fill	7 MPa	N	-
Mud Slabs/Learn Concrete	0.5 MPa	N	-
Housekeeping pads	25 MPa	N	0.55
Footings, interior piers, interior foundation walls, interior slabs-on-grade,	35 MPa	N	0.55
Exterior piers, exterior foundation walls	35 MPa	F-2	0.45
Sidewalks and curbs	35 MPa	C-1	0.45

## 2.5 ADMIXTURES

- .1 Air Entraining Admixture: to ASTM C 260.
- .2 Chemical Admixtures: to ASTM C 494. Consultant to approve accelerating or set retarding admixtures during cold and hot weather placing.
- .3 Water Reducing Agent: to ASTM C 494, non-chloride.
- .4 Retardation Agent: to ASTM C 494, non-chloride.
- .5 Superplasticizer: to ASTM C 494, use only when approved by Consultant.

## 2.6 CURING COMPOUNDS

- .1 Curing Compounds to CAN/CSA-A23.1 and to ASTM C 309.
- .2 Consultant to approve use of curing compounds in all liquid retaining structures. If approved, use only potable water approved compounds for curing in liquid retaining structures.

## 2.7 FLOOR SEALERS

- .1 Natural coloured floors (hardened or unhardened). Standard of Acceptance: Sealtight HIAC by W.R. Meadows. Florseal WB by Sika.

## 2.8 EXPANSION JOINT BOARD FILLER

- .1 Expansion joint board filler to be expanded polystyrene board (EPS) Type 1 density.

## 2.9 ISOLATION JOINT FILLER

- .1 For Isolation Joints: Standard of Acceptance: Deck-O-Foam by W.R. Meadows.

## **2.10 SAWCUT JOINT FILLER**

- .1 Sawcut Control Joints - self-levelling two component epoxy urethane filler. Standard of Acceptance: Loadflex by Sika, REZI-WELD FLEX by W.R. Meadows.

## **2.11 GROUT**

- .1 Nonshrink, Premixed Non-metallic Grout: Standard of Acceptance: CG-86 Grout by W.R. Meadows. Master Flow 713 Plus by BASF Building Systems, CPD non-shrink grout by CPD.

## **2.12 BONDING AGENT**

- .1 Latex Bonding Agent: Standard of Acceptance: Intralok by W.R. Meadows. CPD Latex Adhesive by CPD.

## **2.13 ANCHORS**

- .1 All proprietary anchoring products to be as specified on drawings and installed (including standard depth of embedment) as per manufacturer's published recommendations.
- .2 Standard of Acceptance: Hilti (Canada) Products, Hilti Hit-HY 200 Adhesive Anchor System, AISI 316 stainless steel, unless noted on drawings. Minimum 400 MPa yield strength, 500 MPa ultimate strength.

## **2.14 WATERSTOPS**

- .1 Urethane PVC Waterstops to CGSB 41-GP-35M (Withdrawn), central bulb, ribbed profile, size as noted on drawings. Standard of Acceptance: PVC Waterstops by Southern Metal & Plastic Products, and PVC Waterstops by Sika Greenstreak. PVC Waterstops to be NSF61 approved.

## **2.15 REPAIR PRIMER**

- .1 Concrete Patch Repair Primer: Standard of Acceptance: SIKATOP Armtec 110 by Sika Canada.

## **2.16 SELF-LEVELING PATCHING MORTAR**

- .1 Self-leveling patching mortar for horizontal patching. Standard of Acceptance: SIKATOP III Plus by Sika Canada.

## **2.17 NON-SAG PATCHING MORTAR**

- .1 Non-sag patching mortar for vertical, overhead and other applications indicated. Standard of Acceptance: SIKATOP 123 Plus by Sika Canada, MEADOW-CRETE OV by W.R. Meadows.

## **PART 3 - EXECUTION**

### **3.1 COLD WEATHER REQUIREMENTS**

- .1 Carry out cold weather concreting in accordance with the requirements of CAN/CSA A23.1 and the Contractor's Quality Plan.
- .2 When the air temperature is at or below 5°C or there is a likelihood of it falling to that limit within 24 hours of placing, employ suitable means to maintain temperature of all concrete surfaces between 10°C and 21°C for at least 3 days after placing. Provide sufficient thermometers, in accordance with CAN/CSA A23/1.
- .3 Remove or replace any portion of concrete allowed to freeze prior to reaching a compressive strength of at least 10 MPa. Do not place concrete on frozen surfaces.
- .4 Provision shall be made for venting of all combustion products from gas-fired heaters. Repair any concrete damaged by carbonation.

### **3.2 HOT WEATHER REQUIREMENTS**

- .1 Carry out hot weather concreting in accordance with requirements of CAN/CSA A23.1 and the Contractor's Quality Plan.
- .2 When the air temperature is above 27°C, curing shall be by water spray, wet sand or burlap and not by curing compounds.
- .3 Do not place concrete with material temperature higher than 25°C. Concrete with temperature higher than 25°C on arrival at the site will be rejected.

### **3.3 FORMWORK**

- .1 Construct formwork strong, tight, braced and tied so as to maintain shape and position within tolerances specified in CAN/CSA A23.1. Top form ties shall not be located within 150 mm of the top of the concrete placement.
- .2 Camber all formwork to compensate for anticipated deflections in formwork prior to hardening of concrete. Positive means of adjustment (wedges or jacks) or shores and struts to be provided and all settlement taken up during concrete placing operation.
- .3 Provide temporary cleanout and inspection openings.
- .4 Install 25 mm triangular wood chamfer strips in corners of forms for all corners of piers, foundation walls and equipment bases which will be exposed in the finished structure.
- .5 All formwork shall be left in place until concrete has attained sufficient strength to support its own weight plus all likely construction loads.
- .6 Minimum stripping time for vertical formed surfaces for elements not exceeding 3,000 mm in height and 400 mm in depth shall be 24 hours.

### 3.4 FINISH FOR FORMED SURFACES

- .1 Non-exposed Concrete Finish:
  - .1 A "rough form finish" as defined by CAN/CSA-A23.1 will be acceptable for surfaces not exposed to view in finished structure.
- .2 Exposed Concrete Finish:
  - .1 A "smooth-form finish" as defined by CAN/CSA-A23.1 will be required for all surfaces exposed to view in finished structure.
  - .2 Utilize only new sheets of plywood coated with release agent and cone-type ties, unless noted otherwise.
  - .3 Apply a sack-rubbed finish in accordance with CAN/CSA-A23.1 to all exposed concrete if required by Consultant to compensate for surfaces which do not meet the criteria for a "smooth form finish".
  - .4 Horizontal joints shall occur at same elevation on all visually related surfaces.
- .3 Architectural Concrete Finish - where indicated on drawings:
  - .1 Follow recommendations of CAN/CSA-A23.1 and ACI 303.
  - .2 Form all recesses using dressed lumber.
  - .3 Form chamfers at all outside corners formed by intersection of a vertical and horizontal surface, using dressed lumber.
  - .4 Edges of plywood panels shall be milled to ensure tight contact with adjacent edges and surfaces. All edge joints shall be arranged symmetrically in any panel or surface.
  - .5 Horizontal joints shall occur at same elevation on all visually related surfaces.
  - .6 All joints and form tie patterns shall be arranged and approved by the Consultant before formwork is built.

### 3.5 REINFORCEMENT

- .1 Detail, place and protect reinforcing steel in accordance with CAN/CSA-A23.1.
- .2 Before placing, clean all reinforcement of any loose scale, dirt or any other coatings which would impair the bond.
- .3 Place reinforcement accurately and secure in place by use of chairs, spacers and hangers.
- .4 Specified cover to reinforcing steel as required in CSA/CAN-A23.1, except as noted below:
  - .1 Concrete deposited against and permanently exposed to earth surface. 75 mm
  - .2 Concrete deposited in forms but exposed to earth or weather. 50 mm
  - .3 Piers - 50 mm
  - .4 Slabs - interior 25 mm - exterior 30 mm
- .5 Lap lengths and bar development lengths to be in accordance with CAN/CSA A23.3.
- .6 Tension lap splices to be Class "B".

- .7 Provide corner bars to match longitudinal reinforcing at all intersections (including footings) unless otherwise indicated.
- .8 Straightening or rebinding of reinforcing bars is not permitted. Discard bars with bends or kinks not shown on bar lists.
- .9 Adequately support slab bars on continuous high chairs to resist against weight of workmen and equipment.
- .10 Welding of reinforcing shall not be performed without prior approval of methods by Consultant. All welding shall conform to CSA Standard W186 and shall only be performed by welders certified by the Canadian Welding Bureau.
- .11 Unless otherwise noted at all openings in slabs and walls provide additional reinforcing as noted below.
- .12 Unless otherwise noted at all openings in slabs, reinforcement that is disrupted due to openings, additional reinforcement shall be placed on the sides to cover the disrupted reinforcement. Provide hooked ends at all reinforcing terminated at openings.

### **3.6 PLACING**

- .1 Place concrete in accordance with CAN/CSA-A23.1.
- .2 Notify Consultant before concrete is placed, so that they may, at their discretion, review all preparations for conformance with requirements of the Quality Plan.

### **3.7 CONSTRUCTION JOINTS**

- .1 Locate construction joints as noted on drawings. Any additional construction joints shall be located so as not to impair the structural integrity of the finished structure and shall be reviewed and accepted by Consultant.
- .2 Prepare all existing concrete surfaces in accordance with CAN/CSA-A23.1. All laitance and foreign matter shall be removed and the surface mechanically roughened to partially expose aggregate.
- .3 Waterstops to be installed in all construction joints in below grade structures. Waterstops to be installed in accordance with manufacturer's instructions.

### **3.8 INSERTS AND OPENINGS**

- .1 Set sleeves, ties, hangers, waterstops, anchor bolts and other inserts and openings as indicated or specified elsewhere. Sleeves and openings greater than 200 mm not indicated on structural drawings must be approved by Consultant.
- .2 No sleeves, ducts, pipes or other openings shall pass through beams or columns, except where specifically detailed on structural drawings or reviewed by Consultant.

- .3 Do not eliminate or displace reinforcement to accommodate hardware. If inserts cannot be located as specified, obtain approval of all modifications from Consultant before placing of concrete.
- .4 Fully coordinate locations and sizes of sleeves and openings shown on structural drawings with architectural, mechanical and electrical drawings.
- .5 Set all anchor bolts using templates provided by appropriate trade requiring same. Securely fasten anchor bolts in place to maintain correct position and alignment during concreting. Misplaced anchor bolts shall be considered defective concrete and shall be removed and replaced or otherwise corrected to Consultant's satisfaction.

### **3.9 FLOOR FINISHING**

- .1 Finish floors in accordance with CAN/CSA-A23.1 utilizing expert tradesmen whose only occupation is floor finishing.
- .2 Slab and floor tolerance measurements shall be made in accordance with the Straightedge Method as specified in CAN/CSA-A23.1 and in accordance with the Contractor's Quality Plan.

### **3.10 CURING**

- .1 Cure all concrete in accordance with the requirements of CAN/CSA-A23.1.
- .2 Curing methods and materials to be in accordance with the Contractor's Quality Plan.
- .3 Cure vertical surfaces by leaving forms in place or with curing compounds.
- .4 Cure concrete floor slabs using continuous sprinkling, and/or fabric kept continuously wet.

### **3.11 FORM GREASE REMOVAL**

- .1 All newly cast concrete to receive any proprietary waterproofing/sealing agent to be water blasted and/or prepared to manufacturer's requirements. Consult manufacturer's literature for requirements prior to applying any products to newly cast concrete.

### **3.12 PATCHING**

- .1 Remove all defective and honeycombed concrete down to sound concrete in accordance with the Quality Plan.
- .2 Patch with expanding grout and latex bonding agent in accordance with CAN/CSA-A23.1 to match adjacent surfaces.
- .3 Patch all cone tie holes with an approved non-metallic, non-shrink mortar except in exposed architectural concrete.
- .4 Install grey plastic set back plugs in cone tie holes of exposed concrete after removal.

### **3.13 REPAIR OF TEMPERATURE AND SHRINKAGE INDUCED CRACKS**

- .1 Repair cracks in the completed structures in accordance with the Quality Plan, employing a suitable approved polyurethane injection technique to make such cracks completely watertight after repair.
- .2 Remove surface injections materials following completion of work and finish affected areas to match surrounding concrete.

### **3.14 GROUTING**

- .1 Do all grouting around pipes, under equipment bases, under base plates, etc. as indicated in accordance with the manufacturer's instructions, with an approved non-metallic, non-shrink mortar.
- .2 Void under structural steel base plates to be completely filled with an approved non-shrink grout. Exercise extreme care to ensure that no voids are left under base plates and that full bearing of base plate on supporting concrete is attained.

### **3.15 SLABS-ON-GRADE**

- .1 Prior to placing concrete, verify that subgrade has been compacted and accepted by Soils Consultant.
- .2 Fill all saw cut joints with an approved control joint sealant.
- .3 Unless noted otherwise place reinforcement or welded wire fabric mesh 50 mm below top surface of concrete slabs-on-grade. Support reinforcement or mesh on precast concrete chairs with embedded tie wires.

### **3.16 EXTERIOR SLABS**

- .1 Broom finish all exterior slabs. Seal with two (2) coats approved sealer.
- .2 On exterior slabs-on-grade provide control joint pattern at 1200 mm on centre each way unless otherwise detailed and install 13 mm premoulded joint filler every second joint.

### **3.17 EQUIPMENT BASES**

- .1 Carefully examine the architectural, mechanical, and electrical drawings, specifications and shop drawings for requirements. This work is not necessarily shown on structural drawings.
- .2 Layout of all concrete bases, curbs, pits, etc., for architectural, mechanical, and electrical work to be responsibility of trades responsible for Work of those sections.
- .3 Unless otherwise indicated, bases shall rest on the concrete floor slab.

- .4 Provide all reinforcing for bases, curbs, pits, etc. Set all anchor bolts, sleeves and other miscellaneous metal items which are required to be embedded or attached to concrete. Anchor bolts, sleeves and other miscellaneous metal items, including setting templates for same, shall be supplied by Contractors requiring same. Reinforcing for bases shall be 15M @ 300 mm each way top and bottom plus 1-15M perimeter bar top and bottom, unless noted otherwise.
- .5 Finish exposed parts of the bases and curbs with cement mortar. Fill voids, trowel smooth, level edges and corners to provide a neat appearance to the Consultant's approval. Harden exposed faces of curbs and bases in accordance with the requirements of this section.
- .6 Provide grouting approximately 25 mm thick between equipment base plates and concrete. The space between base plates and concrete shall be completely filled with grout. Grout shall consist of non-shrinking type and be premixed. Clean surface of concrete and wet same prior to grouting. Do not remove levelling wedges before grout attains its final set. Fill voids left by removal of wedges with grout and finish exposed surface of grout to make neat appearance.

### **3.18 ALTERATIONS TO EXISTING CONCRETE**

- .1 Remove existing concrete as designated via saw cutting or chipping. Where existing reinforcing is to be incorporated into new construction, removal shall be via chipping only.
- .2 Existing concrete surfaces to be roughened and existing reinforcing thoroughly cleaned prior to casting new concrete. Provide additional dowelled reinforcing as noted.
- .3 Apply approved bonding agent at interfaces between new and existing concrete.
- .4 Fill existing small openings with non-shrink concrete mortar as approved by Consultant.
- .5 Where new openings expose existing reinforcing apply migrating corrosion inhibitor to all cut surfaces. Apply non-sag cementitious patching mortar to uniform 25 mm thickness to provide a smooth finished surface.

### **3.19 ANCHORING SYSTEMS**

- .1 Contractor to have proprietary anchoring system manufacturer's representative on site for initial application of all proprietary anchoring systems.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 REFERENCES**

- .1 ASTM International Inc.:
  - .1 ASTM A36/A36M-14, Standard Specification for Carbon Structural Steel.
  - .2 ASTM A82/A82M-07, Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
  - .3 ASTM A307-14, Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength.
  - .4 ASTM A580/A580M-15, Standard Specification for Stainless Steel Wire.
  - .5 ASTM A641/A641M-09a (2014), Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire.
  - .6 ASTM-A666-15, Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
  - .7 ASTM C 73-14, Standard Specification for Calcium Silicate Brick (Sand-Lime Brick).
  - .8 ASTM C 207 Standard Specification for Hydrated Lime for Masonry Purposes
  - .9 ASTM C 270 Standard Specification for Mortar for Unit Masonry
  - .10 ASTM C 216-15, Standard Specification for, Facing Brick (Solid Masonry Units Made of Clay or Shale).
  - .11 ASTM D 2240-05 (2010), Standard Test Method for Rubber Property - Durometer Hardness.
  - .12 ASTM D1056-14, Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber.
  - .13 ASTM E 336-14, Standard Test Method for Measurement of Airborne Sound Attenuation between Rooms in Buildings.
- .2 Brick Industry Association (BIA):
  - .1 Technical Note No. 20-2006, Cleaning Brick Work.
- .3 Canadian Standards Association (CSA International):
  - .1 CSA-A23.1-14/A23.2-14, Concrete Materials and Methods of Concrete Construction/Methods of Test for Concrete.
  - .2 CAN/CSA A82-14, Fired Masonry Brick Made From Clay or Shale).
  - .3 CAN/CSA-A165 SERIES-14, Standards on Concrete Masonry Units.
  - .4 CAN/CSA-A179-04(R2014), Mortar and Grout for Unit Masonry.
  - .5 CSA-A370-14, Connectors for Masonry.
  - .6 CAN/CSA A371-04, Masonry Construction for Buildings.
  - .7 CSA S304.1-14, Design of Masonry Structures.
  - .8 CSA A23.1-14/A23.2-14, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
  - .9 CSA-A3000-13, Cementitious materials compendium (Consists of A3001, A3002, A3003, A3004 and A3005), Includes Update No. 1 (2014), Update No. 2 (2014), Update No. 3 (2014).
  - .10 CSA W186-M 1990 (R2012), Welding of Reinforcing Bars in Reinforced Concrete Construction.

- .4 International Masonry Industry All-Weather Council (IMIAC):
  - .1 Recommended Practices and Guide Specification for Hot and Cold Weather Masonry Construction.
- .5 Reinforcing Steel Institute of Canada (RSIC):
  - .1 Reinforcing Steel Manual of Standard Practice, 2004.
- .6 Documents from the Institut de la Maçonnerie du Québec (IMQ)
  - .1 Masonry work for buildings
  - .2 Technical bulletins No. 7-8R
- .7 Institute for Research in Construction (CNRC-NRC)
  - .1 Construction Technology Update No. 68

## 1.2 QUALITY PLAN

- .1 Develop/ implement a Quality Plan that verifies the masonry work meets the project specifications.
- .2 The Quality Plan shall describe, as a minimum, the following plans and procedures:
  - .1 Identify the personnel responsible for implementation and oversight of the quality control plan for this section in an organization chart. Describe the roles and responsibilities of each person listed.
  - .2 Provide samples of the Contractor's quality control inspection forms to be used on the project. The quality control forms shall, as a minimum, include the following:
    - .1 Shop Drawing and Sample review and sign off.
    - .2 Inspection of reinforcing steel, masonry accessories, inserts, and lintels.
    - .3 Material testing logs.
    - .4 Final inspection of completed work.
    - .5 Shop Drawing and Sample review and sign off.
    - .6 Inspection of reinforcing steel, masonry accessories, inserts, and lintels.
    - .7 Material testing logs.
    - .8 Final inspection of completed work.
- .3 Describe quality control procedural steps related to:
  - .1 Preparation.
  - .2 Reinforcing installation.
  - .3 General construction of masonry work.
  - .4 Anticipated timeframes for schedule of general conformance reviews by the Consultant.
  - .5 Coordination of material testing.
  - .6 Defective work, including: identification, documentation, submission of proposed repair procedures, and follow-up inspection.
- .4 The Quality Plan shall be prepared taking into account the specific requirements of this project. Generic quality plans that, in the Consultant's reasonable opinion, fail to address the specific requirements of this section will be returned 'Revise and Resubmit'.

- .5 The Quality Plan shall be submitted to the Consultant for review at least 10 business days before the scheduled commencement of work under this section. Acceptance of the Quality Plan by the Consultant shall be considered a prerequisite for commencement of masonry work. Failure of the Contractor to coordinate the timely submission of a complete Quality Plan, which ultimately results in the delay of the start of masonry work, shall not be at risk to the Owner or Consultant for back charge.

### 1.3 ADMINISTRATIVE REQUIREMENTS

- .1 Pre-installation meetings: comply with Section 01 31 19 - Project Meetings. Conduct pre-installation meeting one week prior to commencing on-site installation to:
  - .1 Verify project requirements, including mock-up requirements.
  - .2 Verify substrate conditions.
  - .3 Coordinate products, installation methods and techniques.
  - .4 Sequence work of related sections.
  - .5 Coordinate with other building subtrades.
  - .6 Review manufacturer's installation instructions.
  - .7 Review masonry cutting operations, methods and tools and determine worker safety and protection from dust during cutting operations.
  - .8 Review warranty requirements.
- .2 Sequencing: sequence with other work in accordance with Section 01 32 16 - Construction Progress Schedules - Bar (GANTT) Chart. Comply with manufacturer's written recommendations for sequencing construction operations.

### 1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit copy of manufacturer's instructions, printed product literature and data sheets for masonry mortar and grout, masonry horizontal reinforcement, and masonry accessories and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2 Submit copy of Workplace Hazardous Materials Information System (WHMIS) - Material Safety Data Sheets (MSDS) in accordance with Section 01 35 29 - Health and Safety Requirements and Section 01 35 43 - Environmental Procedures.
- .3 Shop Drawings:
  - .1 Indicate horizontal and vertical spacing of wall reinforcement and ties to suit application.
  - .2 Shop drawings consist of bar bending details, lists and placing drawings.
  - .3 On placement drawings, indicate sizes, spacing, location and quantities of reinforcement and connectors.
- .4 Samples:
  - .1 Provide samples as follows:
    - .1 Two (2) cured, and coloured samples of mortar, illustrating mortar colour and colour range, supplemented with specific requirements. The samples must be presented in the U-shaped plastic extrusions measuring 10 mm X 10 mm X 100 mm in length. The samples must be correctly identified.

- .2 Two (2) flashing material samples, illustrating colour and colour range, size, shape, and profile. Include as specified:
  - .1 Sheet metal flashings.
  - .2 Composite flashings.
  - .3 Plastic and rubber flashings.

## **1.5 WALL MOCK-UP**

- .1 For brick re-pointing, provide mock-up in two areas as directed by consultant..
- .2 The wall mock-up should display what the final colour and texture of the joint will look like and blending into existing mortar joints.
- .3 The wall mock-up must form an integral part of the works.
- .4 Do not start work until the wall mock-up have been approved by the architect.

## **1.6 CLOSEOUT SUBMITTALS**

- .1 Provide manufacturer's instructions for care, cleaning and maintenance of prefaced masonry units for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

## **1.7 QUALITY AYSSURANCE**

- .1 Mock-ups:
  - .1 Construct mock-ups in accordance with Section 01 45 00 - Quality Control.
  - .2 Construct mock-up panel of exterior masonry wall construction 1200 x 1800 mm showing masonry colours and textures, use of reinforcement, ties, through-wall flashing, weep holes, jointing, coursing, mortar and workmanship.
  - .3 Mock-up used:
    - .1 To judge workmanship, substrate preparation, operation of equipment and material application.
  - .4 Allow forty-eight (48) hours for review of mock-up by Consultant before proceeding with work.
  - .5 When accepted by Consultant, mock-up will demonstrate minimum standard for this work. Mock-up may remain as part of finished work to the approval of the Consultant.

## **1.8 QUALITY TESTING OF MORTAR AND GROUT**

- .1 The testing of mortar and grout shall be included as part of the Quality Plan.
- .2 Testing company services will be paid for by the Contractor from a cash allowance carried Division 1.
- .3 Test mortar and grout in accordance with requirements outlined in CSA-A179-14.
- .4 Prior to beginning masonry work prepare mortar and grout mixes on site under the supervision of the Consultant, and Material Testing Firm appointed by the Contractor. Samples of mortar materials are to be taken by Material Testing Firm to determine a site-control value for the ratio of aggregate to cementitious material. Samples of mortar and grout mixes to also be taken for compressive strength testing. The results of these tests will serve as a control values for the remainder of the testing.

- .5 During masonry construction, Material Testing Firm to take mortar samples to determine the ratio of aggregate to cementitious material and mortar and grout samples for compressive strength testing. The frequency of this testing to be in accordance with the requirements outlined in CSA-A179-14. Notify the Consultant and Material Testing Firm when these tests are required. Provide a minimum of 2 business days' notice.
- .6 The results of the Quality Control testing shall be communicated to the Consultant in a manner and frequency to facilitate the Owner's Quality Assurance Plan process.

## **1.9 FIELD MEASUREMENTS**

- .1 Make field measurements necessary to ensure proper fit of members.

## **1.10 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Storage and Handling Protection:
  - .1 Store materials in dry location and in accordance with manufacturer's recommendations.
  - .2 Store and protect material from nicks, scratches, and blemishes.
  - .3 Keep materials dry until use except where wetting of bricks is specified.
  - .4 Store under waterproof cover on pallets or plank platforms held off ground by means of plank or timber skids.
  - .5 Replace defective or damaged materials with new.

## **1.11 SITE CONDITIONS**

- .1 Weather Requirements: to CSA-A371.
- .2 Cold Weather Requirements:
  - .1 To CSA-A371 with following requirements.
    - .1 Maintain temperature of mortar between 5 degrees C and 50 degrees C until batch is used or becomes stable.
    - .2 Ambient Conditions: maintain materials and surrounding air temperature to:
      - .1 Minimum 5 degrees C prior to, during, and 48 hours after completion of masonry work.
      - .2 Maximum 32 degrees C prior to, during, and 48 hours after completion of masonry work.
    - .3 Maintain temperature of masonry above 0 degrees C for minimum of 3 days, after mortar is installed.
    - .4 Preheat unheated wall sections in enclosure for minimum 72 hours above 10 degrees C, before applying mortar.
- .3 Hot Weather Requirements:
  - .1 Protect freshly laid masonry from drying too rapidly, by means of waterproof, non-staining coverings.
  - .2 Keep masonry dry using waterproof, non-staining coverings that extend over walls and down sides sufficient to protect walls from wind driven rain, until masonry work is completed and protected by flashings or other permanent construction.
  - .3 Spray mortar surface at intervals and keep moist for maximum of three days after installation.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURED BRICK UNITS**

- .1 Face Brick (Existing):
  - .1 Burned clay brick: to CAN/CSA A82.06, ASTM C261.
    - .1 At locations where existing brick façade is being removed, contractor to clean and store existing brick for re-instatement at areas of re-pointing, and where indicated on drawings.
    - .2 If salvageable brick quantities are insufficient, contractor to provide new brick to match existing as per below.
- .2 Face Brick:
  - .1 Burned clay brick: to CAN/CSA A82.06, ASTM C261.
    - .1 Type: FBX.
    - .2 Grade: SW.
    - .3 Size: to match existing.
    - .4 Colour and texture: to match existing, colour to the satisfaction of the consultant from manufacturer's complete colour range.
    - .5 Acceptable manufacturers: Hanson Brick, Brampton Brick, or approved alternate.

### **2.2 CONCRETE BLOCK**

- .1 Standard concrete block units: to CAN/CSA-A165 Series (CAN/CSA-A165.1).
  - .1 Classification: H/15/A/M.
  - .2 Size: metric modular as indicated.
  - .3 Special shapes: Provide bull-nosed units at all exposed corners, sills, and tops of walls. Provide purpose-made shapes for lintels, beams, and bond beams. Provide additional special shapes as indicated.
- .2 Exposed Faces: Uniform texture, free of imperfections, indentations, and surface cracks impairing finish or appearance.
- .3 Special fire resistant concrete block units: to CAN/CSA-A165 Series (CAN/CSA-A165.1) as modified below.
  - .1 Classification: H/15/B/M except as modified by fire resistance requirements specified below.
  - .2 Fire resistant characteristics: aggregate used in units and equivalent thickness of units to National Building Code of Canada 2010, for fire-resistance ratings indicated.
  - .3 Size: Standard metric modular as indicated.
  - .4 Special shapes: provide square, bull-nosed units at all exposed corner, sills and tops of walls s. Provide purpose-made shapes for lintels and bond beams and provide additional shapes as indicated.

### **2.3 MORTAR AND GROUT**

- .1 Use same brands of materials and source of aggregate for entire project.
- .2 Mortar and Grout: to CAN/CSA A179.

- .3 All mortar and grout must be manufactured in a plant where processes are certified ISO 9001:2008.
- .4 Aggregate: supplied by one supplier, passing 1.18mm sieve where 6mm / ¼" thick joints are indicated.
- .5 Mortar for interior/exterior masonry above grade:
  - .1 Loadbearing: Type S based on Proportion specifications
  - .2 Non-Loadbearing: Type S based on Proportion specifications
- .6 Following applies regardless of mortar types and uses specified above:
  - .1 Mortar for new pointing: Type N based on Proportion specifications.
  - .2 Repointing: Use a Type O Mortar on Proportion Specifications.
  - .3 Replacing masonry Unit: Use a hydraulic-lime-based mortar or a Pozzolan-lime-based mortar.
- .7 Coloured mortar: use colouring admixture not exceeding 10% of cement content by mass or integrally coloured masonry cement, to produce coloured mortar to match approved sample.
  - .1 Manufacturer: Solomon Colours, King Packaged materials or approved equal.
  - .2 Mortar pigments: SGS Concentrated A, H, and X Series Mortar Colours.
    - .1 Colour: To match existing as later approved by Consultant. Custom colour matching were manufacturers standard colour range is not a satisfactory match to the Consultant. Contractor to allow for up to three (3) custom colours.
    - .2 Incorporate colour and admixtures into mixes in accordance with manufacturer's instructions.
    - .3 Material: Natural and synthetic, milled, blended iron oxides.
    - .4 Carbon added for darker colours shall not exceed 4 percent.
    - .5 Produce uniform and consistent colour.
    - .6 Inert, stable to atmospheric conditions, sunfast, weather resistant, alkali resistant, water insoluble, lime proof, and nonbleeding.
    - .7 Free of deleterious fillers and extenders.
    - .8 Use any type of additive to alter the setting time, workability or any other property of the plastic or cured mortar is not permitted.
    - .9 Particle Size: 95 to 99 percent minus 325 mesh.
    - .10 pH: 6.5 to 9.0.
    - .11 Compliance: ASTM C 979.
    - .12 Tests: ASTM C 91 and ASTM C 270. Exceed 1,800 psi (12.4 kPa) at 28 days strength requirement.
- .8 Non-Staining Mortar: use non-staining masonry cement for cementitious portion of specified mortar type.
- .9 Parging Mortar: Type N to CSA A179.
- .10 Water: clean and potable.
- .11 Lime:
  - .1 Quick Lime: to CAN/CSA A179, Type N, S, based on application.
  - .2 Hydrated Lime: to CAN/CSA A179, Type S.

- .12 Bonding Agent: latex type.
- .13 Polymer Latex: organic polymer latex admixture of butadiene-styrene type non-emulsifiable bonding admixture.

## 2.4 MORTAR MIXES

- .1 Pointing Mortar: Prehydrate pointing mortar by mixing ingredients dry, then mix again adding just enough water to produce damp unworkable mix that will retain its form when pressed into ball. Allow to stand for not less than 1 hour or more than 2 hours then remix with sufficient water to produce mortar of proper consistency for pointing.
- .2 Stain Resistant Pointing Mortar: one part Portland cement,  $\frac{1}{8}$  part hydrated lime, and two parts graded (80 mesh) aggregate, proportioned by volume. Add aluminum tristearate, calcium stearate, or ammonium stearate to 2 percent of Portland cement by weight.

## 2.5 ANCHORAGE AND REINFORCING

- .1 Bar Reinforcement: Steel to CAN/CSA A371 and CAN/CSA G30.18, Grade 400
- .2 Wire Reinforcement: to CSA-A371 and CSA G30.14, ladder type.
- .3 Connectors: to CAN/CSA A370 and CSA-S304.
- .4 Material: high tensile strength steel wire meeting ASTM A82/A82M.
  - .1 Acceptable material: Fero, Blok-Lok, Hohmann & Barnard Inc., or approved alternate.
- .5 Finish Schedule: Provide minimum level of corrosion protection for masonry connectors as outlined in CSA A370 and as follows:
  - .1 Interior Masonry – (not subjected to moisture) unprotected carbon steel or with minimal zinc coating (mill galvanized).
  - .2 Interior Masonry – (subject to moisture), and above grade exterior masonry in buildings less than 13 metres/42' in height (measured from the floor level of the first storey) – hot dipped zinc galvanized after fabrication with minimum zinc coating in accordance to ASTM A153/A153M Class B wire ties/reinforcing 458 g/sq.m. and ASTM A123/A123M plates/strips/sheets 610 g/sq.m. (on each face).
- .6 Horizontal reinforcement: Horizontal joint reinforcement for masonry block walls: Ladder Type Reinforcement. Heavy Duty (4.76 mm side rods and 9 gauge cross rods at 400 centres). Refer to details on structural drawings. Reinforcement to be hot-dipped galvanized to ASTM A153. Provide prefabricated corners and tees at intersecting walls. Reinforcement to be 50 mm narrower than wall. Standard of Acceptance: BL 10 Ladder Reinforcement by Blok-Lok.
- .7 Veneer ties – existing block back-up:
  - .1 1.52 mm (16 ga) stainless steel angle tie with 4.76 mm stainless steel wire tie. Size angle tie to suit total cavity thickness. Install ties on 400 x 400 grid, and no more than 200 mm from any opening. Acceptable Products: BL-5407 Masonry Fastener Assembly (BL-407 Veneer Anchor and BL-523 Brass Expansion Bolt) and Flex-O-Lok® Ties by Blok-Lok, Heavy Duty Rap-Tie by Fero.

- .2 Secure ties with one 6.4 mm Hex Head, Type 304, stainless steel sleeve anchor. Embedment, hole size and installation to manufacturer's recommendations. Blow hole clear after drilling. Acceptable Products: Sleeve Anchor HLC-HX304SS by Hilti, Dynabolt SHN-1413 by ITW, Sleeve-all Stainless Steel by Simpson, or anchors recommended by tie manufacturer.
- .3 Corrosion Protection: as a minimum to CSA-S304.1, galvanized and CAN/CSA A370.

## **2.6 REINFORMENT FABRICATION**

- .1 Fabricate reinforcing in accordance with CAN/CSA-A23.1 and Reinforcing Steel Manual of Standard Practice by the Reinforcing Steel Institute of Canada.
- .2 Fabricate connectors in accordance with CAN/CSA A370.
- .3 Upon approval of Consultant, weld reinforcement in accordance with CSA W186.
- .4 Ship reinforcement and connectors, clearly identified in accordance with drawings.

## **2.7 REINFORCEMENT SOURCE QUALITY CONTROL**

- .1 Upon request, provide Consultant with certified copy of mill test report of reinforcement steel and connectors, showing physical and chemical analysis.
- .2 Upon request inform Consultant of proposed source of material to be supplied.

## **2.8 MASONRY ACCESSORIES**

- .1 Control joint filler: closed cell neoprene sponge with tear strip, purpose-made for horizontal and vertical applications conforming to ASTM D1056, size and shape to suit application.
  - .1 Acceptable material: 'NS Neoprene Sponge', by Blok-Lok or approved alternate.
- .2 Lap adhesive: recommended by masonry flashing manufacturer.
- .3 Weep hole vents: Polyester compressible mesh sized to suit masonry unit and mortar joint, colour to match mortar or as approved by Consultant.
  - .1 Acceptable material: 'Weep Vent', by Mortar Net Solutions, or approved alternate.
- .4 Premanufactured Drip Plates: 75 mm / 3" 38 mm / 1½" wide smooth, factory-formed with 45° hemmed edge, complete with inside outside corners, Type 316 stainless steel finish.
  - .1 Acceptable product: 'Drip Plate by Blok-Lok / Hohmann & Barnard Inc., or approved alternate.

## **2.9 MOISTURE CONTROL**

- .1 Weep Hole Protector:
  - .1 Pre-manufactured high density nylon or polyethylene open mesh, 250 mm (10") high, thickness to suit cavity.
    - .1 Acceptable material: 'Mortar Net' by Mortar Net Ltd.

- .2 Grout Screens: 6 mm square monofilament screen fabricated from high-strength, non-corrosive polypropylene polymers to isolate flow of grout in designated areas.
  - .1 Size: to suit application.
  - .2 Acceptable material: '#MGS – Mortar/Grout Screen' by Hohmann & Barnard, Inc., or approved alternate.

## **2.10 FLASHINGS**

- .1 Flashings: Refer to Section 07 26 00 Vapour Retarders, 07 27 00 - Vapour Barriers, and 07 28 00 Air/Vapour Barriers.
- .2 Prefinished Metal Flashings: Refer to Section 07 62 00 – Sheet Metal Flashing and Trim.
- .3 Aluminum Flashings: Refer to Section 07 62 00 – Sheet Metal Flashing and Trim.

## **2.11 JOINT SEALANTS AND BACKER RODS**

- .1 Non-staining type, as specified in Section 07 92 00 - Joint Sealants.

## **2.12 CLEANING COMPOUNDS**

- .1 Cleaning Compounds:
  - .1 Compatible with substrate and acceptable to masonry manufacturer for use on products.
  - .2 Cleaning compounds compatible with brick masonry units and in accordance with manufacturer's written recommendations and instructions.

## **2.13 TOLERANCES**

- .1 Tolerances for standard concrete unit masonry tolerances in accordance with CAN/CSA A165.1, supplemented as follows:
  - .1 Maximum variation between units within specific job lot not to exceed 2 mm.
  - .2 No parallel edge length, width or height dimension for individual unit to differ by more than 2 mm.
  - .3 Out of square tolerance not to exceed 2 mm.
- .2 Tolerances for architectural concrete masonry units in accordance with CAN/CSA A165.1, supplemented as follows:
  - .1 Maximum variation in length or height between units within specific job lot for specified dimension not to exceed 2 mm.
  - .2 No parallel edge length, width or height dimension for individual unit to differ by more than 2 mm.
  - .3 Out of square tolerance not to exceed 2 mm.
  - .4 Maximum variation in width between units within specific job lot for specified dimension not to exceed 2 mm.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLERS**

- .1 Experienced and qualified masons to carry out erection, assembly and installation of masonry work.

#### **3.2 MANUFACTURER'S INSTRUCTIONS**

- .1 Compliance: comply with manufacturer's written data, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.

#### **3.3 EXAMINATION**

- .1 Examine conditions, substrates and work to receive work of this Section.
  - .1 Coordinate with Section 01 71 00 - Examination and Preparation.
  - .2 Identify the structural weaknesses that might cause problems and report them before commencing work.
  - .3 Examine the joint profiles and the methods to reproduce them before repointing.
  - .4 Examine the vertical and horizontal joints in order to determine which were done first and if they all have the same profile; also keep in mind the other execution details that define the authenticity of the original work.
- .2 Examine openings to receive masonry units. Verify opening size, location, and that opening is square and plumb, and ready to receive work of this Section.
  - .1 Visually inspect substrate prior to commencing with Work of this section.
  - .2 Inform Consultant of unacceptable conditions immediately upon discovery.
  - .3 Proceed with installation only after unacceptable conditions have been remedied.
- .3 Verification of Conditions:
  - .1 Verify that:
    - .1 Substrate conditions which have been previously installed under other sections or contracts, are acceptable for product installation in accordance with manufacturer's instructions prior to installation of masonry.
    - .2 Field conditions are acceptable and are ready to receive work.
    - .3 Built-in items are in proper location, and ready for roughing into masonry work.
  - .2 Commencing installation means acceptance of existing substrates.

#### **3.4 PREPARATION**

- .1 General:
  - .1 Surface Preparation: prepare surface in accordance with manufacturer's written recommendations and coordinate with Section 01 71 00 - Examination and Preparation.
  - .2 Establish and protect lines, levels, and coursing.
  - .3 Protect adjacent materials from damage and disfiguration.

- .2 Restoration and repointing:
  - .1 The cutting depth of the joints to be redone must be around 25 mm (from 2 to 2½ times the thickness of a 10 mm joint), or until you reach the mortar that is sound looking. During the work described hereafter, the contractor-mason must be very diligent to prevent any damage to the stone, the biscuit or the edge of the brick.
  - .2 Verify the state of the joints and remove deteriorated mortar using one of the following methods:
    - .1 Using a cold chisel, either by hand or attached to a compressed air cannon, apply a light pressure so as not to damage the masonry unit.
    - .2 Using a radial saw (with a 100 mm diameter diamond blade) for the horizontal joints. However, this can only be done by experienced workers who are recognized for their ability to do this kind of work. If this is the case, then only drill at the centre of the joint and finish the job using a chisel.
    - .3 Remove the waterproofing product around the edge of the openings (doors, windows, etc.) in order to be able to re-point as much of the surface as possible.
    - .4 Determine whether or not the voids need to be refilled.
    - .5 Before repointing, the contractor must inform the architect if he/she finds any voids that are not specified on the plans and are structurally abnormal.

### 3.5 MASONRY INSTALLATION

- .1 Do masonry work in accordance with CSA-A371 except where specified otherwise.
- .2 Build masonry plumb, level, and true to line, with vertical joints in alignment, respecting construction tolerances permitted by CSA-A371.
- .3 Layout coursing and bond to achieve correct coursing heights, and continuity of bond above and below openings, with minimum of cutting.
- .4 Install bullnose concrete block to all exposed interior corners unless otherwise indicated.

### 3.6 BRICK INSTALLATION

- .1 Bond: to match existing.
- .2 Coursing height: 200 mm / 8" for three/two bricks and four/three joints as indicated.
- .3 Jointing: concave, raked where exposed or where paint or similar thin finish coating is specified.
  - .1 Mixing and blending: mix units within each pallet and with other pallets to ensure uniform blend of colour and texture.
  - .2 Clean unglazed clay masonry as work progresses.

### 3.7 CONCRETE BLOCK INSTALLATION

- .1 Concrete block units:
  - .1 Bond: running.
  - .2 Coursing height: 200 mm for one block and one joint.
  - .3 Jointing: concave to all interior locations from floor level to one course above ceiling height and to underside of deck in exposed structure locations.

- .2 Special Shapes:
  - .1 Install bullnose block to the following locations unless otherwise indicated:
    - .1 All exposed interior wall corners, including interior face of exposed exterior wall corners, returns, offsets, reveals and indents without cut ends being exposed and without losing bond or module.
    - .2 All exposed partial height wall caps.
    - .3 Window sills.
    - .4 Exposed concrete block at window and door jambs exceeding 100mm in depth.
  - .2 Install reinforced concrete block lintels over openings in masonry where steel or reinforced concrete lintels are not indicated.
  - .3 End bearing: not less than 200 mm as indicated on drawings.
  - .4 Install special site cut shaped units.

### 3.8 CONSTRUCTION

- .1 Build in miscellaneous items such as bearing plates, steel angles, bolts, anchors, inserts, sleeves, and conduits.
- .2 Construct masonry walls using running bond unless otherwise noted.
- .3 Build around frames previously set and braced. Fill behind hollow frames within masonry walls with mortar or grout and embed anchors.
- .4 Fit masonry closely against electrical and plumbing outlets so collars, plates, and covers overlap and conceal cuts.
- .5 Install movement joints and keep free of mortar where indicated.
- .6 Hollow Units: spread mortar setting bed from outside edge of face shells. Gauge amount of mortar on top and end of unit to create full joints, equivalent to shell thickness. Avoid excess mortar.
- .7 Solid Units: apply mortar over entire vertical and horizontal surfaces. Avoid bridging of airspace between brick veneer and backup wall with mortar.
- .8 Ensure compacted head joints. Use full or face-shell joint as indicated.
- .9 Tamp units firmly into place.
- .10 Do not adjust masonry units after mortar has set. Where resetting of masonry is required, remove, clean, and reset units in new mortar.
- .11 After mortar has achieved initial set up, tool joints.
- .12 Do not interrupt bond below or above openings.
- .13 Apply parging in uniform coating not less than total 10 mm thick to exposed concrete, piers, walls, foundation walls, light standards and where indicated.

- .14 Exposed masonry:
  - .1 Remove chipped, cracked, and otherwise damaged units, in accordance with CSA A-165, in exposed masonry and replace with undamaged units.
- .15 Jointing:
  - .1 Allow joints to set just enough to remove excess water, then tool with round jointer to provide smooth, joints true to line, compressed, uniformly concave joints where concave joints are indicated.
  - .2 Strike flush joints in walls to receive plaster, tile, insulation, or other applied material except paint or similar thin finish coating.
- .16 Cutting:
  - .1 Cut out for electrical switches, outlet boxes, and other recessed or built-in objects.
  - .2 Make cuts straight, clean, and free from uneven edges.
- .17 Building-In:
  - .1 Build in items required to be built into masonry.
  - .2 Prevent displacement of built-in items during construction. Check plumb, location and alignment frequently, as work progresses.
  - .3 Brace door jambs to maintain plumb. Fill spaces between jambs and masonry with mortar.
- .18 Provision for Movement:
  - .1 Unless otherwise indicated, leave 3 mm space below shelf angles.
  - .2 Unless otherwise indicated, leave 10 mm space between top of non-load bearing walls and partitions and structural elements. Do not use wedges.
  - .3 Built masonry to tie in with stabilizers, with provision for vertical movement.
- .19 Loose Steel Lintels:
  - .1 Install loose steel lintels. Centre over opening width.
- .20 Interface with other work:
  - .1 Cut openings in existing work as indicated.
  - .2 Make good existing work. Use materials to match existing
- .21 Brick Removals
  - .1 Turned brick coursings embedded into concrete block walls are to be trimmed where possible. Fill openings with mortar.
  - .2 Grout solid around left over opening in concrete block where full brick coursing must be removed.

### 3.9 REPAIR/RESTORATION

- .1 Upon completion of masonry, fill holes and cracks, remove loose mortar, and repair defective work.
- .2 For surfaces to receive air/vapour barrier membranes, ensure substrates are smooth, sound, and free of voids, spalled areas, and loose aggregate and sharp protrusions. Remove contaminants such as grease, oil and wax from exposed surfaces. Remove dust, dirt, loose stone, and debris. Use repair materials and methods that are acceptable to air/vapour barrier membrane manufacturer.

### **3.10 MORTAR AND GROUT MIXING**

- .1 Clean all mixing boards and mechanical mixing machine to be free of dried mortar, traces of rust and other contaminants; do not thaw equipment with salt or other anti-freeze agents. Clean between batches.
- .2 Mortar must be weaker than the units it is binding.
- .3 Contractor to appoint one individual to mix mortar, for duration of project. In the event that this individual must be changed, mortar mixing must cease until the new individual is trained, and mortar mix is tested.
- .4 Mix the repointing mortar until consistency is firm enough to form a ball with hands.
- .5 The total mixing time should be between 3 and 5 minutes. Coloured mortar should be mixed between 8 and 10 minutes.
- .6 If using 30-kg bags of coloured or non-coloured mortar, Contractor must not mix less than one bag at a time.

### **3.11 MORTAR PLACEMENT**

- .1 Install mortar to requirements of CAN/CSA A179.
- .2 Remove excess mortar from grout spaces.
- .3 Unless otherwise specified, if room temperature is equal to or greater than 25°C, mortar must be placed in under 1.5 hours after mixing. If room temperature is less than 25°C, mortar must be placed in under 2.5 hours after mixing.

### **3.12 GROUT PLACEMENT**

- .1 Install grout in accordance with manufacturer's instructions.
- .2 Install grout in accordance with CAN/CSA A179.
- .3 Unless otherwise specified grout must be placed within 1.5 hours of mixing.
- .4 Work grout into masonry cores and cavities to eliminate voids.
- .5 Do not install grout in lifts greater than 400 mm, without consolidating grout by rodding.
- .6 Do not displace reinforcement while placing grout.
- .7 Grout masonry in accordance with CSA-S304.1, CAN/CSA A371 and CAN/CSA A179 and as indicated.
- .8 Install building paper below voids to be filled with grout; keep paper 25 mm back from faces of units.

### 3.13 PLACEMENT CONDITIONS

- .1 Unless otherwise recommended by the manufacturer, cold weather placement:
  - .1 When the temperature during the day ranges from:
    - .1 0°C to 4°C: The sand or mixing water must be heated to a temperature between 20°C and 70°C.
    - .2 0°C to -4°C: The sand and the mixing water must be heated to a temperature between 20 and 70 °C.
    - .3 -4°C to -7°C:
      - .1 The sand and mixing water must be heated to a temperature between 20°C and 70 °C.
      - .2 Both sides of the walls under construction must be heated.
      - .3 Windbreakers must be used when wind speed exceeds 25 km/h.
  - .2 -7°C and lower:
    - .1 The sand and the mixing water must be heated to a temperature between 20°C and 70°C.
    - .2 Enclosures and supplementary heating must be planned for in order to maintain air temperature above 0 °C.
    - .3 The temperature of the masonry unit at the time of placement cannot be less than 7°C.
  - .3 Hot Weather Placement:
    - .1 Cover the opening with a waterproof tarpaulin to prevent it from drying too quickly. Make sure to use a tarpaulin that does not stain.
    - .2 Mortar shall never be directly exposed to the sun or to high wind for a long period.

### 3.14 REPOINTING

- .1 Use potable water to wash off all dust and residue from the exposed joints, but leave a bit of moisture in the existing joints to prevent water from absorbing too quickly into the old and pre-existing mortar.
- .2 Apply a first layer of mortar in the joints in a manner to obtain a uniform depth (+ 25 mm) using a pointing trowel to fill in the joints; once this layer has cured (24 hours), apply successive layers of 6 mm. Make sure each layer is well compacted to prevent air pockets, and allow each layer to lightly cure before applying the next one, until you are level with the wall surface. Finish the new joints in the same way as the original ones.

### 3.15 COLOUR UNIFORMITY

- .1 In order to ensure colour uniformity of the mortar, the contractor must:
  - .1 Use the same supplier for all mortar and grout.
  - .2 Ensure that the quantity of water in the mortar joints remains the same while smoothing them.
  - .3 Always use a clean mixer.

### 3.16 CURING

- .1 Curing is essential to optimize the physical properties of mortar.
- .2 Curing must be done using a moist cure starting with the initial setting of the mortar.

- .3 During working hours, spray the mortar lightly with water using a sprayer.
  - .1 After working hours and on weekends, create a system whereby the mortar is enclosed with a jute, which is in turn enclosed by polyethylene, and constantly wet it so that it remains humid creating a greenhouse effect.
  - .2 The jute and polyethylene should never come in direct contact with the mortar. Leave a minimum space of 4 inches between the jute and the wall surface to allow air to circulate.
  - .3 Minimum cure times: as recommended by the manufacturer.

### **3.17 BONDING AND TYING**

- .1 Tie masonry veneer to backing in accordance with NBC, CSA-S304.1, CSA-A371 and as indicated.

### **3.18 VERTICAL/HORIZONTAL REINFORCING**

- .1 Vertical reinforcing to be one piece from top of floor to underside of floor above. Reinforcing to be visible prior to grouting wall. Use suitable dowels between floors.
- .2 Where vertical reinforcement must be spliced between floors, follow a construction procedure that ensures specified lap lengths. Procedure to be approved by Consultant.
- .3 Where low-lift grouting is necessary and approved by the Consultant, comply with the height limitations of CSA A370, while ensuring specified lap lengths.
- .4 Notch bond beam blocks each side of openings if vertical jamb passes through lintel bearing.
- .5 Unless noted otherwise, install standard ladder-type horizontal joint reinforcement in all walls at 400 mm /16" centres.
- .6 Unless noted otherwise, install full height vertical 20M bar in grouted cores on both sides of all openings.

### **3.19 REINFORCED LINTELS AND BOND BEAMS**

- .1 Reinforce masonry beams, masonry lintels and bond beams as indicated.
- .2 Place and grout reinforcement in accordance with CSA-S304.1, CAN/CSA A371, and CAN/CSA A179.
- .3 Support and position reinforcing bars in accordance with CAN/CSA A371.
- .4 A "bond beam" course is to be formed from standard stretcher and pier blocks, with webs notched to receive the horizontal reinforcing or from purpose-made blocks over web knock-outs. Reinforcing to have 20 mm clear cover to top of masonry unit.
- .5 Where the course below the bond beam is not required to be grouted, install hardware cloth to retain the grout. Discontinue hardware cloth at vertically grouted cores.

- .6 Standard bond beam reinforcing, unless noted otherwise: 2-15M
- .7 Bond beam reinforcing to be continuous unless noted otherwise, lapped with Class B splices.
- .8 At intersecting walls, provide 1-20 M corner bar at all bond beams, unless noted otherwise. Corner bar legs to provide Class B splices with horizontal reinforcement. Knock out face shells of blocks at intersection of bond beams to allow free-flow of grout between walls.
- .9 Unless otherwise detailed, the first course above an opening greater than 400 mm in a concrete block wall is to be formed from "bond beam" blocks with a solid bottom. Horizontal reinforcement is to be placed in the bottom of the block with spacers to maintain 20 mm below the bar.
- .10 Reinforcing to be continuous over the opening and to extend 200 mm each side, unless noted otherwise.

### **3.20 ANCHORS**

- .1 Supply and install metal anchors in accordance with CAN/CSA A370 and CAN/CSA A371.

### **3.21 LATERAL SUPPORT AND ANCHORAGE**

- .1 Supply and install lateral support and anchorage in accordance with CSA-S304.1 and as indicated.

### **3.22 MOVEMENT/CONTROL JOINTS**

- .1 Control Joints:
  - .1 Construct continuous vertical control joints for every 7.62m of wall. Continuous horizontal control joints not to exceed 2.5 times the vertical control joint spacing. Location of control joints to be approved by consultant prior to installation.
  - .2 Install continuous control joint fillers in control joints.
  - .3 Apply joint sealant in control joint, in accordance with Section 07 92 00 – Joint Sealants.
    - .1 Joint sealant colour to match mortar colour.
    - .2 Tool joint sealant to a smooth finish to match mortar joint.
- .2 Movement Joints:
  - .1 Build-in continuous movement joints in accordance with CSA – A371.
- .3 Reinforcement will not be continuous across movement joints unless otherwise indicated.

### **3.23 REINFORCEMENT FIELD BENDING**

- .1 Do not field bend reinforcement and connectors except where indicated or authorized by Consultant.
- .2 When field bending is authorized, bend without heat, applying a slow and steady pressure.
- .3 Replace bars and connectors which develop cracks or splits.

### 3.24 INSTALLATION: MATERIALS

- .1 Install continuous movement joint fillers in movement joints at locations indicated on drawings.
- .2 Lap adhesive: apply adhesive to flashing lap joints.
- .3 Mechanical fasteners: install fasteners to suit application and in accordance with manufacturer's written installation instructions.
- .4 Reglets: install reglets at locations indicated on drawings.

### 3.25 INSTALLATION: MOISTURE CONTROL

- .1 Install weep hole vents in vertical joints immediately over flashings, in exterior wythes of cavity wall and masonry veneer wall construction, at maximum horizontal spacing of 600 mm on centre.
- .2 Weep hole protector: install purpose made diverters in cavities where indicated and as directed, size and shape to suit purpose and function.
- .3 Grout Screens: install purpose made diverters in cavities where indicated and as directed, size and shape to suit purpose and function.

### 3.26 INSTALLATION: FLASHINGS

- .1 Build in flashings in masonry in accordance with CAN/CSA A371.
  - .1 Install drip plates and flashings under exterior masonry bearing on foundation walls, slabs, shelf angles, and steel angles over openings, and at base of cavity wall and where cavity is interrupted by horizontal members or supports and as shown on drawings. Install flashings under weep hole courses and as indicated.
  - .2 In cavity walls and veneered walls, carry flashings over horizontal face of drip plates of exterior masonry, under outer wythe, then up backing not less than 150 mm and as follows:
    - .1 For masonry backing embed or bond flashing 25 mm in joint.
    - .2 For concrete backing, insert or bond flashing into reglets.
    - .3 For wood frame backing, staple flashing to walls behind water resistive paper, and lap joints 150 mm minimum.
    - .4 For gypsum board and glass fibre faced sheathing backing, bond to wall using manufacturer's recommended adhesive.
    - .5 Lap joints 150 mm and seal with adhesive.
- .2 Form flashing (end dams) at lintels, sills, and wall ends to prevent water from travelling horizontally past flashing ends.
- .3 Install vertical flashing where outer veneer returns at window or door jambs, to prevent contact of veneer with inner wall.

### 3.27 SITE TOLERANCES

- .1 Tolerances in notes to CSA-A371 apply.

### 3.28 FIELD QUALITY CONTROL

- .1 Refer to Section 01 21 00 – Allowances.
- .2 Noise reduction between two rooms will be tested by independent testing agency appointed and paid by contractor under Section 01 21 00 – Allowances in accordance with ASTM E 336.
- .3 Notify inspection agency minimum of 24 hours in advance of requirement for tests.

### 3.29 CLEANING

- .1 Clean in accordance with Section 01 74 11 - Cleaning.
- .2 Remove droppings and splashings using clean sponge and water.
- .3 Clean masonry with low pressure clean water and soft natural bristle brush.
- .4 Perform cleaning as soon as possible after installation to remove construction and accumulated environmental dirt.
- .5 Clean unglazed clay masonry: 10 m<sup>2</sup> area of wall designated by Consultant as directed below and leave for one week. If no harmful effects appear and after mortar has set and cured, protect windows, sills, doors, trim and other work, and clean all existing brick masonry as follows.
  - .1 Remove large particles with wood paddles without damaging surface. Saturate masonry with clean water and flush off loose mortar and dirt.
  - .2 Scrub with solution of 25 mL trisodium phosphate and 25 mL household detergent dissolved in 1 L of clean water using stiff fibre brushes, then clean off immediately with clean water using hose. Alternatively, use proprietary compound recommended by brick masonry manufacturer in accordance with manufacturer's directions.
  - .3 Repeat cleaning process as often as necessary to remove mortar and other stains.
  - .4 Use acid solution treatment for difficult to clean masonry as described in Technical Note No.20 by the Brick Industry Association.
- .6 Clean concrete brick masonry as work progresses.
  - .1 Allow mortar droppings on masonry to partially dry then remove by means of trowel, followed by rubbing lightly with small piece of brick and finally by brushing.
- .7 Upon completion of installation, remove surplus materials, rubbish, tools, and equipment barriers.
- .8 Final Cleaning
  - .1 Perform cleaning after installation to remove construction and accumulated environmental dirt.
  - .2 Upon completion of installation and verification of performance of installation, remove surplus materials, rubbish, tools and equipment barriers.
- .9 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
  - .1 Divert unused or damaged masonry units and glass block from landfill as specified in Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

### **3.30 PROTECTION OF COMPLETED WORK**

- .1 Cover completed and partially completed work not enclosed or sheltered with waterproof covering at end of each work day. Anchor securely in position.
- .2 Finished masonry works must be protected from mortar spatter by covering them with non-staining tarpaulins or polyethylene.
- .3 Protect the windows, frames, doors and sills from spatter or other damaging elements.

### **3.31 PROTECTION**

- .1 Temporary Bracing:
  - .1 Provide temporary bracing of masonry work during and after erection until permanent lateral support is in place.
  - .2 In addition to required bracing, brace masonry walls as necessary to resist wind pressure and lateral forces during construction.
- .2 Moisture Protection:
  - .1 Keep masonry dry using waterproof, non-staining coverings that extend over walls and down sides sufficient to protect walls from wind driven rain, until completed and protected by flashing or other permanent construction.
  - .2 Cover completed and partially completed work not enclosed or sheltered with waterproof covering at end of each work day. Anchor securely in position.
  - .3 Air Temperature Protection: protect completed masonry

### **3.32 SCHEDULE**

- .1 Approximate area of repointing is 25 m<sup>2</sup>. Area in excess of this quantity to subject to Unit Pricing after Consultant approval to proceed.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 STANDARDS**

- .1 ASTM International:
  - .1 ASTM A36/A36M-14, Standard Specification for Carbon Structural Steel.
  - .2 ASTM A123/A123M-17, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
  - .3 ASTM A193/A193M-17, Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Services and Other Special Purpose Applications.
  - .4 ASTM F1554-20-17e1, Standard Specification for Anchor Bolts, Steel, 36, 55 and 105-ksi Yield Strength.
  - .5 ASTM F3125M-15A, Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi (830 MPa) and 150 ksi (1040 MPa) Minimum Tensile Strength, Inch and Metric Dimensions.
- .2 Canadian General Standards Board (CGSB):
  - .1 CAN/CGSB-85.10-99 (Withdrawn), Protective Coatings for Metals.
- .3 Canadian Institute of Steel Construction (CISC)/Canadian Paint Manufacturer's Association (CPMA):
  - .1 Handbook of the Canadian Institute of Steel Construction.
  - .2 CISC Guide for Specifying Architecturally Exposed Structural Steel (AESS) 2012.
  - .3 CISC/CPMA Standard 2-75, Quick Drying Primer for use on Structural Steel.
  - .4 CISC/CPMA Standard 1-73a, Quick-Drying, One-Coat Paint for Use on Structural Steel.
- .4 Canadian Standards Association (CSA International):
  - .1 CSA G40.20-13/G40.21-13, General Requirements for Rolled or Welded Structural Quality Steel/ Structural Quality Steel.
  - .2 CSA-G164-18, Hot Dip Galvanizing of Irregularly Shaped Articles.
  - .3 CSA-S16-14, Limit States Design of Steel Structures.
  - .4 CSA-S136-16, North American Specifications for the Design of Cold Formed Steel Structural Members.
  - .5 CSA W47.1-09 (R2014), Certification of Companies for Fusion Welding of Steel.
  - .6 CSA W48-18, Filler Metals and Allied Materials for Metal Arc Welding.
  - .7 CSA W55.3-08 (R2013), Certification of Companies for Resistance Welding of Steel and Aluminum.
  - .8 CSA W59-18, Welded Steel Construction (Metal Arc Welding).
- .5 Master Painters Institute:
  - .1 MPI-INT 5.1-08, Structural Steel and Metal Fabrications.
  - .2 MPI-EXT 5.1-08, Structural Steel and Metal Fabrications.
- .6 The Society for Protective Coatings (SSPC) and National Association of Corrosion Engineers (NACE) International:
  - .1 NACE No. 3/SSPC-6-06, Commercial Blast Cleaning.

### **1.2 QUALIFICATIONS**

- .1 Fabrication and installation of structural steel to be performed only by firm fully approved by Canadian Welding Bureau to requirements of CSA Standard W47.1 (Division 1 or Division 2.1) and/or CSA Standard W55.3.

- .2 In addition to those qualifications listed elsewhere in this Section, engage a firm competent in fabricating AESS elements similar to that indicated for this Project. Provided list of previous projects with AESS requirements and client references for review by the Consultant. Where doubt exists as to the qualifications of the proposed AESS fabricator, the Consultant may, at their discretion, order Contractor to arrange for an alternative AESS fabricator at no extra cost or delay to Owner.
- .3 In addition to those qualifications listed elsewhere in this Section, engage a competent Erector who has completed comparable AESS work. Provide a list of previous projects with similar AESS requirements and client references for review by Consultant. Where doubt exists as to the qualifications of the proposed AESS erector, the Consultant may, at their discretion, order Contractor to arrange for an alternative AESS fabricator at no extra cost or delay to Owner.

### 1.3 QUALITY PLAN

- .1 Develop and implement a Quality Plan that verifies the structural steel fabrication and installation is in conformance with this Section.
- .2 The Quality Plan shall describe, as a minimum, the following plans and procedures:
  - .1 Identify the personnel responsible for implementation and oversight of the quality control plan for this section in an organization chart. Describe the roles and responsibilities of each person listed.
  - .2 Provide samples of Contractor's quality control inspection forms to be used on the project. The quality control forms shall, as a minimum, include the following:
    - .1 Shop Drawing Review and Sign Off.
    - .2 Structural Steel Inspection Request.
    - .3 Deficiency Sign-Off.
  - .3 Quality plan shall include procedural steps for review of shop drawings by the Contractor prior to submission to the Consultant.
  - .4 Describe quality control procedural steps related to:
    - .1 Shop and site fabrication.
    - .2 Installation of structural steel.
    - .3 Welding.
    - .4 Metal fabrications, including stairs, handrails, guardrails, and platforms.
    - .5 Metal deck installation.
    - .6 Defective work, including: identification, documentation, submission of proposed repair details, and follow-up inspection.
  - .5 Risk Management: List and describe any anticipated project specific risks associated with this section or related sections and outline proposed means of mitigation.
- .3 The Quality Plan shall be prepared taking into account the specific requirements of this project. Generic quality plans that, in the Consultant's opinion, fail to address the specific requirements of this project will be returned 'Revise and Resubmit'.
- .4 The Quality Plan shall be submitted to the Consultant for review at least 10 business days prior to the scheduled commencement of shop fabrication. Allow five (5) business days for review of Quality Plan by Consultant. Acceptance of the Quality Plan by the Consultant shall be considered a prerequisite for structural steel fabrication. Failure of the Contractor to coordinate the timely submission of a complete Quality Plan, which ultimately results in the delay of the start of structural steel fabrication, shall not be at the risk of the Owner or Consultant for back charge.
- .5 It is acceptable for Quality Plan for work of this section to also include quality control procedures for work of related sections.

#### 1.4 INSPECTIONS

- .1 Site inspections to ensure conformance with this Section are to be conducted by an inspection company appointed by the Contractor. Shop and site inspections to be performed only by a firm certified by the Canadian Welding Bureau for the requirements of CSA Standard W178 (Qualification of Welding Inspection Organizations) for buildings by visual methods.
- .2 Testing company services will be paid for by the Contractor from a cash allowance carried Division 1.
- .3 All inspection procedures to be as outlined in CAN/CSA S16.
- .4 Site inspections, in general, are to check installation of high strength bolts, field welding procedures, and alignment and plumbness of framing after erection. Site inspections are to occur at the following erection milestones as a minimum:
  - .1 Structural steel 80% installed
  - .2 100% installation of all structural steel, metal fabrications, etc.
- .5 Supply all necessary cooperation to facilitate site inspections. Provide safe access and working areas for testing on site.

#### 1.5 SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Submit connection design details, erection diagrams, and shop details for each member, hereafter referred to as shop drawings. Structural steel shop drawings shall be reviewed and accepted in accordance with the Contractor's Quality Plan prior to forwarding on to the Consultant.
- .3 Shop drawings to be submitted in the form of reproducible tracing plus one set of white prints. Quantity and format of shop drawings are to be in accordance with Section 01 33 00 – Submittal Procedures. Reproduction of Contract Documents will not be acceptable as shop drawings.
- .4 Submit shop drawings in a single, complete set in order that all details may be read in conjunction with plans, elevations and all other dependent details.
- .5 All materials, finishes, and loadings shall be clearly illustrated. All submittals shall be made in English with any abbreviations clearly defined.
- .6 Where shop drawings are re-submitted, clearly illustrate all revisions from previous submissions using revision marks and "bubbles".
- .7 Structural steel shop drawings to be stamped and signed by a qualified Professional Engineer registered in the Province of Ontario in the employ of the steel fabricator to signify that fabricator's responsibilities with respect to detailing and connection design have been completed and reviewed for compliance with Contract Documents.
- .8 Clearly show, in plan, all members, bridging, bracing, connections, steel lintels, hangers, etc.
- .9 For assemblies, components, and connections designated as AECS, clearly identify the following:
  - .1 Distinguish between shop and field welds and show size, length, and type of each weld.
  - .2 Grinding, finish, and profile of welds.
  - .3 Type and finish of bolts. Indicate which side of the connection bolt heads should be placed.
  - .4 Orientation of exposed seams in HSS members.
  - .5 Special tolerances.
  - .6 Erection requirements.

- .10 Drawings to be prepared by fabricator in accordance with A.I.S.C. Structural Steel Detailing Manual.
- .11 Do not commence fabrication until complete set of shop drawings has been reviewed by the Consultant. Where fabrication is initiated prior to such review, all subsequently required revisions shall be at no cost to the Owner.
- .12 Submit mill test reports prior to fabrication of structural steel. Mill test reports to show chemical and physical properties and other details of steel to be incorporated in project. Mill test reports to be certified by metallurgists qualified to practice in the Province of Ontario.
- .13 Provide structural steel fabricator's affidavit stating that materials and products used in fabrication conform to applicable material and products standards specified and indicated.

## **1.6 EXAMINATION**

- .1 Prior to fabrication, review all dimensions in conjunction with all Contract Documents. Report any conflicts or uncertainties for clarification.
- .2 Prior to erection, examine all site conditions and dimensions which may affect this work. Report any inconsistencies to Consultant for direction.

## **1.7 COORDINATION OF QUALITY PLAN WITH WORK ON SITE**

- .1 Ensure field inspection processes are carried out in conformance with the Quality Plan.
- .2 Consultant may elect to review the contents of the Quality Plan to assess if the work is proceeding in general conformance with the Contract Documents. The Consultant may also elect to review the work on site and prepare appropriate record of observations for the Owner. Supply all necessary cooperation to facilitate Consultant's review of work on site. Provide safe access and working areas for review and inspection on site.

## **1.8 COORDINATION**

- .1 Review all Contract Documents and shop drawings related to all other trades which may affect this work. Report any discrepancies to Consultant for direction.
- .2 Cooperate with all other trades to fully coordinate all dimensions, openings, details, etc. which may be required during fabrication or erection.

## **1.9 SUPPLY AND INSTALLATION OF MISCELLANEOUS ITEMS**

- .1 Examine Contract Documents and shop drawings of all other trades and provide all items noted by Division 5.
- .2 Supply all built-in items such as anchor bolts, bearing plates, steel lintels, etc. unless noted otherwise. Turn over such built-in items to the trade responsible for installation.

## 1.10 STORAGE AND HANDLING

- .1 Store and handle steel members in accordance with the Contractor's Quality Plan to prevent damage which will impair adequacy or appearance of material in finished structure.
- .2 All members damaged during shipping, handling or erection shall be repaired to the satisfaction of the Consultant at no cost to the Owner.
- .3 Take special precautions when erecting long slender members.
- .4 Erect finished AESS pieces using softened slings or other methods such that they are not damaged. Provide padding as required to protect elements while rigging and aligning member's frames. Weld tabs for temporary bracing and safety cabling only at points concealed from view in the completed structure or where approved by the Consultant.

## **PART 2 - PRODUCTS**

### 2.1 MATERIALS

- .1 Structural Steel:
  - .1 Hot rolled structural sections and bars - Grade 350W to CAN/CSA G40.21 unless indicated otherwise.
  - .2 Hollow structural sections - Grade 350W to CAN/CSA G40.21 manufactured to CAN/CSA G40.20, Class 'H' only, unless indicated otherwise.
  - .3 Angles and plates – Grade 300W to CAN/CSA G40.2 unless indicated otherwise.
- .2 Bolts - high strength to ASTM A325M with suitable nuts and hardened steel washers.
- .3 Anchor Bolts - mild steel to ASTM A307 with suitable nuts and hardened steel washers, 20 mm diameter unless indicated otherwise. Provide template for trade responsible for installation.
- .4 Drill-in-Anchors:
  - .1 Expansion wedge type anchors: sizes as noted, Type 316 stainless steel. Standard of Acceptance: Hilti Kwik Bolt TZ.
  - .2 Adhesive anchors: sizes as noted, type 316 stainless steel. Standard of Acceptance: Hilti HAS Rod secured with Hilti Hi HY 200 Adhesive Anchoring System (Safe Set).
- .5 Welding Materials - conforming to W48.3 and suitable for use intended.
- .6 Paint:
  - .1 Shop and touch-up paint to CISC/CPMA 2-75.
  - .2 Colour of shop applied primer: grey.
- .7 Galvanizing:
  - .1 Galvanizing to stricter requirements of ASTM A123/A123M-13 or CAN/CSA-G164 (withdrawn), minimum zinc coating 600 g/m<sup>2</sup>.
  - .2 Zinc-rich touch-up coating, ready mixed to CAN/CGSB-1.181-99. Standard of Acceptance: Fosroc Galvafrid distributed by W.R. Meadows.

## 2.2 DESIGN AND FABRICATION

- .1 All fabrication to comply with requirements of CAN/CSA S16. All welding to conform to requirements of CSA W59. Use only welders approved by Canadian Welding Bureau for work class being performed.
- .2 Fabrication
  - .1 Fabricate structural steel not designated as AESS, in accordance with CAN/CSA-S16 and in accordance with reviewed shop drawings.
  - .2 Fabricate structural steel elements, connections, and assemblies designated as AESS in accordance with the requirements of CISC-AESS-Categories specified on drawings and in accordance with reviewed shop drawings and visual samples.
    - .1 Fabricate and assemble AESS elements, connections, assemblies in the shop to the greatest extent possible. Locate field joints in AESS assemblies at concealed locations or as approved by Consultant.
    - .2 Fabricate AESS with surface quality consistent with the applicable CISC-AESS Category requirements and accepted visual samples.
    - .3 Appearance and quality of welds in AESS elements shall be consistent with applicable CISC-AESS-Category requirements and accepted visual samples. Assemble and weld built-up sections by methods that will maintain alignment of members to the required tolerances.
    - .4 Provide bolt type and finish specified. Place bolt heads as indicated on the approved shop drawings.
- .3 Substitutions of member sizes will be permitted only if equivalent stiffness and load carrying capacity are provided and no interference with other details will result. Substitutions, including all necessary modifications to the work of this Section and all other trades, to be at no cost to the Owner.
- .4 Where design reactions are not indicated, design and detail all connections to resist a total shear based on tributary floor, roof and wall loads noted and considering any concentrated loading which occurs on members. As a minimum, connections shall be capable of supporting one-half the allowable uniformly distributed load for the member and span considered.
- .5 In general, framed connections with double angles, end connection plates or seated connections with top or side clip angles are acceptable. The Consultant may require the use of a specific connection type at their discretion, if considered necessary to ensure structural action assumed in design.
- .6 Design all splices to develop full capacity of member unless noted otherwise.
- .7 Detail and reinforce all slots, holes and openings in members so as to avoid overstressing. Construct re-entrant corners free from notches and with largest practical radii, with a minimum radius of 13 mm.
- .8 Grind smooth or detail all butt welds, connections and splices in members, which will be exposed when construction is complete, so as to be as unobtrusive as possible. Appearance, location and details of exposed splices and connections to be to the Consultant's approval.
- .9 Unless sizes are indicated, design beam bearing plates in accordance with method presented in C.I.S.C. Handbook. Limit bearing stresses to 2 MPa maximum on solid plain masonry and 8 MPa maximum on concrete.
- .10 Unless detailed otherwise, beams up to 300 mm deep to bear 200 mm onto walls, and beams over 300 mm deep to bear 400 mm onto walls. Where wall thickness limits length of bearing available, bear beams on full wall thickness.

- .11 Where indicated and where steel beams or columns interrupt reinforced bond beams, field weld dowels to the steel member to match those in bond beam and of length sufficient to lap 36 bar diameters.
- .12 Stitch weld double angle members back to back to limit the slenderness ratio of each angle to less than that of the whole member.
- .13 Unless indicated otherwise, where non load bearing masonry walls extend up to and parallel to underside of steel beams, install pairs of 76 x 76 x 6.4 mm clip angles 150 mm minimum length at 1200 mm centres or as otherwise detailed to provide lateral support for walls. If wall is parallel to but offset from steel members, install sections of 76 x 76 x 6.4 mm angle between primary framing members (i.e. joists or beams) at 1200 mm centres to receive lateral support clip angles. If wall is perpendicular to joists or beams, install clip angles on bottom chord or flange of each primary framing member crossing wall.
- .14 For attachment of wood framing or blocking, provide 18 mm diameter drilled holes for 16 mm bolts unless noted. Space at 400 mm centres and stagger each side of flange or chord.
- .15 Unless indicated otherwise, column anchor bolts to be 20 mm diameter with minimum 300 mm embedment with headed stud or hardened steel nut and washer welded to end. "J" bolt type anchor bolts will not be permitted.

## **2.3 PREPARATION AND CORROSION PROTECTION**

- .1 Clean structural steel to the requirements of SSPC - SP3 as a minimum.
- .2 Apply one shop coat of primer paint except as follows:
  - .1 Do not paint surfaces and edges to be field welded. If painted, remove paint for field welding for a distance of at least 50 mm on all sides of joint.
  - .2 Do not paint members of portions thereof which will be encased in, or in direct contact with, cast-in-place concrete.
- .3 Blast clean all steel members (including angle lintels, shelf angles, anchor plates and bolts, mechanical rooftop framing, etc.) which will be exposed to weather or a corrosive environment in finished structure, to requirements of SSPC - SP6. Galvanize to stricter requirements of ASTM A 123/A 123M-13 or CAN/CSA-G164 (withdrawn).
- .4 Where members will be exposed to view in completed structure, carefully clean and paint so as to be free of imperfections which will mar finished painted surface.
- .5 After erection, touch-up all field bolts, field welds and all damaged or missing shop paint with one touch-up coat of paint.

## **2.4 BEARING PLATES**

- .1 Provide bearing plates for all beams bearing on masonry or concrete. Minimum size 200 mm long x 10 mm thick x width of member plus 25 mm. Supply loose for building in by trade responsible for constructing wall.

### **PART 3 - EXECUTION**

#### **3.1 ERECTION**

- .1 Erection of all structural steel members to conform to requirements of CAN/CSA S16.
- .2 Make adequate provision for erection stresses and install adequate temporary bracing to withstand all loads to which structure may be subject during erection and subsequent construction, including loads due to wind, equipment and operation of same. Leave temporary bracing in place as long as necessary for safety or until walls and/or permanent bracing upon which frame depends for lateral stability and all connections thereto, are completed.
- .3 Supply beam and column anchor bolts for installation by trade constructing bearing surface. Prior to erection, check location and elevation of all anchor bolts and advise the Consultant Engineer of any discrepancies. Any corrective measures necessary to be approved by the Consultant.
- .4 Support column bases at minimum 4 points by leveling nuts or steel shims so as to provide a minimum 40 mm grout space below base plates.
- .5 Fabricate connections to comply with requirements of CAN/CSAS16-01. Field connections may be accomplished by welding or with high strength bolts. Bolted connections shall be pretensioned as per the requirements of CAN/CSA S16-01. Perform field welding carefully so as not to cause any damage to joists, structural steel, bridging or deck.
- .6 Do not weld across beam flanges.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 SCOPE OF WORK**

- .1 Provide components made of steel unless otherwise indicated.
- .2 Provide the following components as required and / or where indicated:
  - .1 Angle lintels over all masonry openings unless otherwise indicated.
  - .2 Pipe railings.
  - .3 Corner guards.
  - .4 Exterior access ladders.
  - .5 Trench covers and frames.
  - .6 Interior Access covers.
  - .7 Miscellaneous channel frames.
  - .8 Under counter support brackets.
  - .9 Masonry lateral support brackets.
  - .10 Other metal fabrications shown and not specifically covered in other Sections.
- .3 The above list is intended as a guide only and not to be considered as a complete list of all items to be provided. Examine drawings thoroughly to determine items and quantities required. The above list of items will not override items and quantities identified on Contract Drawings.
- .4 The Contractor is to coordinate the correct installation of any fabricated items including obtaining suitable templates and guides required for a top-quality installation. Items to be fabricated and supplied to the site for installation in a timely manner which does not impact schedules or quality of workmanship of the associated trades.
- .5 All exterior metal fabrications exposed to weather to be hot-dip galvanized, unless noted otherwise.

### **1.2 REFERENCES**

- .1 ASTM International:
  - .1 ASTM A 36/A 36M-14, Standard Specification for Carbon Structural Steel.
  - .2 ASTM A 53/A 53M-12, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
  - .3 ASTM A 123/A 123M-17, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
  - .4 ASTM A269/A269M-15a, Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
  - .5 ASTM A 307-14e1, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
  - .6 ASTM F3125M-15A, Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi (830 MPa) and 150 ksi (1040 MPa) Minimum Tensile Strength, Inch and Metric Dimensions.
- .2 Canadian General Standards Board (CGSB):
  - .1 CAN/CGSB-85.10-99 (Withdrawn), Protective Coatings for Metals.

- .3 Canadian Institute of Steel Construction (CISC)/ Canadian Paint Manufacturer's Association (CPMA):
  - .1 Handbook of the Canadian Institute of Steel Construction.
  - .2 CISC Guide for Specifying Architecturally Exposed Structural Steel (AESS) (2012).
  - .3 CISC/CPMA Standard 2-75, Quick Drying Primer for Use on Structural Steel.
  - .4 CISC/CPMA Standard 1-73a, Quick Drying, One-Coat Paint for Use on Structural Steel.
- .4 Canadian Standards Association (CSA International):
  - .1 CSA G40.20-13/G40.21-13, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
  - .2 CAN/CSA G164-M92 (Withdrawn), Hot Dip Galvanizing of Irregularly Shaped Articles.
  - .3 CSA S16-14, Design of Steel Structures.
  - .4 CSA-S136-16, North American Specifications for the Design of Cold Formed Steel Structural Members.
  - .5 CSA-S157-17, Strength Design in Aluminum.
  - .6 CSA W47.1-09 (R2014), Certification of Companies for Fusion Welding of Steel.
  - .7 CSA W47.2-11 (R2015), Certification of Companies for Fusion Welding of Aluminum.
  - .8 CSA W48-18, Filler Metals and Allied Materials for Metal Arc Welding (Developed in co-operation with the Canadian Welding Bureau).
  - .9 CSA W59-18, Welded Steel Construction (Metal Arc Welding) Metric.
- .5 Environmental Choice Program:
  - .1 CCD-047-98(R2005), Architectural Surface Coatings.
  - .2 CCD-048-98(R2006), Surface Coatings - Recycled Water-borne.
- .6 Health Canada / Workplace Hazardous Materials Information System (WHMIS):
  - .1 Material Safety Data Sheets (MSDS).
- .7 The Master Painters Institute (MPI):
  - .1 Architectural Painting Specification Manual - current edition.

### **1.3 QUALIFICATIONS**

- .1 Metal fabrication to be performed only by firm fully approved by Canadian Welding Bureau to requirements of CSA Standard W47.1 (Division 1 or Division 2.1) and/or CSA Standard W55.3.

### **1.4 DESIGN REQUIREMENTS**

- .1 Steel design to CSA-S16, Limit States Design of Steel Structures.
- .2 Aluminum design to CSA-S157, Strength Design in Aluminum.
- .3 Design ladders to the requirements of the Ontario Ministry of Labour Regulations and the Engineering Data Sheet 2-04 as a minimum standard.
- .4 Design of Metal Fabrications to be completed by Professional Engineer registered or licensed in the Province of Ontario, Canada who is qualified and experienced in the design work being performed.

## **1.5 QUALITY PLAN**

- .1 Develop and implement a Quality Plan that verifies the metal fabrication and installation is in conformance with this Section.
- .2 Submit details of Quality Plan to Consultant for review. It is acceptable for the Quality Plan for work of this section to be incorporated into the Quality Plan included in Section 05 12 23 – Structural Steel.

## **1.6 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Shop Drawings:
  - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada in the employ of the steel fabricator to signify the fabricator's responsibilities with respect to detailing and connection design have been completed and reviewed for compliance with the Contract Documents.
  - .2 Indicate materials, core thicknesses, finishes, connections, joints, method of anchorage, number of anchors, supports, reinforcement, details, and accessories.
  - .3 For all aluminum fabrications, clearly indicated base metal yield strength (Fy) and reduced yield strength (Fwy) at welded heat affected zone.
  - .4 Provide details to illustrate bracing and bridging systems, column and beam splices, bearing and base plates, connections and any other standard items or details required.
  - .5 Metal fabrication shop drawings shall be reviewed and accepted in accordance with the Contractor's Quality Plan prior to forwarding on to the Consultant.
  - .6 Do not commence fabrication until complete set of shop drawings has been reviewed and accepted by the Consultant. Where fabrication is initiated prior to such review, all subsequently required revisions shall be at no cost to the Owner.
- .3 Certifications: submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

## **1.7 EXAMINATION**

- .1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for metal fabrications installation in accordance with manufacturer's written instructions.
  - .1 Visually inspect substrate prior to commencing with Work of this section.
  - .2 Inform Consultant of unacceptable conditions immediately upon discovery.
  - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed Consultant.

## **1.8 COORDINATION OF QUALITY PLAN WITH FABRICATION**

- .1 Ensure shop fabrication is carried out in conformance with the Quality Plan.

## **1.9 COORDINATION OF QUALITY PLAN WITH WORK ON SITE**

- .1 Ensure field installation processes are carried out in conformance with the Quality Plan.
- .2 Consultant may elect to review the contents of the Quality Plan to assess if the work is proceeding in general conformance with the Contract Documents. The Consultant may also elect to review and inspect the work on site and prepare appropriate record of observations for the Owner. Supply all necessary cooperation to facilitate Consultant's review of work on site. Provide safe access and working areas for review and inspection of work on site.

## **1.10 GENERAL COORDINATION**

- .1 Review all Contract Documents and shop drawings related to all other trades that may affect this work. Report any discrepancies to the Consultant for review.
- .2 Cooperate with all other trades to fully coordinate all dimensions, openings, details, etc. which may be required during fabrication or installation.
- .3 Supply all built-in items such as anchor bolt, bearing plates, steel lintels, etc. unless noted otherwise. Turn over such built-in items to the trade responsible for installation.

## **1.11 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Replace defective or damaged materials with new.

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS**

- .1 All metals to be new materials free from corrosion or other defects impairing strength, durability or finished appearance, in all respects to uses required and subject to review of Consultant. Furnish samples for review as required. All materials to be of best commercial quality for purposes specified.
- .2 Hot rolled structural sections and bars: CAN/CSA-G40.21, Grade 350W.
- .3 Hollow structural sections (HSS): CAN/CSA-G40.21, Grade 350W, Class 'H' only, unless indicated otherwise.
- .4 Angles and plates: CAN/CSA-G40.2, Grade 300W, unless indicated otherwise.
- .5 Steel pipe: to ASTM A 53/A 53M.

- .6 Welding materials: to CSA W59.
- .7 Welding electrodes: to CSA W48 Series.
- .8 Bolts and anchor bolts: to ASTM A 307.
- .9 Aluminum sections and plates to be aluminum alloy 6061-T6 to B209-65 and B308-65 (CSA Alloy GS11N-T6). Structural sections to be 6351-T6 alloy.
- .10 Stainless steel tubing: to ASTM A 269, Type 302 commercial grade seamless welded with AISI No. 4 finish.
- .11 Grout: non-shrink, non-metallic, flowable, 15 MPa at 24 hours.
  - .1 Acceptable materials: 'Por-Rock', by Hallemite Products Ltd. or 'SET 15 Minute Anchoring Cement' by SET Products Ltd.
- .12 Sheet steel: hot dip galvanized, cold rolled, with stretcher level degree of flatness to ASTM A653/A653M; zinc coating designation Z275.
- .13 Shop primer for interior components: CAN/CGSB-1.40.
- .14 Zinc rich paint:
  - .1 Shop primer for exterior components to be painted: Inorganic zinc rich paint.
  - .2 Touch-up: CAN/CGSB-1.181.
    - .1 Acceptable materials: 'Inorganic Coating 'No.2000.302'', by Glidden, or equivalent product approved by Consultant.
- .15 Bituminous enamel: alkali resistant asphaltic coating.

## 2.2 FINISHES

- .1 Thoroughly clean steel of loose scale, rust, oil, dirt and other foreign matter. Suitably prepare steel surfaces by power tool cleaning to receive specified finishes.
- .2 Grind smooth sharp projections.
- .3 Remove oil and grease by solvent cleaning.
- .4 Apply coatings in the shop and before assembly. Where size permits, galvanize components after assembly.
- .5 Interior components: shop apply coat of primer to interior components after fabrication except where stainless steel, galvanized or zinc rich paint finish is required.
- .6 Use primer unadulterated, as prepared by manufacturer. Paint on dry surfaces, free from rust, scale, grease. Do not paint when temperature is lower than 7 degrees C.
- .7 Exterior components to be painted, except where other finish is indicated: blast clean metal to "Near White Grade" (SSPC-SP-10) and spray apply a coat of zinc rich paint, maximum 3 mm / 1/8" thick.

- .8 Hot dip galvanize all exterior components not scheduled to be painted, components located within exterior building elements, and where indicated, interior components after fabrication in accord with the stricter requirements of ASTM A123/ A123 M and CAN/CSA-G164-(withdrawn), minimum coating weight 600 g/m<sup>2</sup>.
- .9 Apply coat of bituminous enamel to contact surfaces of metal components in contact with cementitious materials and dissimilar metals.
- .10 Stainless steel: AISI No. 4 finish.
- .11 Shop coat primer: to CAN/CGSB 1.40 and in accordance with Section 09 91 23 - Interior Painting and Section 09 91 13 - Exterior Painting.
- .12 Zinc primer: zinc rich, ready mix to CAN/CGSB 1.181 and in accordance with Section 09 91 23 - Interior Painting and Section 09 91 13 - Exterior Painting.

## **2.3 ISOLATION COATING**

- .1 Isolate aluminum from following components, by means of bituminous paint:
  - .1 Dissimilar metals except stainless steel, zinc, or white bronze of small area.
  - .2 Concrete, mortar and masonry.
  - .3 Wood.

## **2.4 ANGLE LINTELS**

- .1 Refer to Structural drawings for sizes and locations of steel angle lintels.
- .2 Steel angles: exterior and wet areas galvanized, interior dry areas prime painted, sizes indicated for openings. Provide 200 mm minimum bearing at ends.
- .3 Weld or bolt back-to-back angles to profiles as indicated.

## **2.5 PIPE RAILINGS**

- .1 Unless indicated otherwise, steel pipe: 38 mm / 1½" nominal outside diameter, formed to shapes and sizes as indicated.
- .2 Galvanize pipe railings after fabrication. Shop coat prime interior railings after fabrication.

## **2.6 EXTERIOR ACCESS LADDER**

- .1 Construct roof access ladder as follows:
  - .1 42 mm O.D. x 3 mm thick stringers, length as required.
  - .2 25 mm diameter knurled solid steel rungs, minimum 600 mm wide, spaced at 300 mm o.c. vertically, welded to stringers.
  - .3 Attach stringers to block walls with bent steel brackets. Size stringer and brackets as sized and detailed by fabricator for intended use. Pre-drill holes for bolt fastening to stringers and anchorage to wall.

- .4 When fastening to parapet, coordinate metal stud location in parapet to fasten brackets to metal stud as required. Coordinate fastening locations with aluminum composite panels as required
- .5 Fasten brackets to existing beam framing using stainless steel anchors as required.
- .6 Provide galvanized steel grating landing minimum 150 mm above parapet.
- .7 Steel Safety Cage: where height ladder exceeds 3m in height, provide safe cage beginning at 2.2m above grade, 50 mm x 10 mm 2" x 3/8" thick flat horizontal and vertical bars as detailed.
- .8 Hot dipped galvanized finish.

## **2.7 TRENCH COVERS AND FRAMES**

- .1 Unless indicated otherwise, steel fabricate from 6 mm / 1/4" thick raised pattern plate set in L 55 x 55 x 6 frame. Include anchors at 1200 mm / 4'-0" on centre for embedding in concrete. Supply trench covers in 1200 mm / 4'-0" removable lengths.
- .2 Finish: Galvanized finish for exterior, prime paint for interior.

## **2.8 SUMP INTERIOR ACCESS COVERS**

- .1 Interior access cover subject to approval of Consultant. Standard of acceptance: Type T Floor Access Door by The BILCO Company, or approved equal.
- .2 Furnish and install where indicated on plans access door Type T, size as indicated on drawings. The floor access door shall be single leaf and pre-assembled from the manufacturer.
- .3 Cover to support a minimum live load of 4.8kPa with a maximum deflection of 3mm.
- .4 Cover: Shall be 6mm aluminum smooth pattern plate with extruded aluminum molding fastened to the cover to receive floor covering
- .5 Frame shall be extruded aluminum with strap anchors bolted to the exterior.
- .6 Hinges shall be specifically designed for horizontal and shall be bolted to the underside of cover.
- .7 Lifting mechanisms: Cam-action hinges shall pivot on torsion bars to provide, smooth, easy, and controlled cover operation throughout the entire arc of opening and to act as a check in retarding downward motion of the cover when closing.
- .8 A removable exterior turn/lift handle with a spring loaded ball detent shall be provided to open the cover.
- .9 Operation of the cover shall be smooth and easy with controlled operation throughout the entire arc of opening and closing.

## **2.9 STEEL GRATINGS**

- .1 Steel gratings – Armco Irving X-bar rectangular pressure locked, with 25 x 3 mm bearings bars at 30 mm centres and cross bars at 100 mm centres, hot-dip galvanized after fabrication, designed to support a uniform load of 9.6 kPa with a maximum deflection not exceeding 1/200 of the span.
- .2 All panels to be banded. Clearance at sides not to exceed 3 mm.

- .3 Continuous gratings to be arranged in panels of approximately 2000 mm lengths, except over slide gates, where 300 mm sections are to be used.
- .4 When panels are laid side by side, ensure that carrier of spacer bars line up to preserve a continuous appearance. Clips are required to prevent movement when subjected to moving loads.
- .5 Gratings to be supported on framing angles and supporting members set into or bolted to concrete as indicated. Framing angles and supports to be hot dip galvanized steel.

## **2.10 CHANNEL FRAMES**

- .1 Fabricate frames from steel, sizes of channel and opening as indicated.
- .2 Weld channels together to form continuous frame for jambs and head of openings, sizes as indicated.
- .3 Weld strap anchors to channel jamb frame at spacing as required by shop drawing engineer.
- .4 Finish: Galvanized finish for exterior, prime paint for interior.

## **2.11 UNDER COUNTER SUPPORT BRACKETS**

- .1 Unless indicated otherwise, fabricate under counter brackets from 50 mm x 10 mm thick steel flat bar.
- .2 Weld flat bar together to form continuous support bracket for counter tops as indicated. Space brackets for 914 mm / 3'-0" maximum spacing for counter support.
- .3 Pre-drill holes for fastening of counter top as required by Section 06 40 00 – Architectural Woodwork.
- .4 Shop prime steel under counter support brackets in accordance with Section – 09 91 23 Interior Painting.

## **2.12 MASONRY LATERAL SUPPORT BRACKETS**

- .1 Fabricate masonry lateral support brackets in sizes, shapes and quantities required to meet requirements of OBC and CSA-A30-94.
- .2 Provide channel or angle brackets to support tops of non-loadbearing masonry partitions.
- .3 Provide support brackets complete with all anchors and fasteners.
- .4 Shop prime steel under exposed masonry support brackets and cages in accordance with Section 09 91 23 Interior Painting.

## **2.13 SLEEVES**

- .1 Provide Schedule 40 steel pipe sleeves for pipes passing through walls. Where walls are water retaining, sleeves to be complete with 6.5 x 75 mm water bars. Sleeves to be unpainted in order to obtain improved bond to concrete.

### **PART 3 - EXECUTION**

#### **3.1 FABRICATION**

- .1 Fabricate components in the shop in largest size practicable to minimize field jointing.
- .2 Fabricate components square, straight, true, free from warpage and other defects. Accurately cut, machine file and fit joints, corners, copes and mitres.
- .3 Reinforce fabricated components to safely withstand expected loads.
- .4 Make joints in built-up sections with hairline joints in least conspicuous locations and manner.
- .5 Make allowance for thermal expansion and contraction when fabricating exterior Work.
- .6 Joints shall be welded unless otherwise indicated and unless details of construction do not permit welding. Exposed welds shall be continuous and ground smooth.
- .7 Use self-tapping shake-proof flat headed screws on items requiring assembly by screws or as indicated.
- .8 Close exposed open ends of tubular members with welded on steel plugs.
- .9 Where Work of other Sections is to be attached to Work of this section, prepare Work by drilling and tapping holes, as required to facilitate installation of such other Work.
- .10 Work of this Section, supplied for installation under other Sections, shall be prepared as required ready for installation by: drilling, countersinking and tapping holes, forming shapes and cutting to required sizes.
- .11 Grind off mill stampings and fill recessed markings on steel components left exposed to view.
- .12 Follow recommendations of AISI Committee of Stainless Steel Producers when fabricating, joining, welding, and finishing stainless steel components. Remove heat discolouration with mechanical, chemical or electrochemical means. Provide temporary protective coverings for all stainless steel components.
- .13 All aluminum fabrication to be by shop welding in an inert gas atmosphere in accordance with CSA Standards S157 and W47.2. Field joining by brazing not permitted.
- .14 Where possible, fit and shop assemble work, ready for erection.

#### **3.2 ERECTION**

- .1 Perform welding work in accordance with CSA W59 unless specified otherwise.
- .2 Erect metalwork square, plumb, straight, and true, accurately fitted, with tight joints and intersections.
- .3 Provide suitable means of anchorage acceptable to Consultant such as dowels, anchor clips, bar anchors, expansion bolts and shields, and toggles as follows, unless otherwise indicated:
  - .1 To concrete and solid masonry with expansion type anchor bolts.
  - .2 To hollow construction with toggle bolts.

- .3 To sheet metal with screws or bolts.
- .4 To structural steel or plates with bolts or by welding.
- .5 To wood with bolts or lag screws.
- .6 Fill space between railing members and sleeves with non-shrink grout.
- .4 Provide all components required for anchoring. Make anchoring in concealed manner wherever possible. Make exposed fastenings, where approved by Consultant, neatly and of the same material, colour, texture and finish as base metal on which they occur. Keep exposed fastenings evenly spaced.
- .5 Chemical anchor system to be Hilti HIT-HY 200 adhesive anchoring system (safe set), unless noted otherwise.
- .6 Supply components for work by other trades in accordance with shop drawings and schedule.
- .7 Make field connections with bolts to CSA S16 or Weld field connection as detailed on the erection drawings.
- .8 Thread dimensions of galvanized or other plated materials to be such that nuts will thread over bolts, without rethreading or chasing.
- .9 All fastenings to be selected to avoid galvanic action between dissimilar metals.
- .10 Deliver items over for casting into concrete and building into masonry together with setting templates to appropriate location and construction personnel.
- .11 Touch-up rivets, field welds, bolts and burnt or scratched surfaces with primer after completion.
- .12 Touch-up galvanized surfaces with zinc rich primer where burned by field welding.

### 3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 – Cleaning:
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 – Cleaning.

### 3.4 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by metal fabrications installation.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 REFERENCES**

- .1 American National Standards Institute/National Particleboard Association (ANSI/NPA)
  - .1 ANSI/NPA A208.1-2009, Particleboard.
- .2 ASTM International
  - .1 ASTM A123/A123M-13, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
  - .2 ASTM A 653/A 653M-15, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvanealed) by the Hot-Dip Process.
  - .3 ASTM C 578-15, Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.
  - .4 ASTM C 1289-15, Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board.
  - .5 ASTM C1396/C1396M-11, Standard Specification for Gypsum Board.
  - .6 ASTM F1482-14a, Standard Practice for Installation and Preparation of Panel Type Underlayments to Receive Resilient Flooring.
  - .7 ASTM D 1761-12, Standard Test Methods for Mechanical Fasteners in Wood.
  - .8 ASTM D5055-13e1, Standard Specification for Establishing and Monitoring Structural Capacities of Prefabricated Wood I-Joists.
  - .9 ASTM D5456-14b, Standard Specification for Evaluation of Structural Composite Lumber Products.
- .3 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-11.3-M87, Hardboard.
  - .2 CAN/CGSB-51.32-M77, Sheathing, Membrane, Breather Type.
  - .3 CAN/CGSB-51.34-M86, Vapour Barrier, Polyethylene Sheet for Use in Building Construction and amendment.
  - .4 CAN/CGSB-71.26-M88, Adhesive for Field-Gluing Plywood to Lumber Framing for Floor Systems.
- .4 CSA International
  - .1 CAN/CSA-A123.2-03 (R2014), Asphalt Coated Roofing Sheets.
  - .2 CAN/CSA-A247-M86 (R1996), Insulating Fiberboard.
  - .3 CSA B111-1974 (R2003), Wire Nails, Spikes and Staples.
  - .4 CSA O112.9-10 (R2014), Evaluation of Adhesives for Structural Wood Products (Exterior Exposure).
  - .5 CSA O121-08 (R2013), Douglas Fir Plywood.
  - .6 CAN/CSA O122-06 (R2011), Structural Glued-Laminated Timber.
  - .7 CSA O141-05 (R2014), Softwood Lumber.
  - .8 CSA O151-09 (R2014), Canadian Softwood Plywood.
  - .9 CSA O153-13, Poplar Plywood.
  - .10 CSA O325-07 (R2012), Construction Sheathing.
  - .11 CSA O437 Series-93 (R2011, Standards on OSB and Waferboard).
  - .12 CSA-Z809-08, Sustainable Forest Management.

- .5 National Lumber Grades Authority (NLGA)
  - .1 Standard Grading Rules for Canadian Lumber 2010.
- .6 Underwriters' Laboratories of Canada (ULC)
  - .1 CAN/ULC-S706-09, Standard for Wood Fibre Insulating Boards for Buildings.

## **1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 – Submittal Procedures.

## **1.3 QUALITY ASSURANCE**

- .1 Lumber by grade stamp of an agency certified by Canadian Lumber Standards Accreditation Board.
- .2 All lumber shall be sound, straight, dressed all sides and kiln dried, and moisture content at any time during shipment and storage shall not exceed 19%.
- .3 Grading: 120, National Grading Rule for Dimension Lumber.
- .4 Plywood, particleboard, OSB and wood based composite panels in accordance with CSA and ANSI standards.

## **1.4 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 – Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: 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 wood from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.

## **PART 2 - PRODUCTS**

### **2.1 FRAMING STRUCTURAL AND PANEL MATERIALS**

- .1 Lumber: softwood, S4S, moisture content 19% (S-dry) or less in accordance with standards:
  - .1 CSA O141.
  - .2 NLGA Standard Grading Rules for Canadian Lumber.
- .2 Furring, blocking, nailing strips, grounds, rough bucks, cants, curbs, fascia backing and sleepers:
  - .1 S2S in accordance with the following standards:
    - .1 CSA O141.
    - .2 NLGA Standard Grading Rules for Canadian Lumber, 1987 edition.

- .2 Board sizes: "Standard" or better grade.
- .3 Dimension sizes: "Standard" light framing or better grade.
- .3 Plywood, OSB and wood based composite panels: to CSA O325.
- .4 Interior mat-formed wood particleboard: to ANSI/NPA 208.1.
- .5 Gypsum sheathing: refer to Section 09 21 16 – Gypsum Board Assemblies, 09 21 99 – Partitions.

## **2.2 ACCESSORIES**

- .1 Air Barrier: Refer to Section 07 27 00 Air Barrier.
- .2 Air-Vapour Barrier: Refer to Section 07 28 00 Air Barrier.
- .3 Vapour Retarders: Refer to Section 07 26 00 Air Barrier.
- .4 Polyethylene film: to CAN/CGSB-51.34, Type 1, 6 mil thick.
- .5 Sealants: in accordance with Section 07 92 00 – Joint Sealants.
- .6 General purpose adhesive: to CSA O112.9.
- .7 Nails, spikes and staples: to CSA B111.
- .8 Bolts: 12.5 mm/1/2" diameter unless indicated otherwise, complete with nuts and washers.
- .9 Proprietary fasteners: toggle bolts, expansion shields and lag bolts, screws and lead or inorganic fibre plugs, explosive actuated fastening devices, recommended for purpose by manufacturer.
- .10 Fastener Finishes:
  - .1 Galvanizing: to ASTM A 123/A 123M ASTM A 653, use galvanized fasteners for exterior work and interior highly humid areas, pressure-preservative, fire-retardant treated lumber.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- .1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for product installation in accordance with manufacturer's written instructions.
  - .1 Visually inspect substrate prior to commencing with Work of this section.
  - .2 Inform Consultant of unacceptable conditions immediately upon discovery.
  - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Consultant.

### 3.2 PREPARATION

- .1 Treat surfaces of material with wood preservative where indicated.
- .2 Apply preservative by dipping, or by brush to completely saturate and maintain wet film on surface for minimum 3 minute soak on lumber and one minute soak on plywood.
- .3 Re-treat surfaces exposed by cutting, trimming or boring with liberal brush application of preservative before installation.
- .4 Confirm compatibility of treated surfaces with adjacent materials. Notify Consultant of unacceptable conditions immediately upon discovery. Proceed with treatment only after approval of adjacent materials are deemed acceptable. Treat material as follows:
  - .1 Wood cants, fascia backing, curbs, nailers, sleepers on roof deck.
  - .2 Wood furring for wood products on outside surface of exterior masonry and concrete walls.
  - .3 Wood cants, fascia backing, curbs, nailers, sleepers on roof deck.
  - .4 Wood furring strapping on outside surface of exterior masonry and concrete walls.
  - .5 Wood sleepers supporting wood subflooring over concrete slabs in contact with ground or fill.

### 3.3 PRESSURE TREATED COMPONENTS

- .1 Use preservative pressure treated lumber and plywood within exterior wall and roof systems.
- .2 Where it is necessary to cut, bore or otherwise alter pressure treated components in the field, treat cut surfaces with heavy coat of wood preservative in accordance manufacturer's written recommendations.
- .3 Use fire retardant pressure treated plywood at backboards and where plywood is installed on steel stud framed wall, behind gypsum board and parapets extend beyond 600 mm/2'-0".

### 3.4 MATERIAL USAGE

- .1 Exterior Wall Sheathing:
  - .1 Pressure treated plywood, DFP or CSP sheathing grade, T&G, thickness as indicated.
  - .2 Glass fibre sheathing, thickness as indicated.
- .2 All concealed locations except backboards: DFP or CSP, C grade, square edge, thickness as indicated.
- .3 Electrical equipment mounting boards:
  - .1 Plywood, DFP or CSP, G1S, A grade, square edge 3/4" thick.
- .4 Refer also to Section 09 21 16 – Gypsum Board Assemblies.

### 3.5 INSTALLATION

- .1 Install members true to line, levels and elevations, square and plumb.
- .2 Construct continuous members from pieces of longest practical length.

- .3 Install spanning members with "crown-edge" up.
- .4 Select exposed framing for appearance. Install lumber and panel materials so that grade-marks and other defacing marks are concealed or are removed by sanding where materials are left exposed.
- .5 Install exterior wall sheathing in accordance with manufacturer's printed instructions.
  - .1 Substrates to receive air/vapour must be sound and free of sharp protrusions, gaps, and voids exceeding 6mm/1/4" in width. Remove contaminants such as grease, oil and wax from exposed surfaces. Use repair materials and methods acceptable to air/vapour barrier membrane manufacturer.
- .6 Install exterior roof sheathing in accordance with requirements of the OBC and roofing manufacturers recommended installation.
- .7 Install furring and blocking as required to space-out and support casework, cabinets, wall and ceiling finishes, facings, fascia, soffit, siding, electrical equipment mounting boards, and other work as required.
- .8 Install rough bucks, nailers and linings to rough openings as required to provide backing for frames and other work.
- .9 Install wood cants, fascia backing, nailers, curbs and other wood supports as required and secure using galvanized steel fasteners.
- .10 Use dust collectors and high quality respirator masks when cutting or sanding wood panels.
- .11 Frame, anchor, fasten, tie and brace members to provide necessary strength and rigidity.
- .12 Countersink bolts where necessary to provide clearance for other work.
- .13 Use nailing disks for soft sheathing as recommended by sheathing manufacturer.

### **3.6 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 – Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 – Cleaning.

### **3.7 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by rough carpentry installation.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 REFERENCES**

- .1 American National Standards Institute (ANSI)
  - .1 ANSI A208.1-09, Particleboard.
  - .2 ANSI A208.2-09, Medium Density Fiberboard (MDF) for Interior Applications.
  - .3 ANSI/HPVA HP-1-2009, Standard for Hardwood and Decorative Plywood.
- .2 ASTM International
  - .1 ASTM E 1333-14, Standard Test Method for Determining Formaldehyde Concentrations in Air and Emission Rates From Wood Products Using a Large Chamber.
  - .2 ASTM D 2832-92(R2011), Standard Guide for Determining Volatile and Nonvolatile Content of Paint and Related Coatings.
  - .3 ASTM D 5116-10, Standard Guide For Small-Scale Environmental Chamber Determinations of Organic Emissions from Indoor Materials/Products.
- .3 Architectural Woodwork Manufacturers Association of Canada (AWMAC) and Architectural Woodwork Institute (AWI)
  - .1 Architectural Woodwork Quality Standards Illustrated, Edition Two, 2014.
- .4 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-71.20-M88, Adhesive, Contact, Brushable.
  - .2 CAN/CGSB 11.3-M87, Hardboard.
- .5 CSA International
  - .1 CSA B111-74(R2003), Wire Nails, Spikes and Staples.
  - .2 CSA O112.10-08(R2014), Evaluation of Adhesives for Structural Wood Products (Limited Moisture Exposure).
  - .3 CSA O121-08(R2014), Douglas Fir Plywood.
  - .4 CSA O141-05(R2014), Softwood Lumber.
  - .5 CSA O151-09(R2014), Canadian Softwood Plywood.
  - .6 CSA O153-13), Poplar Plywood.
  - .7 CSA-Z809-08, Sustainable Forest Management.
  - .8 CSA Z760-94-(R2001), Life Cycle Assessment.
- .6 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).
- .7 International Organization for Standardization (ISO)
  - .1 CAN/CSA-ISO 14040-06(R2011), Environmental Management-Life Cycle Assessment - Principles and Framework.
  - .2 CAN/CSA-ISO 14041-98(R2003), Environmental Management-Life Cycle Assessment - Goal and Scope Definition and Inventory Analysis.
- .8 National Electrical Manufacturers Association (NEMA)
  - .1 ANSI/NEMA LD-3-05, High-Pressure Decorative Laminates (HPDL).

- .9 National Hardwood Lumber Association (NHLA)
  - .1 Rules for the Measurement and Inspection of Hardwood and Cypress 2011.
- .10 National Lumber Grades Authority (NLGA)
  - .1 Standard Grading Rules for Canadian Lumber 2010.

## **1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for architectural woodwork and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2 Submit two copies of WHMIS MSDS in accordance with Section 01 35 29 Health and Safety Requirements 01 35 43 – Environmental Procedures.
- .3 Shop Drawings:
  - .1 Submit shop drawings. Indicate details of construction, profiles, jointing, fastening and other related details.
    - .1 Scales: profiles full size, and details half full size as required, to Consultant approval, to clearly define the Work.
  - .2 Indicate materials, thicknesses, finishes and hardware.
  - .3 Indicate locations of service outlets in casework, typical and special installation conditions, and connections, attachments, anchorage and location of exposed fastenings.
- .4 Samples:
  - .1 Submit for review and acceptance of each unit.
  - .2 Samples may be returned for inclusion into work.
  - .3 Submit duplicate samples of hardwood, plywood, and particleboard: sample size 12" x 12" or 12" long unless otherwise specified or requested by Consultant.
  - .4 Submit duplicate samples of laminated plastic for colour selection.
  - .5 Submit duplicate samples of laminated plastic joints, edging, cutouts and postformed profiles.
- .5 Certifications: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

## **1.3 QUALITY ASSURANCE**

- .1 Lumber by grade stamp of an agency certified by Canadian Lumber Standards Accreditation Board.
- .2 Plywood, particleboard, OSB and wood based composite panels to CSA and ANSI standards.

## **1.4 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 – Common Product Requirements and with manufacturer's written instructions.

- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
  - .1 Protect millwork against dampness and damage during and after delivery.
  - .2 Store millwork in ventilated areas, protected from extreme changes of temperature or humidity.
- .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 architectural woodwork from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS**

- .1 Softwood lumber: unless specified otherwise, S4S, moisture content 15 % or less in accordance with following standards:
  - .1 CSA O141.
  - .2 CAN/CSA-Z809 or FSC or SFI certified.
  - .3 NLGA Standard Grading Rules for Canadian Lumber.
  - .4 AWMAC premium grade, moisture content as specified.
- .2 Machine stress-rated lumber is acceptable for all purposes.
- .3 Ensure manufacturing process adheres to Lifecycle Assessment (LCA) Standards to ISO 14040/14041 LCA Standards, CSA Z760-94 Life Cycle Assessment.
- .4 Hardwood lumber: moisture content 5-9% % or less in accordance with following standards:
  - .1 National Hardwood Lumber Association (NHLA).
  - .2 CAN/CSA-Z809 or FSC or SFI certified.
  - .3 AWMAC premium grade, moisture content as specified.
  - .4 Wood trim/cap shall be solid maple, sizes as indicated.
  - .5 All edge returns shall be solid maple, sizes and locations as indicated.
  - .6 Handrails to be solid oak in size and locations as indicated.
- .5 Douglas fir plywood (DFP): to CSA O121, standard construction, CAN/CSA-Z809.
- .6 Canadian softwood plywood (CSP): to CSA O151, standard construction, CAN/CSA-Z809.
- .7 Hardwood plywood: to ANSI/HPVA HP-1, CAN/CSA-Z809.
- .8 Poplar plywood (PP): to CSA O153, standard construction, CAN/CSA-Z809.
- .9 Interior mat-formed wood particleboard: to ANSI/NPA A208.1, CAN/CSA-Z809.
- .10 Birch plywood: to AWMAC Paint Grade , CAN/CSA-Z809MDF (medium density fibreboard) core: to ANSI A208.2, thickness as indicated, density 769 kg/m<sup>2</sup>.

- .11 Wood Veneer – architectural custom grade, flat cut, plain sliced, book matched maple
  - .1 Top coated with post-catalyzed lacquer finish by Chemcraft.
  - .2 10% Sheen
  - .3 Stain to match sample supplied by consultant, up to three (3) colours.
- .12 Laminated plastic for flatwork: Refer to 06 47 00 – Plastic Laminate Finishing.
- .13 Laminated plastic for postforming work: Refer to 06 47 00 – Plastic Laminate Finishing.
- .14 Laminated plastic backing sheet: Refer to 06 47 00 – Plastic Laminate Finishing.
- .15 Laminated plastic liner sheet: Refer to 06 47 00 – Plastic Laminate Finishing.
- .16 Melamine Component Panels (MCP):
  - .1 Melamine resin impregnated paper, to ANSI A208.1/ASTM E1333, grade M3, density 630-700 Kg/m<sup>3</sup>, thermal-fused to particleboard core with matching edge binding, sanded, thickness as indicated.
  - .2 Colour (exposed to view including open shelving): From MCP manufacturer's complete colour range, not more than eight (8) colours for entire project. Colours will be solid colours. Cabinet backing to be the same colour as casework.
  - .3 Colour (cabinet interiors): to match exterior unless otherwise noted.
  - .4 Manufacturer: Uniboard Canada, or Panolam, or Flakeboard, or approved alternate.
- .17 Edge Banding:
  - .1 Matching 3 mm 1/8" thick PVC edging, colour as later selected by Consultant from complete colour range.
  - .2 Provide 10 mm / 1/8" thick solid matching wood strip on exposed face of plywood particleboard edges 12 mm / 1/2" or thicker wood to match veneer finish. Strip width to match plywood or particleboard.
  - .3 Edges dadoed or saw kerfed to take plastic "T" moulding in width and colour to match melamine finish.
  - .4 Edge filler to provide a smooth surface for paint finish.
- .18 Cabinet hardware: Refer to Section 08 70 05 Cabinet and Miscellaneous Hardware.
- .19 Tackboard Material (TB): 6 mm / 1/4" thick, manufactured coloured cork laminated to 6 mm / 1/4" particleboard, colour as later selected by Consultant from manufacturer's complete colour range.
  - .1 Acceptable material: Krommenie / Forbo 'Bulletin Board' or approved alternate.
  - .2 Refer to drawings and schedule for locations.
- .20 Whiteboard (WB): Refer to Section 08 80 50 – Glazing.
- .21 Nails and staples: to CSA B111.
- .22 Wood screws: stainless steel, type and size to suit application.
- .23 Splines: wood.
- .24 Sealant: Refer to Section 07 92 00 – Joint Sealing.
  - .1 Manufactured MCP Units:
    - .1 Fabricate manufactured MCP units from Melamine Component Panels (MCP), unless otherwise noted.

.25 Counters Without Cabinets:

- .1 Countertops, nosing and under nosings: plastic laminate on 19 mm /  $\frac{3}{4}$ " plywood (DFP), unless otherwise noted.
- .2 Intermediate supports, locations as indicated but not more than 914 mm / 3'-0" o/c: MCP brackets as detailed, unless otherwise noted.
- .3 Wall support cleats: MCP, unless otherwise noted.
- .4 End gables: where indicated, MCP, unless otherwise indicated.
- .5 Grommets: Locations as indicated.

.26 Lower Cabinet Units:

- .1 Countertops, nosing and under nosing, backsplash and sidesplash: plastic laminate on 19 mm /  $\frac{3}{4}$ " plywood (DFP), unless otherwise noted.
- .2 Case body, backs, shelving unit inserts, doors and gables: plastic laminate on 19 mm /  $\frac{3}{4}$ " plywood (DFP), unless otherwise noted.
- .3 Interiors: melamine on 19 mm /  $\frac{3}{4}$ " plywood (DFP), unless otherwise noted.
- .4 Drawers: fronts, sides, back and bottom from 19 mm /  $\frac{3}{4}$ " plywood (DFP), unless otherwise noted.
- .5 Kickplate: 100 mm x 19 mm / 4" x  $\frac{3}{4}$ " plywood (DFP),.

.27 Upper Cabinet Units:

- .1 Case body, backs, shelving unit inserts, doors and gables: plastic laminate on 19 mm /  $\frac{3}{4}$ " plywood (DFP) unless otherwise noted.
- .2 Interiors: melamine on 19 mm /  $\frac{3}{4}$ " plywood (DFP), unless otherwise noted.

.28 Window/Interior Screen/Pass-through Stools:

- .1 Fabricate stools from plastic laminate on 19 mm /  $\frac{3}{4}$ " plywood (DFP), to profiles as indicated.
- .2 Return plastic laminate on underside of Window/Interior Screen/Pass-through Stools stool return

.29 Tackboards:

- .1 Fabricate manufactured coloured cork tackboards as detailed.

.30 Reception Counter:

- .1 Countertops and nosings: Solid surface on 19 mm /  $\frac{3}{4}$ " plywood (DFP), unless otherwise noted. Underside finished with plastic laminate on 19 mm /  $\frac{3}{4}$ " plywood (DFP), unless otherwise noted.
- .2 Return Gables, locations as indicated: Solid surface on 19 mm /  $\frac{3}{4}$ " plywood (DFP), unless otherwise noted.
- .3 Tackboards: manufactured coloured cork where indicated.
- .4 Base: 100 mm / 4" high MDF, finish as indicated.
- .5 Grommets: locations as indicated.

.31 Solid Wood Handrail

- .1 40mm diameter solid oak
- .2 Finish: clear coats over stain to match composite wood veneer panels. 10% sheen.

## 2.2 FABRICATION

- .1 Install architectural woodwork to Quality Standards of the Architectural Woodwork Manufacturers Association of Canada (AWMAC), Premium grade except where specified otherwise.

- .2 Edge banding: Install edge banding to all panel material of:
  - .1 Case bodies.
  - .2 Shelving.
  - .3 Gables.
  - .4 Doors, drawer fronts, and false panels.
  - .5 Trim.
  - .6 Wall panels.
  - .7 Under counter skirts.
  - .8 Support brackets.
  - .9 Tackboards.
- .3 Set nails and countersink screws apply plain wood filler to indentations, sand smooth and leave ready to receive finish.
- .4 Shop install cabinet hardware for doors, shelves, and drawers. Recess shelf standards unless noted otherwise.
- .5 Shelving to cabinetwork to be adjustable unless otherwise noted.
- .6 Provide cutouts for plumbing fixtures, inserts, appliances, outlet boxes and other fixtures.
- .7 Shop assemble work for delivery to site in size easily handled and to ensure passage through building openings.
- .8 Obtain governing dimensions before fabricating items which are to accommodate or abut appliances, equipment and other materials.
- .9 Ensure adjacent parts of continuous laminate work match in colour and pattern.
- .10 Veneer laminated plastic to core material in accordance with adhesive manufacturer's instructions. Ensure core and laminate profiles coincide to provide continuous support and bond over entire surface. Use continuous lengths up to 12'-0". Keep joints 2'-0" from sink cutouts.
- .11 Form shaped profiles and bends as indicated, using postforming grade laminate to laminate manufacturer's instructions.
- .12 Use straight self-edging laminate strip for flatwork to cover exposed edge of core material. Chamfer exposed edges uniformly at approximately 20 degrees. Do not mitre laminate edges.
- .13 Apply laminate backing sheet to reverse side of core of plastic laminate work.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- .1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for architectural woodwork installation in accordance with manufacturer's instructions.
  - .1 Visually inspect substrate prior to commencing with Work of this section.
  - .2 Inform Consultant of unacceptable conditions immediately upon discovery.
  - .3 Proceed with installation only after unacceptable conditions have been remedied.

### **3.2 INSTALLATION**

- .1 Do architectural woodwork to Quality Standards of AWMAC.
- .2 Install prefinished millwork at locations shown on drawings.
  - .1 Position accurately, level, plumb straight.
- .3 Fasten and anchor millwork securely.
  - .1 Supply and install heavy duty fixture attachments for wall mounted cabinets.
- .4 Use draw bolts in countertop joints.
- .5 Scribe and cut as required to fit abutting walls and to fit properly into recesses and to accommodate piping, columns, fixtures, outlets or other projecting, intersecting or penetrating objects.
- .6 At junction of plastic laminate counter back splash and adjacent wall finish, apply small bead of sealant in accordance with Section 07 92 00 - Joint Sealants.
- .7 Apply water resistant building paper over wood framing members in contact with masonry or cementitious construction.
- .8 Fit hardware accurately and securely in accordance with manufacturer's written instructions.
- .9 Apply joint sealant in accordance with Section 07 92 00 – Joint Sealants.

### **3.3 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 – Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 – Cleaning.
  - .1 Clean millwork and cabinet work inside cupboards and drawers and outside surfaces.
  - .2 Remove excess glue from surfaces.

### **3.4 PROTECTION**

- .1 Protect millwork and cabinet work from damage until final inspection.
- .2 Protect installed products and components from damage during construction.
- .3 Repair damage to adjacent materials caused by architectural woodwork installation.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 REFERENCES**

- .1 American National Standards Institute (ANSI)
  - .1 ANSI 208.1-09, Particleboard.
- .2 ASTM International
  - .1 ASTM D 2832-92(R2011), Standard Guide for Determining Volatile and Nonvolatile Content of Paint and Related Coatings.
  - .2 ASTM D 2369-10(2015) e1, Standard Test Method for Volatile Content of Coatings.
- .3 Architectural Woodwork Manufacturers Association of Canada (AWMAC) and Architectural Woodwork Institute (AWI)
  - .1 Architectural Woodwork Quality Standards Illustrated, Edition 2, 2014.
- .4 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-71.20-M88, Adhesive, Contact, Brushable.
- .5 CSA International
  - .1 CSA O112.10-08(R2013), Evaluation of Adhesives for Structural Wood Products (Limited Moisture Exposure).
  - .2 CSA O121-08 (R2013), Douglas Fir Plywood.
  - .3 CSA O151-09 (R2013), Canadian Softwood Plywood.
  - .4 CSA O153-13, Poplar Plywood.
  - .5 CSA-Z809-08, Sustainable Forest Management.
- .6 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).
- .7 National Electrical Manufacturers Association (NEMA)
  - .1 ANSI/NEMA LD-3-05, High Pressure Decorative Laminates (HPDL).
- .8 Scientific Equipment and Furniture Association (SEFA)
  - .1 SEFA 8-99, Laboratory Furniture.

### **1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for laminate, adhesive, and core materials and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2 Submit two copies of WHMIS MSDS in accordance with Section 01 35 29.06 - Health and Safety Requirements 01 35 43 - Environmental Procedures. Indicate VOC's for adhesives in g/L.

- .3 Samples:
  - .1 Submit for review and acceptance of each unit.
  - .2 Submit duplicate samples of joints, edging, cutouts and postformed profiles.
- .4 Certifications: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

### **1.3 CLOSEOUT SUBMITTALS**

- .1 Provide maintenance data for laminate work for incorporation into manual specified in Section 01 78 00 – Closeout Submittals.

### **1.4 QUALITY ASSURANCE**

- .1 Test Reports: certified test reports showing compliance with specified performance characteristics and physical properties.
- .2 Certificates: product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

### **1.5 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 – Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials off ground, indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect laminate, adhesive, and core materials from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURER**

- .1 Manufacturer:
  - .1 Products specified are manufactured by WilsonartEgger and Formica.

## 2.2 MATERIALS

- .1 Laminated plastic for general flatwork: to NEMA LD3.
  - .1 Laminated plastic for horizontal flatwork:
    - .1 Type: general purpose.
    - .2 Grade: HGS.
    - .3 Thickness: 1.2 mm / 0.039" thick.
    - .4 Standard of Acceptance: 'Type 107' General Purpose Laminate by Wilsonart and Formica.
  - .2 Laminated plastic for vertical flatwork:
    - .1 Type: vertical surface.
    - .2 Grade: VGS.
    - .3 Thickness: 0.030" thick.
    - .4 Standard of Acceptance: 'Type 335' Vertical Surface Laminate by Wilsonart, Egger and Formica.
  - .3 Colour: integral colour throughout.
  - .4 Pattern: solid, woodgrain and/or printed pattern.
  - .5 Finish: as indicated.
  - .6 Plastic Laminate – Type:
    - .1 Plastic Laminate Type 1 (PL-1): H3325 ST28 "Tobacco Gladstone Oak" by Egger.
    - .2 Plastic Laminate Type 2 (PL-2): 8826-58 "Neutral Twill" Matte Finish by Formica.
    - .3 Plastic Laminate Type 3 (PL-3): 1500-60 "Grey" Matte Finish by Wilsonart.
    - .4 Plastic Laminate Type 4 (PL-4): 6277 "Alumasteel" brushed finish by Wilsonart.
- .2 Laminated plastic for post-forming work: to NEMA LD3.
  - .1 Type: post-forming.
  - .2 Grade: HGP.
  - .3 Thickness: 1.016 mm / 0.04" thick.
  - .4 Colour: integral colour throughout.
  - .5 Pattern: printed pattern.
  - .6 Finish: as indicated.
  - .7 Standard of Acceptance: 'Post-forming Type 350' by Wilsonart
  - .8 Plastic Laminate – Type:
    - .1 Plastic Laminate Type 3 (PL-3): 1500-60 "Grey" Matte Finish by Wilsonart.
- .3 Plywood core: to CSA O121 DFP, Forestry Stewardship Council (FSC) certified, solid two sides, 19 mm<sup>3</sup>/<sub>4</sub>" thick.
- .4 Laminated plastic adhesiveLaminated plastic adhesive:: urea resin adhesive to CSA O112.10 contact adhesive to CAN/CGSB-71.20 resorcinol resin adhesive to CSA O112.10 polyvinyl adhesive to CSA O112.10 two component epoxy thermosetting adhesive as recommended by manufacture.
- .5 Sealer: water resistant sealer or glue acceptable to laminate manufacturer.
- .6 Sealants: Refer to Section 07 92 00 – Joint Sealants.
- .7 Draw bolts and splines: as recommended by fabricator.

## **2.3 FABRICATION**

- .1 Comply with NEMA LD3, Annex A.
- .2 Obtain governing dimensions before fabricating items which are to accommodate or abut appliances, equipment and other materials.
- .3 Ensure adjacent parts of continuous laminate work match in colour and pattern.
- .4 Veneer laminated plastic to core material in accordance with adhesive manufacturer's instructions. Ensure core and laminate profiles coincide to provide continuous support and bond over entire surface. Use continuous lengths up to 3660 mm / 12'-0".
- .5 Form shaped profiles and bends as indicated, using postforming grade laminate to laminate manufacturer's instructions.
- .6 Use straight self-edging laminate strip for flatwork to cover exposed edge of core material. Chamfer exposed edges uniformly at approximately 20 degrees. Do not mitre laminate edges.
- .7 Apply laminate backing sheet to reverse side of core of plastic laminate work.

## **PART 3- EXECUTION**

### **3.1 EXAMINATION**

- .1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for laminate, adhesive, and core materials installation in accordance with manufacturer's written instructions.
  - .1 Visually inspect substrate prior to commencing with Work of this section.
  - .2 Inform Consultant of unacceptable conditions immediately upon discovery.
  - .3 Proceed with installation only after unacceptable conditions have been remedied.

### **3.2 MANUFACTURER'S INSTRUCTIONS**

- .1 Compliance: comply with manufacturer's written recommendations, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.

### **3.3 INSTALLATION**

- .1 Install work plumb, true and square, neatly scribed to adjoining surfaces.
- .2 Make allowances around perimeter where fixed objects pass through or project into laminated plastic work to permit normal movement without restriction.
- .3 Use draw bolts and splines in countertop joints. Maximum spacing 450 mm / 18" on centre, 75 mm / 3" from edge. Make flush hairline joints.

- .4 Provide cutouts for inserts, grilles, appliances, outlet boxes and other penetrations. Round internal corners, chamfer edges and seal exposed core.
- .5 At junction of laminated plastic counter back splash and adjacent wall finish, apply small bead of sealant.

### **3.4 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 – Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 – Cleaning.
  - .1 Clean to NEMA LD3, Annex B.
  - .2 Remove traces of primer, caulking, epoxy and filler materials and clean doors and frames.

### **3.5 PROTECTION**

- .1 Cover finished laminated plastic veneered surfaces with heavy kraft paper or put in cartons during shipment.
- .2 Protect installed laminated surfaces in accordance with manufacturer's written recommendations.
  - .1 Remove protection only immediately before final inspection.
- .3 Protect installed products and components from damage during construction.
- .4 Repair damage to adjacent materials caused by laminate, adhesive, and core materials installation.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 REFERENCES**

- .1 American Society for Testing and Materials International (ASTM)
  - .1 ASTM D 412-06 (2013), Standard Test Method for Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers-Tension.
  - .2 ASTM D 635-14, Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position.
  - .3 ASTM D 638-14, Standard Test Method for Tensile Properties of Plastics.
  - .4 ASTM D 695-10, Standard Test Method for Compressive Properties of Rigid Plastics.
  - .5 ASTM D 696-11, Standard Test Method for Coefficient of Linear Thermal Expansion of Plastics Between -30 degrees C and 30 degrees C With a Vitreous Silica Dilatometer.
  - .6 ASTM D 2240-05 (2010), Standard Test Method for Rubber Property-Durometer Hardness.
- .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS):
  - .1 Material Safety Data Sheets (MSDS).
- .3 International Standards Organization (ISO):
  - .1 ISO 19712-2:2007, Plastics – Decorative solid surfacing materials.
  - .2 ISO 4586-2:2015, High-pressure decorative laminates (HPL, HPDL) – Sheets based on thermosetting resins.
- .4 Terrazzo, Tile and Marble Association of Canada (TTMAC):
  - .1 2012/2014 Specification Guide - Tile Installation Manual.

### **1.2 GENERAL DESCRIPTION**

- .1 Work in this section includes items utilizing solid polymer fabrication as shown on the drawings and as described in this specification. Do not change source of supply for materials after work has started, if the appearance of finished work would be affected. Variation in component size and location of openings to be plus or minus 1.5 mm (1/16").

### **1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for solid quartz components and include product location and characteristics, performance criteria, physical size, finish and limitations.
  - .2 Submit two (2) copies of WHMIS MSDS in accordance with Section 01 35 29.06 – Health and Safety Requirements.
- .3 Shop Drawings:
  - .1 Submit shop drawings. Indicate details of construction, profiles, jointing, fastening, and other related details.
    - .1 Scales: profiles and details as required, to Consultant approval, to clearly define the Work.

- .2 Indicate materials, thicknesses, finishes, and hardware.
- .3 Indicate connections, attachments, anchorage locations, and coordination requirements with adjacent work.
- .4 Samples:
  - .1 Submit for review and acceptance of each unit.
  - .2 Submit duplicate samples of a 300 mm wide x 150 mm deep / 1'-0" wide x 6" deep minimum sample of each colour and pattern for approval. Samples shall indicate full range of colour and pattern variation. Approved samples may be retained as a standard for this work to Consultant approval.

#### **1.4 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver materials listed in this Section only when ready for installation. Deliver materials undamaged, in original packages, containers, or bundles bearing manufacturers brand name and identification.
- .2 Delivery and Acceptance Requirements:
  - .1 Minor chipping resulting from shipment, delivery and installation will be grounds for rejection
- .3 Storage and Handling Requirements:
  - .1 Store materials off ground, indoors, under cover, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Protect from weather, other elements and damage from construction operations and other causes.
  - .3 Handle solid quartz components to prevent damage to edges, ends or surfaces. Protect all accessories and trims from being bent or damaged.

#### **1.5 SITE ENVIRONMENTAL REQUIREMENTS**

- .1 Maintain temperature minimum 10 degrees C, maximum 21 degrees C for 48 hours prior to and during installation of solid fabrications, and for at least 48 hours after completion of joint treatment.
- .2 Ventilation: Ventilate building spaces as required to remove excess moisture that would prevent drying of joint treatment material immediately after its application.

#### **1.6 QUALIFICATIONS**

- .1 To ensure warranty coverage, solid fabricators shall be certified with a minimum 5 years' experience working with solid materials by the solid material manufacturer. All fabrications shall be marked with the fabricator's certification label affixed in an inconspicuous location.

#### **1.7 WARRANTY**

- .1 Manufacturer's warranty of ten years against defects in materials, excluding damages caused by physical or chemical abuse or excessive heat, shall be provided. Warranty to cover material and labour for replacement or repair of defective material for a period of ten years after component installation.

## **PART 2 - PRODUCTS**

### **2.1 QUARTZ COUNTERTOPS**

- .1 Solid polymer components: Cast, nonporous, filled polymer, not coated, laminated or of composite construction with through-body colours meeting ANSI Z124.3 or ANSI Z124.6, having minimum physical and performance properties specified to the following physical properties:
  - .1 Density: 1.7 g/cm<sup>3</sup> to ASTM D792
  - .2 Thermal Expansion: 3.9 x 10<sup>-5</sup> m/m °C (2.2 x 10<sup>-5</sup> in./in. °F) to ASTM E228
  - .3 Hardness – Rockwell “M” Scale: >85 to ASTM D785
  - .4 Hardness Barcol Impressor: 56 to ISO 19712-2 (ASTM D2583)
  - .5 Flexural Modulus: 1.2 x 10<sup>6</sup> psi to ASTM D790
  - .6 Flexural Strength: 10,000 psi to ASTM D790
  - .7 Tensile Modulus: 1.5 x 10<sup>6</sup> psi to ASTM D638
  - .8 Tensile Strength: 6,000 psi to ASTM D638
  - .9 Tensile Elongation: 0.4% min. to ASTM D638
  - .10 Compressive Strength: 16,000 psi to ASTM C365
  - .11 Stain/chemical-resistance test: Pass to ISO 19712-2
  - .12 Resistance to cigarette burns: Pass to ISO 19712-2
  - .13 Resistance to dry heat: Pass to ISO 19712-2
  - .14 Resistance to wet heat: Pass to ISO 19712-2
  - .15 Hot/cold cycle water-resistance test: Pass to ISO 19712-2
  - .16 Load test: Pass to ISO 19712-2
  - .17 Dimensional stability: Pass to ISO 4586-2
  - .18 Resistance to surface wear: 0.18% wt/25 revolutions to ISO 4586-2
  - .19 Fungal resistance: ASTM rating of 0, No Observed growth on product at 100x power to ASTM G21.
  - .20 Bacterial resistance: No observed growth on product at 100x power to ASTM G22
  - .21 Microbial resistance: Highly resistant to mold growth to UL 2824 (ASTM D6329)
  - .22 Flammability: Class A to NFPA 101 - Life Safety Code
  - .23 Flame spread index: <25 to ANSI/UL 723 (ASTM E84, NFPA 255)
  - .24 Flame spread rating: 0 to CAN/ULC-S102.2
  - .25 Smoke developed index: <25 to ANSI/UL 723 (ASTM E84, NFPA 255)
  - .26 Smoke development rating: 5 to CAN/ULC-S102.2.
  - .27 Superficial damage to a depth of 0.25 mm / 0.010” repairable by sanding and/or polishing
  - .28 Acceptable Product:
    - .1 ‘Formica Signatures Solid Surfacing’ or approved alternate.

### **2.2 .COMPONENTS**

- .1 Solid polymer Panels: Polished natural polymer, 12 mm thick solid, hard and durable, well-seasoned and of uniform strength with 1/4” – 5/16” rounded edge between cap and front return.
  - .1 Edge Detail: Edge profile as indicated on drawings.
  - .2 Length: one piece to suit application.
    - .1 Solid Surface Type 1 (SLDS-1): 714 “Federal Cornerstone” by Formica.
    - .2 Solid Surface Type 2 (SLDS-2): 742 “Blanco Terrazzo” by Formica.

- .2 Accessories General: Provide accessory products, as specified below, from the solid polymer manufacturer or provide products approved by the solid polymer manufacturer for intended use.
- .3 Seam Adhesive: As required and approved by manufacturer to create permanent, inconspicuous, non-porous, hard seams and joints by chemical bond between solid polymer materials and components to create a monolithic appearance of the fabrication.
  - .1 Colour: colour-match adhesive to the surfaces where solid polymer materials are being bonded together.
- .4 Panel Adhesive: To solid polymer manufacturer written recommendations for use to bond solid polymer components to adjacent and underlying substrates, neoprene based, Underwriter's Laboratories (UL) listed.
- .5 Sealant: Sealants in accordance with Section 07 92 00 - Joint Sealants unless otherwise indicated.
- .6 Mounting Hardware: As required by manufacturer for mounting hardware, including sink/bowl clips, inserts and fasteners for attachment of undermount sinks and lavatories.

## 2.3 FABRICATION

- .1 Shop-fabricate components to sizes and shapes indicated, to the greatest extent practical, in accordance with approved shop drawings and manufacturer's requirements. Rout contours and radii from site obtained template to provide smooth edges. Defective and inaccurate work will be rejected.
- .2 Joints and seams: Form joints and seams between components using manufacturer's approved seam adhesive. Joints shall be inconspicuous in appearance and without voids to create a monolithic appearance.
- .3 Edge Finishing: Rout and finish component edges to a smooth, uniform appearance and finish. Edge shapes and treatment, complete with any inserts, to profiles as detailed on the drawings. Repair or reject defective or inaccurate work.
- .4 Counter and Vanity Top Splashes: Fabricate backsplashes and end splashes from 19 mm / 3/4" thick solid polymer material x 100 mm / 4" high to dimensions and shapes as indicated on the drawings. Fabricate and install backsplashes for permanent installation.
  - .1 End Splashes: Supply end splashes loose for site installation at the jobsite.
- .5 Counter and Vanity Tops: Fabricate solid polymer counter top and vanity top components from 19 mm / 3/4" thick material. Provide edge details, dimensions, locations, and quantities as indicated on the Drawings. Fabricate counter tops complete with 4" high permanently attached, 90 degree transition, permanently attached with coved transition backsplash and loose end splashes at locations as indicated on the drawings.
  - .1 Counter and Vanity Tops with Sinks: Obtain sink and plumbing fixture templates and mounting instructions as furnished by the sink and plumbing fixture manufacturers. Provide counter and vanity tops with cutouts to accept sinks and plumbing fixtures. Fabricate solid polymer counter and vanity tops to accept manufacturer's standard mounting hardware for, rimless sink and plumbing fixtures. Install sink with watertight seam between sink and counter and vanity tops. Coordinate sink, faucet, and plumbing requirements in accordance with Division 22 00 00.

### **PART 3 - EXECUTION**

#### **3.1 COORDINATION**

- .1 Installation of solid polymer components and assemblies will require sound substrate by other trades. To provide a stable, sound, secure installation, close coordination is required between the solid polymer fabricator/installer and other trades to ensure structural base support, proper clearances and other supporting components will be provided for the installation of solid polymer components as required by the solid polymer manufacturer. Contractor to coordinate and provide appropriate substrates and staging areas for solid polymer installations.

#### **3.2 EXAMINATION**

- .1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for solid fabrications installation as per manufacturer's written instructions.
  - .1 Visually inspect substrate prior to commencing with Work of this section.
  - .2 Inform Consultant of unacceptable conditions immediately upon discovery.
  - .3 Proceed with installation only after unacceptable conditions have been remedied.

#### **3.3 INSTALLATION**

- .1 Install all components and fabricated units plumb, level, and rigid. Field joints between solid polymer components to provide a monolithic appearance using solid polymer manufacturers approved seam adhesives, with joints inconspicuous in the finished work.
- .2 Attach sinks to counter and vanity tops with mounting hardware, seam adhesive and sealants to solid polymer manufacturer's recommendations. Coordinate sinks, lavatories, and plumbing fixture connections with Division 22 00 00.
- .3 Sealant: in accordance with Section 07 92 00 – Joint Sealants.

#### **3.4 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 – Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 – Cleaning.
  - .1 Clean solid polymer components and adjacent surfaces.
  - .2 Remove excess glue from surfaces.

#### **3.5 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by solid polymer installation.
- .3 Protect installed products and components from damage during construction.
- .4 Protect solid polymer components from damage until final inspection.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 REFERENCES**

- .1 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-37.2-M88, Emulsified Asphalt, Mineral-Colloid Type, Unfilled, for Dampproofing and Waterproofing and for Roof Coatings.
  - .2 CAN/CGSB 37.3-M89, Application of Emulsified Asphalts for Dampproofing or Waterproofing.
  - .3 CAN/CGSB 37.5-M89, Cutback Asphalt Plastic Cement.
  - .4 CGSB 37-GP-6Ma-83, Asphalt, Cutback, Unfilled, for Dampproofing.
  - .5 CGSB 37-GP-9Ma-83, Primer, Asphalt, Unfilled, for Asphalt Roofing, Dampproofing and Waterproofing.
  - .6 CGSB 37-GP-11M-76(R1984), Application of Cutback Asphalt Plastic Cement.
  - .7 CGSB 37-GP-12Ma-84, Application of Unfilled Cutback Asphalt for Dampproofing.
  - .8 CGSB 37-GP-15M-76(R1984), Application of Asphalt Primer for Asphalt Roofing, Dampproofing and Waterproofing.
  - .9 CAN/CGSB 37.16-M89, Filled, Cutback, Asphalt for Dampproofing and Waterproofing.
  - .10 CAN/CGSB 37.28-M89, Reinforced Mineral Colloid Type, Emulsified Asphalt for Roof Coatings and for Waterproofing.
  - .11 CGSB 37-GP-36M-76, Application of Filled Cutback Asphalts for Dampproofing and Waterproofing.
  - .12 CGSB 37-GP-37M-77, Application of Hot Asphalt for Dampproofing or Waterproofing.
- .2 Canadian Standards Association (CSA International)
  - .1 CSA A123.4-04(R2013), Bitumen for Use in Construction of Built-Up Roof Coverings and Dampproofing and Waterproofing Systems.
- .3 Health Canada
  - .1 Workplace Hazardous Materials Information System (WHMIS)
    - .1 Material Safety Data Sheets (MSDS).

### **1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for bituminous dampproofing application and include product characteristics, performance criteria, physical size, finish, and limitations.
  - .2 Submit 2 copies of WHMIS MSDS in accordance with Section 01 35 29 - Health and Safety Requirements and 01 35 43 - Environmental Procedures.
- .3 Manufacturer's Instructions: provide to indicate special handling criteria, installation sequence, and cleaning procedures.

### 1.3 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials off ground indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect dampproofing materials from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.

### 1.4 SITE CONDITIONS

- .1 Ambient Conditions: temperature, relative humidity, moisture content.
  - .1 Apply dampproofing materials only when surfaces and ambient temperatures are within manufacturers' prescribed limits.
  - .2 Do not proceed with Work when wind chill effect would tend to set bitumen before proper curing takes place.
  - .3 Maintain air temperature and substrate temperature at dampproofing installation area above 5 degrees C for 24 hours before, during and 24 hours after installation.
  - .4 Do not apply dampproofing in wet weather.
- .2 Safety: comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of asphalt, sealing compounds, primers and caulking materials.

## **PART 2 - PRODUCTS**

### 2.1 MATERIALS

- .1 Asphalt:
  - .1 For application and curing at temperatures above 5 degrees C: asphalt emulsion dampproofing conforming to CAN/CGSB-37.2.
    - .1 Package label or bill of lading for bulk hot liquid asphalt must indicate type, flash point, equiviscous temperature range, and final blowing temperature.
    - .2 Acceptable materials: '700-01' Asphalt Emulsion Dampproofing by Bakor, or approved alternate.
  - .2 For application and curing at temperatures below 5 degrees C: premium grade fibrated asphalt coating for horizontal and vertical foundation wall applications conforming to CAN/CGSB-37.16.
    - .1 Package label or bill of lading for bulk hot liquid asphalt must indicate type, flash point, equiviscous temperature range, and final blowing temperature.
    - .2 Acceptable materials: '710-11' Premium Grade Foundation Coating by Bakor, or approved alternate.

- .2 Sealing compound: plastic cutback asphalt cement to CAN/CGSB-37.5.
  - .1 Acceptable materials: '710-11' Premium Grade Foundation Coating manufactured by Bakor or approved alternate.
- .3 Asphalt primer:
  - .1 Acceptable materials:
    - .1 For temperatures above 5 degrees C, to CAN/CGSB-37.2: '700-01' Asphalt Emulsion Dampproofing as manufactured by Bakor diluted 20% with clean water, or approved alternate.
    - .2 For temperatures below 5 degrees C to the requirements of CAN/CGSB 37.9: '910-01' Penetrating Asphalt Primer by Bakor or approved alternate.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for bituminous dampproofing application installation in accordance with manufacturer's written instructions.
  - .1 Visually inspect substrate.
  - .2 Inform Consultant of unacceptable conditions immediately upon discovery.
  - .3 Proceed with installation only after unacceptable conditions have been remedied.

#### **3.2 WORKMANSHIP**

- .1 Keep hot asphalt:
  - .1 Below its flash point.
  - .2 At or below its final blowing temperature.
  - .3 Within its equiviscous temperature range at place of application.

#### **3.3 PREPARATION**

- .1 Before applying dampproofing:
  - .1 Seal exterior joints between foundation walls and footings, joints between concrete floor slab and foundation and around penetrations through dampproofing with sealing compound.

#### **3.4 APPLICATION**

- .1 Do dampproofing in accordance with manufacturer's written recommendations and CAN/CGSB-37.3 except where specified otherwise.
- .2 Do sealing work in accordance with CGSB 37-GP-11M except where specified otherwise.
- .3 Do priming of surface in accordance with CGSB 37-GP-15M except where specified otherwise.
- .4 Apply primer to CGSB primer standard.

- .5 Apply dampproofing in accordance with manufacturer's written recommendations and applicable CGSB application standard.
- .6 Application of Dampproofing Coating for Temperatures Above 5 degrees C:
  - .1 Apply a coat of asphalt emulsion dampproofing diluted 20% with clean water at the rate of 0.5l/m<sup>2</sup> as a primer and allow to dry.
  - .2 Apply a second coat of asphalt emulsion dampproofing at rate of 1.0 to 1.5 l/m<sup>2</sup> and allow to dry.
- .7 Application of Dampproofing Coating for Temperatures Below 5 degrees C (40 degrees F).
  - .1 Apply a coat of primer at rate of 0.5 to 2.0l/m<sup>2</sup> and allow to cure until touch dry.
  - .2 Apply a coat of fibrated asphalt dampproofing at rate of 1.0 to 1.5 l/m<sup>2</sup> and allow to cure.
- .8 Finish dampproofing application with top edge straight, clean, and level.

### 3.5 SCHEDULE

- .1 Apply continuous, uniform coating to entire exterior faces of foundation walls from 2" below finished grade level to and including tops of foundation wall footings. Apply continuous, uniform coating to exterior side of foundation walls enclosing rooms below finished grade. Include exterior portion of interior walls where floors in adjacent rooms are at different elevations.
- .2 Apply two additional coats of dampproofing to vertical corners and construction joints for a minimum width of 230 mm / 9" on each side, and all around and for 230 mm / 9" along pipes passing through walls.

### 3.6 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

### 3.7 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Protect completed dampproofing from precipitation or contact with ground water until ready for backfilling or simultaneously backfilling after each panel course completed.
- .3 Remove protection before backfilling.
- .4 Protect dampproofing with protection board from damage by backfilling or other causes.
- .5 Protect dampproofing from frost damage in accordance with manufacturer's instructions.
- .6 Repair damage to adjacent materials caused by dampproofing application.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 REFERENCES**

- .1 American Society for Testing and Materials International (ASTM)
  - .1 ASTM C 208-12, Specification for Cellulosic Fiber Insulating Board.
  - .2 ASTM C 591- 15, Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation.
  - .3 ASTM C 612- 14, Standard Specification for Mineral Fibre Block and Board Thermal Insulation.
  - .4 ASTM C 726-12, Standard Specification for Mineral Fiber Roof Insulation Board.
  - .5 ASTM C 728-15, Standard Specification for Perlite Thermal Insulation Board.
  - .6 ASTM C 1126-15, Standard Specification for Faced or Unfaced Rigid Cellular Phenolic Thermal Insulation.
  - .7 ASTM C 1289-15, Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board.
  - .8 ASTM E 96/E 96M-14, Standard Test Methods for Water Vapour Transmission of Materials.
  - .9 ASTM C 1338- Determination of Fungi Resistance
- .2 Canadian General Standards Board (CGSB)
  - .1 CGSB 71-GP-24M-77(R1983), Adhesive, Flexible, for Bonding Cellular polystyrene Insulation.
- .3 CSA Group
  - .1 CSA B149 PACKAGE-15, Consists of B149.1, Natural Gas and Propane Installation Code and B149.2, Propane Storage and Handling Code.
- .4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
- .5 Material Safety Data Sheets (MSDS). Underwriters Laboratories of Canada (ULC)
  - .1 CAN/ULC S102-10, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
  - .2 CAN/ULC-S604-2012, Standard for Type A Chimneys.
  - .3 CAN/ULC-S701-11, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Coverings.
  - .4 CAN/ULC-S702-14, Standard for Thermal Insulation, Mineral Fibre, for Buildings.
  - .5 CAN/ULC-S704-11, Standard for Thermal Insulation Polyurethane and Polyisocyanurate, Boards, Faced.

### **1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for board insulation and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2 Submit copy of WHMIS MSDS in accordance with Section 01 35 29- Health and Safety Requirements 01 35 43 - Environmental Procedures. Indicate VOC's during application and curing.
- .3 Samples:
  - .1 Submit 300 x 300 mm x 40 mm / 12" x 12' x 1 1/2" sample of board insulation.

- .4 Certificates:
  - .1 Submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.
- .5 Test Reports:
  - .1 Submit certified test reports showing compliance with specified performance characteristics and physical properties.
- .6 Manufacturer's Instructions:
  - .1 Submit manufacturer's installation instructions.

### 1.3 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, store, and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials off ground, indoors, in dry location, and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect insulation from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.

### 1.4 QUALITY ASSURANCE

- .1 Convene pre-installation meeting one week prior to beginning work of this Section and on-site installations in accordance with Section 01 32 16 - Construction Progress Schedules - Bar (GANTT) Chart.
  - .1 Verify project requirements.
  - .2 Review installation and substrate conditions.
  - .3 Co-ordinate with other building sub-trades.
  - .4 Review manufacturer's installation instructions and warranty requirements.

## **PART 2- PRODUCTS**

### 2.1 INSULATION

- .1 Polyisocyanurate Board Insulation for roof systems:
  - .1 General Compliance:
    - .1 ASTM C1289, Type II, Class 1 Grade 2
    - .2 HCFC free
    - .3 Can/ULC-S704
  - .2 Compressive strength: 20psi (210kPa).
  - .3 Thickness: as indicated.
  - .4 R-Value/inch (25.4 mm / 1"): R5.8.

- .5 Dimensional Stability (ASTM D2126): < 2 percent linear change.
  - .6 Water Absorption (ASTM C209): < 1 percent by volume.
  - .7 Faces: non-asphaltic, fibre-reinforced felt facers both sides.
  - .8 Combustibility: meets CAN/ULC-S107-M87 and CAN/ULC-S126-M86.
  - .9 Closed cell foam with integrally formed and coated inorganic felt or glass fibre mat facer on both major surfaces.
  - .10 Size: maximum board size 1220mm x 2440mm / 4'-0" x 8'-0" , total thickness indicated, width to suit application.
  - .11 Acceptable materials: 'Trisotech' by Tremco, or approved alternate.
- .2 Tapered Polyisocyanurate Insulation:
- .1 General Compliance:
    - .1 ASTM C1289, Type II, Class 1 Grade 2
    - .2 HCFC free
    - .3 Can/ULC-S704
  - .2 Compressive strength: 20psi (210kPa).
  - .3 Thickness: as indicated.
  - .4 R-Value/inch (25.4 mm / 1"): R5.8.
  - .5 Dimensional Stability (ASTM D2126): < 2 percent linear change.
  - .6 Water Absorption (ASTM C209): < 1 percent by volume.
  - .7 Faces: non-asphaltic, fibre-reinforced felt facers both sides.
  - .8 Combustibility: meets CAN/ULC-S107-M87 and CAN/ULC-S126-M86.
  - .9 Closed cell foam with integrally formed and coated inorganic felt or glass fibre mat facer on both major surfaces.
  - .10 Size: maximum board size 1220mm x 2440mm / 4'-0" x 8'-0" , total thickness indicated, width to suit application.
  - .11 Tapered as per drawings and details. Uniform slope and all panels/corners/hips to be factory cut and labelled for ease of installation. Material to be same type and from same manufacturer as base insulation.
  - .12 Acceptable materials: 'Trisotech Tapered Insulation' by Tremco, or approved alternate.
- .3 Stone/Mineral Wool Insulation for Exterior Cavity Walls:
- .1 Compliance: ASTM C612 Type IVB and CAN/ULC-S702 Type 1 mineral fiber insulation.
  - .2 Fire Performance: ASTM E136 and CAN4 S114, non-combustible.
  - .3 Fire Performance, Surface Burning Characteristics: ASTM E84 (UL 723) and CAN/ULC S102, flame spread 0 and smoke developed 0.
  - .4 Water Vapor Transmission: ASTM E96: 27.2 to 33.1 perms (1555 to 1895 mg Pa.s.m<sup>2</sup>).
  - .5 Moisture Resistance: ASTM C1104, moisture sorption of: 0.03 to 0.07 percent.
  - .6 Fungi Resistance: ASTM C1338, pass
  - .7 Thermal Resistance to ASTM C518 (C177),
    - .1 R-value of 4.2 to 4.3 per inch at 75 degrees F (RSI value 0.74 to 0.76 m<sup>2</sup>K/W at 24 degrees C).
  - .8 Corrosive Resistance: ASTM C665, Corrosiveness to Steel - Pass, ASTM C795, Stainless Steel Stress Corrosion Specification as per Test Methods C871 and C692.
  - .9 Density to ASTM C612, from 3.4 to 6.2 lbs/ft<sup>3</sup> (70 kg/m<sup>3</sup>)
  - .10 Thickness: as indicated on drawings.
  - .11 Dimensions: to suit application.
  - .12 Acceptable material as required to suit thickness indicated:
    - .1 'CavityRock' by Rockwell Inc. or approved alternate.

## **2.2 ADHESIVE**

- .1 Adhesive (for Polyisocyanurate at roof locations):
  - .1 Adhesive: Solvent-free, cold fluid applied bituminous-urethane adhesive formulated to adhere roof insulation to substrate, with the following physical properties:
  - .2 Asbestos Content: EPA 600/R13/116 - None.
  - .3 Volatile Organic Compounds (VOC): maximum, ASTM D 3960 - 20 g/L.
  - .4 Non-Volatile Content: minimum, ASTM D 1644 - 98 percent.
  - .5 Density at 25 deg. C (77 deg. F), minimum: ASTM D 1875: 1.01 kg/L (8.5 lb./gal).
  - .6 Elongation at 25 deg. C (77 deg. F): minimum, ASTM D 412 - 1200 percent.
  - .7 T-Peel Strength at 25 deg. C (77 deg. F): minimum: ASTM D 1876 - 66 N (15 lab).
  - .8 Adhesion Strength in Shear at 25 deg. C (77 deg. F), minimum, ASTM D 816 - 552 kPa. (80 psi).
  - .9 8. Low-Temperature Flexibility, maximum, ASTM D 816: -51 deg. C (-60 deg. F).
  - .10 Acceptable product: Fast-n-Free, by Tremco, or approved alternate.

## **2.3 ACCESSORIES**

- .1 Insulation Fasteners: mechanically driven insulation fasteners fabricated from high density polyethylene plastic, complete with zinc plated pin, holding diameter and fastener depth as recommended by manufacture to suit substrate, insulation type and thickness.
  - .1 Acceptable product: 'Ramset Insulfast Fastener' by Ramset, 'Grid-Mate PB Mechanical Fasteners' by Grid-Mate, or approved alternate.
- .2 Refer also to Section 07 51 00 Built-up Bituminous Roofing.

## **PART 3- EXECUTION**

### **3.1 MANUFACTURER'S INSTRUCTIONS**

- .1 Compliance: comply with manufacturer's written data, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.

### **3.2 EXAMINATION**

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for board insulation application in accordance with manufacturer's written instructions.
  - .1 Visually inspect substrate.
  - .2 Inform Consultant of unacceptable conditions immediately upon discovery.
  - .3 Proceed with installation only after unacceptable conditions have been remedied.
- .2 Prior to commencement of work ensure:
  - .1 Substrates are firm, straight, smooth, dry, free of snow, ice or frost, and clean of dust and debris.

### **3.3 INSTALLATION**

- .1 Install insulation after building substrate materials are dry.
- .2 Install insulation to maintain continuity of thermal protection to building elements and spaces.
- .3 Fit insulation tight around electrical boxes, plumbing and heating pipes and ducts, around exterior doors and windows and other protrusions.
- .4 Keep insulation minimum 3" from heat emitting devices such as recessed light fixtures, and minimum 2" from sidewalls of CAN4-S604 type A chimneys and CAN/CGA-B149.1 and CAN/CGA-B149.2 type B and L vents.
- .5 Cut and trim insulation neatly to fit spaces. Butt joints tightly, offset vertical joints. Use only insulation boards free from chipped or broken edges. Use largest possible dimensions to reduce number of joints.
- .6 Offset both vertical and horizontal joints in multiple layer applications.
- .7 Do not enclose insulation until it has been reviewed and accepted by Consultant.

### **3.4 CAVITY WALL SYSTEM RIGID INSULATION INSTALLATION**

- .1 Cavity Wall Insulation Installation in adjustable Z-Girt Locations over air/vapour barrier membrane:
  - .1 In locations where adjustable Z-girts are specified install first layer of insulation tight to air/vapour barrier using adhesive.
  - .2 Using a notched trowel, trowel air/vapour barrier membrane adhesive in ribbon strips to back of insulation board as required, and as recommended by manufacture, for firm tight contact to air/vapour substrate.
  - .3 Butter air/vapour barrier membrane adhesive around all board insulation edges to eliminate any potential air gaps between adjacent boards.
  - .4 Install boards placed tightly together with no gaps between adjacent boards.
  - .5 Install boards placed tightly with no gaps between back of insulation board and air/vapour membrane.
- .2 Leave insulation board joints unbonded over line of expansion and control joints. Bond a continuous 6" wide 0.006" modified bituminous membrane over expansion and control joints using compatible adhesive and primer before application of insulation.

### **3.5 ROOF INSTALLATION**

- .1 Refer to Section 07 51 00 Built-up Bituminous Roofing.

### **3.6 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 REFERENCES**

- .1 American Society for Testing and Materials International (ASTM)
  - .1 ASTM C 553-13, Specification for Mineral Fibre Blanket Thermal Insulation for Commercial and Industrial Applications.
  - .2 ASTM C 665-12, Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.
  - .3 ASTM C 1320-10, Standard Practice for Installation of Mineral Fiber Batt and Blanket Thermal Insulation for Light Frame Construction.
- .2 Canadian Gas Association (CGA)
  - .1 CSA ONT GAS CODE 1996 Ontario Gas Utilization Code, 1996 (Includes Energy Act, Regulation and CAN/CGA-B149.1-M95).
  - .2 CSA ONT PROPANE CODE 1996 Ontario Propane Code, 1996 (Includes Ontario Energy Act and Regulation and CAN/CGA-B149.2-M95).
- .3 Canadian Standards Association (CSA International)
  - .1 CSA B111-1974(R2003), Wire Nails, Spikes and Staples.
- .4 Underwriters Laboratories of Canada (ULC)
  - .1 CAN/ULC-S604-M1991 (R2003, Type A Chimneys.
  - .2 CAN/ULC-S702-14, Standard for Mineral Fibre Insulation.

### **1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for blanket insulation and include product characteristics, performance criteria, physical size, finish, and limitations.
- .3 Certificates:
  - .1 Submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.
- .4 Test Reports:
  - .1 Submit certified test reports showing compliance with specified performance characteristics and physical properties.
- .5 Manufacturer's Instructions:
  - .1 Submit manufacturer's installation instructions.

### 1.3 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 – Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials off ground, indoors, in dry location, and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect specified materials from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.

### 1.4 QUALITY ASSURANCE

- .1 Convene pre-installation meeting one week prior to beginning work of this Section and on-site installations in accordance with Section 01 32 16 – Construction Progress Schedules - Bar (GANTT) Chart.
  - .1 Verify project requirements.
  - .2 Review installation and substrate conditions.
  - .3 Coordinate with other building sub-trades.
  - .4 Review manufacturer's installation instructions and warranty requirements.
- .2 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 29 6 – Health and Safety Requirements.

## **PART 2 - PRODUCTS**

### 2.1 INSULATION

- .1 Stone/Mineral Wool Fiber Thermal Insulation for Exterior Stud Walls:
  - .1 Compliance: CAN/ULC-S702 Type 1 mineral fiber insulation.
  - .2 CCMC Evaluation Listing: 07210: Mineral Fibre Batt Insulation.
  - .3 Fire Performance: CAN4 S114, non-combustible.
  - .4 Fire Performance, Surface Burning Characteristics: ASTM E84 (UL 723) and CAN/ULC S102, flame spread 0 and smoke developed less than 5.
  - .5 Thermal Resistance:
    - .1 R-value of 22 6".
  - .6 Certification: Greenguard indoor air quality certified.
  - .7 Density: to suit R-value.
  - .8 Dimensions: to suit stud type and spacing.
  - .9 Thickness: as indicated.
  - .10 Acceptable material: 'ComfortBatt' by Rockwool, or approved alternate.
  - .11 Acceptable material: 'ComfortBatt' by Roxul Inc., or approved alternate.

- .2 Stone/Mineral Wool Interior Acoustic and Fire-Rated Partitions:
  - .1 Compliance: ASTM C612 Type 1, ASTM C665 Type 1, CAN/ULC-S702 Type 1, UL and ULC Design Numbers.
  - .2 Fire Performance: ASTM E136 and CAN4 S114, non-combustible.
  - .3 Fire Performance Surface Burning Characteristics: ASTM E84 (UL 723) and CAN/ULC S102, flame spread 0 and smoke developed 0.
  - .4 CAN/ULC S129 Smolder Resistance 0.09 percent.
  - .5 Air Erosion: UL 181, maximum air velocity 1000 fpm (5.08 m/s).
  - .6 Thermal Resistance: R-value of 4.1 per inch at 75 degrees F (RSI value 0.72 m2K/W at 24 degrees C).
  - .7 Acoustic Performance: ASTM E90, ASTM E413, ASTM C423, ASTM E1050.
  - .8 Corrosive Resistance: ASTM C665, Corrosiveness to Steel - Pass, ASTM C795, Stainless Steel Stress Corrosion Specification as per Test Methods C871 and C692.
  - .9 Certification: Greenguard Indoor air quality certified.
  - .10 Density: ASTM C612, 2.8 lbs/ft3 (45 kg/m3).
  - .11 Dimensions: to suit application.
  - .12 Thickness: as indicated.
  - .13 Acceptable material: 'Roxul AFB' by Rockwool , or approved alternate.

## **2.2 ACCESSORIES**

- .1 Insulation clips:
  - .1 Impale type, perforated 2" x 2" cold rolled carbon steel 0.03" thick, adhesive back, spindle of 3/32" diameter annealed steel, length to suit insulation, 1" diameter washers of self-locking type.
- .2 Nails: galvanized steel, length to suit insulation plus to CSA B111.
- .3 Staples: 1/2" minimum leg.
- .4 Tape: as recommended by manufacturer.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for blanket insulation application in accordance with manufacturer's written instructions.
  - .1 Visually inspect substrate.
  - .2 Inform Consultant of unacceptable conditions immediately upon discovery.
  - .3 Proceed with installation only after unacceptable conditions have been remedied.

### **3.2 MANUFACTURER'S INSTRUCTIONS**

- .1 Compliance: comply with manufacturer's written data, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.

### **3.3 INSULATION INSTALLATION**

- .1 Install insulation to maintain continuity of thermal protection to building elements and spaces and to ASTM C 1320.
- .2 Fit insulation closely around electrical boxes, pipes, ducts, frames and other objects in or passing through insulation.
- .3 Seal holes or voids made by through penetrations, poke-through termination devices, and unpenetrated openings or joints to ensure continuity and integrity of sound ratings are maintained in partitions identified with STC ratings.
- .4 Do not compress insulation to fit into spaces.
- .5 Keep insulation minimum 75 mm / 3" from heat emitting devices such as recessed light fixtures, and minimum 50 mm / 2" from sidewalls of CAN/ULC-S604 Type A chimneys and CAN/CGA-B149.1 and CAN/CGA-B149.2 Type B and L vents.
- .6 Do not enclose insulation until it has been inspected and approved by Consultant.

### **3.4 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 – Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 – Cleaning.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 REFERENCES**

- .1 American Society for Testing and Materials International (ASTM)
  - .1 ASTM C411-11, Standard Test Method for Hot-Surface Performance of High Temperature Thermal Insulation.
  - .2 ASTM C518-10, Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
  - .3 ASTM C1338-14, Standard Test Method for Determining Fungi Resistance of Insulation Materials and Facings.
  - .4 ASTM D1621-10, Standard Test Method for Compressive Properties of Rigid Cellular Plastics.
  - .5 ASTM D1622/D1622M-14, Standard Test Method for Apparent Density of Rigid Cellular Plastics.
  - .6 ASTM D1623-09, Standard Test Method for Tensile and Tensile Adhesion Properties of Rigid Cellular Plastics (Type C sample).
  - .7 ASTM D2126-09, Standard Test Method for Response of Rigid Cellular Plastics to Thermal and Humid Aging.
  - .8 ASTM D2369-10(2015) e1, Standard Test Method for Volatile Content of Coatings.
  - .9 ASTM D2842-12, Standard Test Method for Water Absorption of Rigid Cellular Plastics
  - .10 ASTM D6226-10, Standard Test Method for Open Cell Content of Rigid Cellular Plastics.
  - .11 ASTM E96/E96M-14, Standard Test Methods for Water Vapor Transmission of Materials.
- .2 Canadian Urethane Foam Contractors' Association Inc. (CUFCA)
- .3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).
- .4 Underwriters' Laboratories of Canada (ULC)
  - .1 CAN/ULC-S101-14, Fire Endurance Tests of Building Construction and Materials.
  - .2 CAN/ULC-S102-10, Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
  - .3 CAN/ULC-S127-14 - Standard Corner Wall Method of Test for Flammability Characteristics of Non-Melting Building Materials.
  - .4 CAN/ULC-S705.1-15, Standard for Thermal Insulation - Spray Applied Rigid Polyurethane Foam, Medium Density, Material Specification.
  - .5 CAN/ULC-S705.2-05, Standard for Thermal Insulation - Spray Applied Rigid Polyurethane Foam, Medium Density, Application.
  - .6 CAN/ULC-S770-15 - Standard Test Method for Determination of Long-term Thermal Resistance of Closed-Cell Thermal Insulating Foams.
  - .7 CAN/ULC-S774-09(R2014) - Standard Laboratory Guide for the Determination of Volatile Organic Compound Emissions from Polyurethane Foam.
  - .8 Canadian Construction Materials Centre (CCMC) Evaluation Report CCMC 13588-L.

### **1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.

- .2 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications, and datasheet and include product characteristics, performance criteria, physical size, finish, and limitations.
  - .2 Submit copy of WHMIS MSDS – Material Safety Data Sheets.
- .3 Test Reports:
  - .1 Submit certified test reports for insulation from approved independent testing laboratories, indicating compliance with specifications for specified performance characteristics and physical properties.
  - .2 Submit test reports in accordance with CAN/ULC-S101 for fire endurance and CAN/ULC-S102 for surface burning characteristics.
- .4 Manufacturer's Instructions:
  - .1 Submit manufacturer's installation instructions and special handling criteria, installation sequence and cleaning procedures.
- .5 Manufacturer's Reports:
  - .1 Submit letter from the manufacturer confirming adhesion of insulation to adjacent materials and membranes. Letter to identify any special measures to be taken by the contractor to warranty the application.
  - .2 Manufacturer's Field Reports: submit to manufacturer's written reports within 3 days of review, verifying compliance of Work, as described in PART 3 - FIELD QUALITY CONTROL.

### 1.3 QUALITY ASSURANCE

- .1 Applicators to conform to manufacturer's quality assurance program.
- .2 Qualifications:
  - .1 Installer: person specializing in sprayed insulation installations with 5 years documented experience, approved by manufacturer.
  - .2 Applicator's qualifications: trained and experienced in application of spray urethane insulation, and be approved by system manufacturer.
  - .3 Manufacturer: company with minimum 5 years' experience in producing of material used for work required for this project, with sufficient production capacity to produce and deliver required units without causing delay in work.
- .3 Mock-up:
  - .1 Construct mock-up in accordance with Section 01 45 00 – Quality Control.
  - .2 Construct mock-up 10m<sup>2</sup>100 sq.ft. minimum, of sprayed insulation including one inside corner and one outside corner, one door and window openings.
  - .3 Mock-up may be part of finished work.
  - .4 Allow 48 hours for review of mock-up by Consultant and manufacturer's representative prior to proceeding with sprayed insulation work.
  - .5 Using the polyurethane foam insulation sample that was sprayed in place, verify the following on site conditions:
    - .1 Core density.
    - .2 Adhesion between the transition membrane and the substrate.
    - .3 Cohesion/adhesion between the insulation material and the substrate.
- .4 Keep copy on site of spray foam manufacturer's current installation instructions and the manufacturer's installation manual or guide for transition membrane installation. Strictly follow manufacturer's instructions.

- .5 Conducted tests daily on both core density and cohesion/adhesion to the substrate, following procedures that meet the requirements of CAN/ULC-S705.
- .6 Once the curing time required by the membrane manufacturer has elapsed, conduct a test to verify adhesion between the membrane and the substrate. Perform all adhesion tests using COM-TEN INDUSTRIES Series 301N1M equipment or approved alternate. Should adhesion be found lower than the required minimum of 110 kPa, mechanically fastened the membrane to substrate.
- .7 Perform adhesion tests on all corners and building angles, and wall to roof intersections as follows:
- .1 One test on every wall less than 30 m/100' in length.
  - .2 Two tests on walls between 30 m/100' and 60 m/200' in length.
  - .3 One test every 30 m /100' on walls more than 60 m/200' long.
  - .4 Mechanically fasten membrane to concrete slab at all areas where adhesion tests are unable to be conducted.
  - .5 Perform transition membranes adhesion tests at perimeter openings as follows:
  - .6 10 openings or more: perform tests on 15% of openings.
  - .7 10 openings or less: perform tests on 30% of openings.
  - .8 Perform adhesion tests on the transition membranes at every tenth column or beam.
  - .9 Adhesion tests are not required if membrane is adjusted mechanically.
  - .10 Permit jobsite access to manufacturer's representative for the purpose of technical assistance or verifying operator certification or the quality of the polyurethane foam application.
  - .11 Submit copy of all adhesion tests to Consultant prior to making application for payment.
- .8 Manufacturer's Field Services: as part of Manufacturer's Services described in PART 3 - FIELD QUALITY CONTROL, schedule site visits with manufacturer's representative, to review Work, at stages listed.
- .1 After delivery and storage of products, and when preparatory Work and mock-up is complete, but before installation begins.
  - .2 Twice during progress of Work at 25% and 60% complete.
  - .3 Upon completion of Work, after cleaning is carried out.
  - .4 Independent Testing Agency:
    - .1 Arrange for site reviews by Manufacturer's authorized agent. Schedule the number of site reviews in accordance with the following schedule:
- | Coverage Area, sq.m./sq.ft.     | No. of Site Reviews |
|---------------------------------|---------------------|
| 3,252 – 6,503/35,000 – 70,000   | 1                   |
| 6,503 – 9,755/105,001 – 140,000 | 2                   |
| 9,755 – 13,006/105001 – 140,000 | 3                   |
| over 13,006 / over 140,000      | 4                   |
- .2 Using the polyurethane foam insulation sample that was sprayed in place, verify the following on site conditions:
    - .1 Core density.
    - .2 Adhesion between the transition membrane and the substrate.
    - .3 Cohesion/adhesion between the insulation material and the substrate.
- .9 Health and Safety Requirements, worker protection:
- .1 Protect workers as recommended by CAN/ULC-S705.2 and manufacturer's recommendations:
  - .2 Workers must wear gloves, respirators, long sleeved clothing, eye protection, protective clothing when applying foam insulation.
  - .3 Workers must not eat, drink, or smoke while applying foam insulation.

## 1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store, and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: 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 specified materials from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.

## 1.5 SITE CONDITIONS

- .1 Ventilate area in accordance with Section 01 51 00 – Temporary Utilities.
- .2 Ventilate area to receive insulation by introducing fresh air and exhausting air continuously during and 24 hour after application to maintain non-toxic, unpolluted, safe working conditions.
- .3 Provide temporary enclosures to prevent spray and noxious vapours from contaminating air beyond application area.
- .4 Protect adjacent surfaces and equipment from damage by overspray, fall-out, and dusting of insulation materials.
- .5 Apply insulation only when surfaces and ambient temperatures are within manufacturers' prescribed limits.

## **PART 2 - PRODUCTS**

### 2.1 MATERIALS

- .1 Insulation:
  - .1 Spray polyurethane to CAN/ULC-S705.1.
  - .2 Performance Requirements:
    - .1 Water Vapour Permeance ASTM E96:41 ng/ Pa-s-sq m (0.70 Perms).
    - .2 Flame Spread Classification CAN/ULC S102: Flame Spread < 500.
  - .3 Hot Surface Performance ASTM C411: Passed when exposed to 93 deg C for 96 hours.
  - .4 Fungi Resistance ASTM C1338: No fungal growth after 28 day incubation.
  - .5 Long Term Thermal Resistance (LTTR): Conform to the following when tested to CAN/ULC S770.
    - .1 RSI 0.9 @ 25.4 mm/R5.1 @ 1 inch
    - .2 RSI 1.9 @ 50.8 mm/R10.8 @ 2 inches
    - .3 RSI 2.9 @ 76.2 mm/R16.5 @ 3 inches
    - .4 RSI 4.0 @ 100 mm/R22.7 @ 4 inches

- .6 Physical Requirements:
  - .1 Colour: manufacturer's standard colour with Indicator Dye Technology.
  - .2 Density ASTM D1622: Minimum 28.9 kg/cu m (1.8 lb/cu ft).
  - .3 Compressive Strength ASTM D1621: 201 kPa (29.2 psi).
  - .4 Tensile Strength ASTM D1623: 325 kPa (47.1 psi).
  - .5 Open Cell Content ASTM DD2856: 6.0 %.
  - .6 Water Absorption ASTM D2842: 0.6 % by volume.
- .7 Sustainable Requirements:
  - .1 Zero ozone depleting blowing agents.
  - .2 Minimum Recycled Content: EcoLogo certified; >5% by weight.
  - .3 Eco-efficiency analysis: life cycle assessment approved by NSF or equivalent.
- .8 Use spray foam from the following family of insulation types as per manufacturer's written recommendations to suit appropriate temperature range:
  - .1 Acceptable Products:
    - .1 'Foamsulate-Eco' by Premium Spray Products Canada – Hesterman Technical Services Inc.
    - .2 'Polar Foam 7300' by Polyurethane Foam Systems Inc.
    - .3 'ProSeal (MD-C-200v3)' by Icynene.
    - .4 'Styrofoam Brand SPF CA' by Dow.
    - .5 'Walltite Eco' by BASF Canada.
    - .6 Or approved alternate.
- .2 Primers: in accordance with manufacturer's recommendations for surface conditions.
- .3 Expansion/Deflection Joint Angles: Preformed angle comprising at least 26 ga steel core zinc coating, as stipulated in ASTM A653/A653M (galvanized steel G-90).

## **2.2 EQUIPMENT**

- .1 Comply with CAN/ULC S705.2 and the equipment manufacturer's recommendations for specific type of application.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for sprayed insulation application accordance with manufacturer's written instructions.
  - .1 Visually inspect substrate.
  - .2 Inform Consultant of unacceptable conditions immediately upon discovery.
  - .3 Proceed with installation only after unacceptable conditions have been remedied.

### **3.2 MANUFACTURER'S INSTRUCTIONS**

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.

### 3.3 APPLICATION

- .1 Apply insulation to clean surfaces in accordance with CAN/ULC-S705.2 and manufacturer's printed instructions.
- .2 Use primer where recommended by manufacturer.
- .3 Apply sprayed foam insulation in thickness as indicated.
- .4 Apply insulation to substrate free of all frost, high moisture content, dust, oil, grease, oxidization, or any other element that may affect this property.
- .5 Ensure metallic surfaces are free of oxidization. Apply primer in accordance with manufacturer's written instructions.
- .6 Do not apply spray foam insulation until the following Work is complete:
  - .1 Anchoring for exterior ladder to existing masonry.
  - .2 Primer where recommended by manufacturer.
  - .3 Transition Membrane and Thru-Wall Flashing Membrane is fully installed and reviewed by Consultant.
  - .4 Furring, blocking, and preparation work for window and door frames and mechanical metal louvers.
  - .5 Sub-girt clip angles and sub-girt framing angle for exterior cladding.
  - .6 Mechanical and electrical work.
  - .7 Adjacent areas have been protected with drop sheets and/or masking tape to adjacent surfaces.
- .7 Apply sprayed foam insulation in consecutive layers not less than 12.5 mm /½" and no more than 50 mm /2" thick, for a total thickness as indicated.
- .8 Do not spray foam over expansion and deflection joints. Install 0.5 mm /26 ga. sheet metal angle 75 mm /3" wide x total foam insulation thickness on both sides of joints and install continuous strip of 25% compressed continuous mineral wool insulation in thickness to match depth of spray foam between angles to absorb deflections.
- .9 Apply spray foam to a maximum tolerance of +6 mm /¼" in relation to the specified thickness.
- .10 Avoid formation of sub-layer air pockets during spray foam application.
- .11 Avoid overspray foam to surfaces other than those indicated. Use drop sheets and/or masking tape to protect adjacent surfaces.
- .12 Remove overspray from non-prescribed surfaces once the foam has hardened. Do not damage adjacent surfaces. Assume responsibility for repair should adjacent surfaces become damaged during removal of overspray.
- .13 Upon completion of spray foam insulation, remove drop sheets and masking tape and protect spray foam work from other trades.
- .14 Complete subsequent coverage to applied insulating foam within the manufacturer's prescribed timeframe.
- .15 Apply spray foam in overlapping layers, to obtain a smooth, uniform surface.

- .16 Apply spray applied foam as follows to areas exceeding 100 linear feet in either direction:
  - .1 Apply first layer in 3 m/10'-0" strips at 1 m/3' intervals. Following a curing period of  $\pm$  four (4) hours, spray foam to all unfilled spaces.
  - .2 In cold weather follow same procedure, for a minimum surface area of 15 lineal metres / 50'.
- .17 Do not spray foam any closer than 75 mm /3" from chimneys, heating vents, steam pipes, recessed lighting fixtures, and other heat sources. Do not spray insides of any exit openings or electrical junction boxes.
- .18 In temperatures below +10°C, mechanically adjusted transition membranes to manufacturer's written instructions.
- .19 Cover all mechanical fixtures with spray applied foam to reduce thermal bridges by means of galvanized spring clip for drywall, screwed 200 mm /8" through the membrane.

### **3.4 FIELD QUALITY CONTROL**

- .1 Manufacturer's Field Services:
  - .1 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.
  - .2 Schedule site visits, to review Work, as directed in PART 1 – QUALITY ASSURANCE.
  - .3 Obtain written reports from manufacturer verifying compliance of Work, in handling, installing, applying, protecting, and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.

### **3.5 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 – Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 – Cleaning.
  - .1 Remove insulation material spilled during installation and leave work area ready for application of wall board.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 REFERENCES**

- .1 American Society for Testing and Materials (ASTM)
  - .1 ASTM E 1745-11, Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs.
  - .2 ASTM E154/E154M-08A (2013) E1, Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover.
  - .3 ASTM E96/E96M-14, Standard Test Methods for Water Vapor Transmission of Materials.
  - .4 ASTM F 1249-13, Standard Test Method for Water Vapor Transmission Rate Through Plastic Film and Sheeting Using a Modulated Infrared Sensor.
  - .5 ASTM E 1643-11, Selection, Design, Installation, and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill under Concrete Slabs.
- .2 American Concrete Institute (ACI)
  - .1 ACI 302.2R-06 Guide for Concrete Slabs that Receive Moisture-Sensitive Flooring Materials.
- .3 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-51.33-M89, Vapour Barrier Sheet, Excluding Polyethylene, for Use in Building Construction.
  - .2 CAN/CGSB-51.34-M86, Vapour Barrier, Polyethylene Sheet, for Use in Building Construction.
- .4 Vapour Barrier / Vapour Retarder definition: the terms vapour barrier and vapour retarder are to be considered as one in the same throughout these documents.

### **1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for vapour retarders and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2 Submit copy of WHMIS MSDS in accordance with Section 01 35 29 – Health and Safety Requirements and 01 35 43 – Environmental Procedures. Product characteristics.
- .3 Certificates:
  - .1 Submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

### **1.3 QUALITY ASSURANCE**

- .1 Mock-Ups:
  - .1 Construct mock-ups in accordance with Section 01 45 00 – Quality Control.
  - .2 Construct mock-up of sheet vapour barrier installation including one lap joint, one inside corner and at one electrical box.

- .3 Mock-up will be used to judge workmanship, substrate preparation, and material application.
- .4 Locate where directed.
- .5 Allow 48 hours for inspection of mock-up by Consultant before proceeding with vapour barrier work.
- .6 When accepted, mock-up will demonstrate minimum standard of quality required for this work. Approved mock-up may remain as part of finished work to the approval of the Consultant.

#### **1.4 DELIVERY, STORAGE, AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: 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 vapour retarders from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.

### **PART 2 – PRODUCTS**

#### **2.1 SHEET VAPOUR BARRIER**

- .1 Exterior Wall and Ceiling Vapour Retarder:
  - .1 Polyethylene film: to CAN/CGSB-51.34, 6 mil thick.
  - .2 Joint Sealing tape: to CCMC #11862-R, 3" wide 'Construction'.
    - .1 Acceptable Product: Sheathing Tape 8808' by 3M, or approved alternate.
- .2 For rigid insulation, refer to Section 07 21 13 – Board Insulation.
- .3 For batt insulation, refer to Section 07 21 16 – Blanket Insulation
- .4 For air barrier, refer to Section 07 27 00 – Air Barriers
- .5 For air / vapour barrier, refer to Section 07 28 00 – Air/Vapour Barriers
- .6 For rigid insulation in built-up bituminous roofing, refer to Section 07 51 00 – Built-up Bituminous Roofing.

#### **2.2 ACCESSORIES**

- .1 Sealant: Refer to Section 07 92 00 – Joint Sealants.
- .2 Staples: minimum 6 mm leg.
- .3 Moulded box vapour barrier: factory-moulded polyethylene box for use with recessed electric switch and outlet device boxes.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for vapour retarder installation in accordance with manufacturer's written instructions.
  - .1 Visually inspect substrate.
  - .2 Inform Consultant of unacceptable conditions immediately upon discovery.
  - .3 Proceed with installation only after unacceptable conditions have been remedied.

#### **3.2 INSTALLATION**

- .1 Ensure services are installed and inspected prior to installation of retarder.
- .2 Install sheet vapour retarder on warm side of exterior wall assemblies prior to installation of gypsum board to form continuous 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.

#### **3.3 UNDER SLAB VAPOUR BARRIER**

- .1 Install sheet vapour barrier over insulation to entire interior concrete floor slab, unless otherwise indicated.
- .2 Cut sheet vapour barrier to form complete coverage. Lap sheet vapour over footings and onto vertical wall surface and seal joint with tape.
- .3 Overlap all both lateral and butt joints 6" and seal with Joint Sealing Tape. Ensure tape area is free from dust, dirt and moisture prior to placing tape.
- .4 Prior to placing concrete slab, repair all damaged areas to manufactures recommendations.
- .5 Do not permit concrete floor finishers to puncture sheet vapour barrier.

#### **3.4 EXTERIOR SURFACE OPENINGS**

- .1 Cut sheet vapour retarder to form openings and ensure material is lapped and sealed to frame.

#### **3.5 PERIMETER SEALS**

- .1 Seal perimeter of sheet vapour barrier 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.

### **3.6 LAP JOINT SEALS**

- .1 Seal lap joints of sheet vapour barrier as follows:
  - .1 Attach first sheet to substrate.
  - .2 Apply continuous bead of sealant over solid backing at joint.
  - .3 Lap adjoining sheet minimum 6" and press into sealant bead.
  - .4 Ensure that no gaps exist in sealant bead. Smooth out folds and ripples occurring in sheet over sealant.

### **3.7 ELECTRICAL BOXES**

- .1 Seal electrical switch and outlet device boxes that penetrate vapour barrier as follows:
  - .1 Install moulded box vapour barrier.
  - .2 Apply sealant to seal edges of flange to main vapour barrier and seal wiring penetrations through box cover.

### **3.8 CLEANING**

- .1 Proceed in accordance with Section 01 74 11 – Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 – Cleaning.
  - .1 Remove insulation material spilled during installation and leave work area ready for application of wall board.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 REFERENCES**

- .1 Canadian Construction Documents Committee
  - .1 CCDC 2-94, Stipulated Price Contract.
- .2 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-19.13M-M87, Sealing Compound, One Component, Elastomeric Chemical Curing.
  - .2 CAN/CGSB-19.24M-M90, Multi-Component, Chemical Curing Sealing Compound.
  - .3 CGSB 19-GP-14M-84, Sealing Compound, One Component, Butyl-Polyisobutylene Polymer Base, Solvent Curing.
- .3 Sealant and Waterproofer's Institute - Sealant and Caulking Guide Specification.

### **1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications, and datasheet and include product characteristics, performance criteria, physical size, finish, and limitations.
  - .2 Submit WHMIS MSDS - Material Safety Data Sheets.
- .3 Quality Assurance Submittals: submit following in accordance with Section 01 45 00 – Quality Control.
  - .1 Existing Substrate Condition: report deviations, as described in PART 3 -EXAMINATION in writing to Consultant.
  - .2 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
  - .3 Manufacturer's Instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence, and cleaning procedures.
  - .4 Submit letter from manufacturer confirming adhesion to proposed substrate.
  - .5 Manufacturer's Field Reports: submit manufacturer's written reports within 3 days of review, verifying compliance of Work, as described in PART 3 – FIELD QUALITY CONTROL.

### **1.3 QUALITY ASSURANCE**

- .1 Qualifications:
  - .1 Applicator: company specializing in performing work of this section with minimum five (5) years' documented experience with installation of air/vapour barrier systems.
    - .1 Completed installation must be approved by the material manufacturer.
- .2 Mock-Up:
  - .1 Construct mock-up in accordance with Section 01 45 00 - Quality Control.
  - .2 Construct typical exterior wall panel, incorporating window and frame and sill, insulation, building corner condition, junction with roof system and fascia panel; illustrating materials interface and seals.

- .3 Locate where directed by Consultant.
- .4 Mock-up may remain as part of finished work for Consultant approval.
- .5 Allow 48 hours for inspection of mock-up by Consultant before proceeding with air barrier Work.
- .3 Site Meetings: as part of Manufacturer's Services described in PART 3 – FIELD QUALITY CONTROL, schedule site visits, to review Work, at stages listed.
  - .1 After delivery and storage of products, and when preparatory Work is complete, but before installation begins.
  - .2 Twice during progress of Work at 25% and 60% complete.
  - .3 Upon completion of Work, after cleaning is carried out.

#### **1.4 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 – Common Product Requirements.
- .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .3 Avoid spillage: immediately notify Consultant if spillage occurs and start clean up procedures.
- .4 Clean spills and leave area as it was prior to spill.

#### **1.5 COORDINATION**

- .1 Ensure continuity of the water resistive air barrier throughout the scope of this section.

#### **1.6 AMBIENT CONDITIONS**

- .1 Install solvent curing sealants and vapour release adhesive materials in open spaces with ventilation.
- .2 Ventilate enclosed spaces in accordance with Section 01 51 00 –Temporary Utilities.
- .3 Maintain temperature and humidity recommended by materials manufactures before, during and after installation.

#### **1.7 SEQUENCING**

- .1 Sequence work in accordance with Section 01 32 16 – Construction Progress Schedules - Bar (GANTT) Charts.
- .2 Sequence work to permit installation of materials in conjunction with related materials and seals.

#### **1.8 WARRANTY**

- .1 Provide manufacturer's standard 12-year assembly warranty under provisions of Section 01 78 00 – Closeout Submittals and in accordance with General Conditions (GC) CCDC 2 GC 12.3.

- .2 Warranty: include coverage of installed sealant and sheet materials which:
  - .1 Fail to achieve air tight and watertight seal.
  - .2 Exhibit loss of adhesion or cohesion.
  - .3 Do not cure.

## **PART 2 - PRODUCTS**

### **2.1 SHEET MATERIALS**

- .1 Self-Adhered Vapour Permeable Water Resistive Air Barrier Membrane:
  - .1 Primary water resistive air barrier membrane and window flashing, self-adhering reinforced modified polyolefin tri-laminate sheet air barrier membrane for wall construction, specifically designed to be water resistant and vapour permeable with adhesive backing protected with release film to the following physical properties:
    - .1 Air leakage: <0.02L/s/m2 @ 75Pa <0.004 CFM/ft2 @ 1.57 lbs/ft2 when tested in accordance with ASTM E 2178.
    - .2 Water Vapour Permeance: 1658 ng/Pa.m<sup>2</sup>.s (29 perms) to ASTM E96, Method B – Desiccant Method.
    - .3 Tested to ASTM E 2357 for Air Leakage of Air Barrier Assemblies.
    - .4 Resistance to Water Penetration: Pass ICC-ES AC 38.
    - .5 Water Penetration Resistance around Nails: Pass when tested to AAMA 711-05 & ASTM D 1970 modified.
    - .6 Surface Burning Characteristics: Class A, when tested in accordance with ASTM E84: Flame Spread Rating of 0 and Smoke Development Classification of 105.
    - .7 Basis Weight: 120 g/m2, when tested in accordance with TAPPI Test Method T-410.
    - .8 Tensile Strength: 182N MD and 129N CD per ASTM D828.
    - .9 Average Dry Breaking Force: 565N MD, and 405N CD per ASTM D 5034.
    - .10 Cyclic and Elongation: Pass at 100 cycles, -29 deg C. per ICC-ES AC 48.
    - .11 Acceptable Product: 'Blueskin VP 160' as manufactured by Henry Bakor, or approved alternate.
- .2 Transition Membrane:
  - .1 Transition Sheet Membrane (For use with spray polyurethane [insulation, refer to Section 07 21 29 - Sprayed Insulation - Polyurethane Foam]):
  - .2 Plain: 1.0 mm/0.04" thick, 457 mm/18" wide modified bitumen membrane, reinforced.
    - .1 Acceptable Product: 'Blueskin SA', by Bakor or approved alternate.
- .3 Membrane Flashings:
  - .1 Refer to Section 07 27 00 Vapour Barriers and 07 28 00 Air / Vapour Barriers.
  - .2 Rubberized reinforced asphalt compound, self-adhered membrane, 1.0 mm thick, width to suit application.
    - .1 Acceptable Product: "Blueskin TWF" by Bakor, or approved alternate.

### **2.2 SEALANTS**

- .1 Sealants in accordance with Section 07 92 00 – Joint Sealants.

## **2.3 ACCESSORIES**

- .1 Joint Sealing tape: to CCMC #11862-R, 3" wide 'Construction Sheathing Tape 8808' by 3M, or approved alternate.
- .2 Adhesive Primer: To manufacturer's written recommendations.
- .3 Membrane flashings:
  - .1 Refer to Section 07 28 00 Air/Vapour Barriers.
  - .2 Rubberized reinforced asphalt compound, self-adhered membrane, 1.0mm thick, width to suite application.
    - .1 Acceptable Product: "Blueskin TWF" by Bakor, or approved alternate.
- .4 Termination Sealant: a moisture cure, medium modulus polymer modified sealing compound to ASTM C920 Type S, Grade NS, Class 25.
  - .1 Acceptable Products: 'HE925 BES Sealant' manufactured by Henry Bakor, or approved alternate.
- .5 Thinner and cleaner: as recommended by sheet material manufacturer.

## **PART 3 - EXECUTION**

### **3.1 MANUFACTURER'S INSTRUCTIONS**

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.

### **3.2 GENERAL**

- .1 Perform Work in accordance with Sealant and Waterproofer's Institute - Sealant and Caulking Guide Specification requirements for materials and installation.
- .2 Perform Work in accordance with National Air Barrier Association - Professional Contractor Quality Assurance Program and requirements for materials and installation.
- .3 Perform Work in accordance with Canadian Urethane Foam Contractor's Association - Professional Contractor Quality Assurance Program and requirements for materials and installation.

### **3.3 EXAMINATION**

- .1 Verify that surfaces and conditions are ready to accept work of this section.
- .2 Ensure surfaces are clean, dry, sound, smooth, and continuous and comply with air barrier manufacturer's requirements.
- .3 Report unsatisfactory conditions to Consultant in writing.
- .4 Do not start work until deficiencies have been corrected.
  - .1 Beginning of Work implies acceptance of conditions.

### 3.4 PREPARATION

- .1 Remove loose or foreign matter, which might impair adhesion of materials.
- .2 Ensure substrates are clean of oil or excess dust; masonry joints struck flush, and open joints filled; and concrete surfaces free of large voids, spalled areas or sharp protrusions.
- .3 Ensure substrates are free of surface moisture prior to application of self-adhesive membrane and primer.
- .4 Ensure metal closures are free of sharp edges and burrs.
- .5 Prime substrate surfaces to receive adhesive and sealants in accordance with manufacturer's instructions.
- .6 Install Through-Wall Flashing Membrane over all foundations and shelf angles to receive exterior masonry and to other areas as indicated. Lap flashing membrane 12" vertically onto wall surface and over entire horizontal surface. Trim back all exposed to view membrane upon completion of exterior cladding.
- .7 Install flashings as per Section 04 05 00 – Common Work Results for Masonry.

### 3.5 INSTALLATION

- .1 Install materials in accordance with manufacturer's instructions.
- .2 Secure Air Barrier where indicated with adhesive or tape. Caulk with acoustic sealant to ensure complete seal. Position lap seal over firm bearing.
- .3 Install Air Barrier, between flashings at roof membrane and adjacent parapet and seal materials with acoustic sealant. Caulk to ensure complete seal. Position lap seal over firm bearing, as indicated.
- .4 Apply sealant within recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.
- .5 Parapet and Roof Junction: Lap Air Barrier 150 mm/6" with firm bearing to adjacent membranes. Seal Air Barrier to roof membrane with continuous bead of acoustic sealant. Seal all joints in parapet and roof junction with tape. Provide continuous airtight seal.

### 3.6 INSTALLATION OF SELF-ADHERED AIR BARRIER MEMBRANE

- .1 Adhesive Primer for Primary Water Resistive Air Barrier Membrane:
  - .1 Conditions not typically requiring adhesive-primers: Application above 5°C to clean and dry plywood substrate. Ensure substrate and membrane temperatures are above 5°C.
  - .2 Conditions requiring use of adhesive-primers:
    - .1 Metal, gypsum sheathing, concrete, concrete unit masonry, and other masonry substrates.
    - .2 Should appropriate adhesion not be obtained due to conditions beyond the control of the installer, the adhesion may be aided by continuous application of adhesive-primer to the substrate and laps. Ensure all primed surfaces are covered in same day.

- .2 Inside and Outside Corners:
  - .1 Seal inside and outside corners of sheathing boards with a strip of self-adhering vapour permeable membrane extending a minimum of 75 mm/3" on either side of corner.
  - .2 For inside corners, pre-treat the corner with a continuous 13 mm/½" bead of termination sealant.
  - .3 Adhesive prime surfaces where indicated to achieve surface adhesion as per manufacturers' instructions.
  - .4 Align and position self-adhering transition membrane, remove protective film and press firmly into place. Ensure minimum 50 mm/2" minimum overlap at all side laps and 75 mm/3" minimum overlap at all end laps of membrane.
  - .5 Roll all laps and membrane with a counter top roller to ensure seal.
- .3 Transition Areas:
  - .1 Tie-in to structural beams, columns, floor slabs, and intermittent floors, parapet curbs, foundation walls, roofing systems and at the interface of dissimilar materials as indicated in drawings with self-adhered air barrier transition membrane in accordance with Section 07 27 00 Air/Vapour Barriers.
- .4 Windows, Doors and Rough Openings:
  - .1 Place transition membrane in accordance with Section 07 27 00 Air/Vapour Barriers across window sills. Pre-treat inside corners with a bead of termination sealant. Install window sill pan membrane and end dam terminations, seal cuts and terminations with termination sealant per window manufacturer's instructions and ASTM E 2112.
  - .2 Wrap head and jamb of rough openings with transition membrane.
  - .3 Extend specified self-adhered air barrier membrane into rough window openings sufficient to provide a connection to interior vapour retarder.
    - .1 Prime surfaces where indicated to achieve surface adhesion as per manufacturers' instructions.
    - .2 Align and position transition membrane, remove protective film and press firmly into place. Ensure minimum 50 mm/2" overlap at all side laps and 75 mm/3" overlap at all end laps of membrane.
    - .3 Roll all laps and membrane with a counter top roller to ensure seal.
- .5 Through-Wall Flashing Membrane:
  - .1 Apply through-wall flashing membrane along the base of masonry veneer walls and over lintels as detailed.
  - .2 Prime surfaces and allow to dry, press membrane firmly into place, overlap minimum 50 mm/2" at all side and end laps. Promptly roll all laps and membrane to ensure the seal.
  - .3 Form continuous flashing membrane and extend up back-up wall minimum of 200 mm /8".
  - .4 Seal the top edge of the membrane where it meets substrate using termination sealant. Trowel-apply a feathered edge to seal termination to shed water.
  - .5 Install through-wall flashing membrane and extend 13 mm/½" from outside edge of veneer. Provide "end dam" flashing as detailed.
- .6 Sheet Air Barrier Installation:
  - .1 Apply self-adhering sheet air barrier membrane complete and continuous to substrate in an overlapping shingle fashion in accordance with manufacturer's recommendations and written instructions. Stagger all vertical joints.
  - .2 Prime surfaces where indicated to achieve surface adhesion as per manufacturers' instructions and allow to dry.
  - .3 Align and position self-adhering membrane to substrate, remove top panel of protective release film and press firmly into place.

- .4 Ensure alignment, hold membrane in place to avoid wrinkles and sequentially remove remaining panels of protective film and press firmly into place.
  - .5 Ensure minimum 75 mm /3" overlap at all end and 50 mm /3" side laps of subsequent membrane applications.
  - .6 Apply pressure to all membrane surfaces, laps, and flashings using an appropriate roller to provide best possible surface adhesion.
  - .7 At the end of each day's work seal the top edge of the membrane where it meets the substrate with termination sealant. Trowel to a feathered edge to seal termination and shed water.
- .7 Application of Termination Sealant:
- .1 Seal membrane terminations, heads of mechanical fasteners, masonry tie fasteners, around penetrations, duct work, electrical and other apparatus extending through the sheet air barrier membrane and around perimeter edge of membrane terminations at window and door frames with termination sealant.

### **3.7 FIELD QUALITY CONTROL**

- .1 Manufacturer's Field Services:
  - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting, and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.
  - .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, as directed in PART 1 - QUALITY ASSURANCE.

### **3.8 CLEANING**

- .1 Proceed in accordance with Section 01 74 11 – Cleaning.
- .2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools, and equipment.

### **3.9 PROTECTION OF WORK**

- .1 Protect finished work in accordance with Section 01 61 00 – Common Product Requirements.
- .2 Do not permit adjacent work to damage work of this section.
- .3 Permit damp substrates to dry. Do not expose the backside of the substrate to moisture or rain.
- .4 Cap and protect exposed back-up walls against wet weather conditions during and after application of membrane, including wall openings and construction activity above completed air barrier installations.
- .5 Water resistive air barrier membranes are not designed for permanent exposure. Cover as soon as possible. Do not exceed 150 day exposure to the elements.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 REFERENCES**

- .1 ASTM International Inc.
  - .1 ASTM D412-06a (2013), Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers-Tension.
  - .2 ASTM D882-12, Standard Test Method for Tensile Properties of Thin Plastic Sheeting.
  - .3 ASTM D903-98(2010), Standard Test Method for Peel or Stripping Strength of Adhesive Bonds.
  - .4 ASTM D1004-13, Standard Test Method for Tear Resistance (Graves Tear) of Plastic Film and Sheeting.
  - .5 ASTM D1876-08(2015) e1, Standard Test Method for Peel Resistance of Adhesives (T-Peel Test).
  - .6 ASTM D1938-14, Standard Test Method for Tear-Propagation Resistance (Trouser Tear) of Plastic Film and Thin Sheeting by a Single-Tear Method.
  - .7 ASTM E2357-11 Standard Test Method for Determining Air Leakage of Air Barrier Assemblies.
  - .8 ASTM D5147/D5147M-14, Standard Test Methods for Sampling and Testing Modified Bituminous Sheet Material
  - .9 ASTM E154-08a(2013)e1, Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover
  - .10 ASTM E2178-13: Standard Test Method for Air Permeance of Building Materials.
  - .11 ASTM E283-04(2012): Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.
  - .12 ASTM E1677-11 Specification for Air Retarder (AR) Material or System for Low-Rise Framed Building Walls
  - .13 ASTM E330/E330M-14: Standard Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference.
  - .14 ASTM E331-00(2009): Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference
  - .15 ASTM E96/E96M-15, Standard Test Methods for Water Vapor Transmission of Materials.
- .2 Canadian Construction Documents Committee
  - .1 CCDC 2-08, Stipulated Price Contract.
- .3 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-19.13M-M87, Sealing Compound, One Component, Elastomeric Chemical Curing.
  - .2 CAN/CGSB-19.24M-M90, Multi-Component, Chemical Curing Sealing Compound.
  - .3 CGSB 19-GP-14M, Sealing Compound, One Component, Butyl-Polyisobutylene Polymer Base, Solvent Curing.
  - .4 CGSB 37-GP-56M: Membrane, Modified, Bituminous, Prefabricated, and Reinforced.
  - .5 CAN/CGSB 37.58-M86, Membrane, Elastomeric, Cold-Applied Liquid, for Non-Exposed Use in Roofing and Waterproofing.
- .4 Canadian Standards Association (CSA International)
  - .1 CSA A371-14, Masonry Construction for Buildings.

.5 Sealant and Waterproofer's Institute - Sealant and Caulking Guide Specification.

## **1.2 ACTION AND INFORMATIONAL SUBMITTALS**

.1 Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.

.2 Product Data:

- .1 Submit manufacturer's printed product literature, specifications, and datasheet and include product characteristics, performance criteria, physical size, finish, and limitations.
- .2 Submit WHMIS MSDS - Material Safety Data Sheets in accordance with Section 01 35 29– Health and Safety Requirements and manufacturer's instructions.

.3 Quality Assurance Submittals: submit following in accordance with Section 01 45 00 – Quality Control.

- .1 Existing Substrate Condition: report deviations, as described in PART 3 -EXAMINATION in writing to Consultant.
- .2 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .3 Submit letter from manufacturer confirming adhesion to proposed substrate.
- .4 Manufacturer's Instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence and cleaning procedures.

## **1.3 QUALITY ASSURANCE**

.1 Submit in writing, a document stating that the applicator of the primary air/vapour barrier membranes specified in this section is recognized by the manufacturer as suitable for the execution of the Work.

.2 Perform Work in accordance with the manufacturer's written instructions of the air/vapour barrier membrane and this specification.

.3 Maintain one copy of manufacturer's written instructions on site.

.4 Qualifications:

- .1 Applicator: company specializing in performing work of this section with minimum five (5) years documented experience with installation of air/vapour barrier systems.
  - .1 Completed installation must be approved by the material manufacturer.

.5 At the beginning of the Work and at all times during the execution of the Work, allow access to Work site by the air/vapour barrier membrane manufacturers' representative.

.6 Source components used in this section from one manufacturer, including sheet membrane, air/vapour barrier sealants, primers, mastics, and adhesives.

.7 Mock-Up:

- .1 Construct mock-up in accordance with Section 01 45 00 - Quality Control.
- .2 Construct typical exterior wall panel, incorporating window and door frames c/w jamb, sill and head conditions, insulation, building corner condition, junction with foundation wall and roof system(s) and other building conditions as directed by the Consultant; illustrating materials interface and seals.
- .3 Locate where directed.

- .4 Mock-up may remain as part of finished work to Consultant's written approval.
- .5 Allow 48 hours for inspection of mock-up by Consultant before air/vapour barrier Work.
- .8 Site Meetings: as part of Manufacturer's Services described in PART 3 - FIELD QUALITY CONTROL, schedule site visits, to review Work, at stages listed.
  - .1 After delivery and storage of products, and when preparatory Work is complete, but before installation begins.
  - .2 Twice during progress of Work at 25% and 60% complete.
  - .3 Upon completion of Work, after cleaning is carried out.

#### **1.4 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 – Common Product Requirements.
- .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .3 Deliver materials to the job site in undamaged and original packaging indicating the name of the manufacturer and product.
- .4 Store role materials on end in original packaging.
- .5 Keep solvent away from open flame or excessive heat.
- .6 Protect rolls from direct sunlight until ready for use.
- .7 Avoid spillage: immediately notify Consultant if spillage occurs and start clean up procedures.
- .8 Clean spills and leave area as it was prior to spill.

#### **1.5 AMBIENT CONDITIONS**

- .1 Install solvent curing sealants and vapour release adhesive materials in open spaces with ventilation.
- .2 Ventilate enclosed spaces in accordance with Section 01 51 00 – Temporary Utilities.
- .3 Maintain temperature and humidity recommended by materials manufactures before, during and after installation.

#### **1.6 SEQUENCING**

- .1 Sequence work in accordance with Section 01 32 16 – Construction Progress Schedules - Bar (GANTT) Charts.
- .2 Sequence work to permit installation of materials in conjunction with related materials and seals.

## **1.7 WARRANTY**

- .1 Provide manufacturer's five (5) year warranty under provisions of Section 01 78 00 – Closeout Submittals and in accordance with General Conditions (GC) CCDC 2 GC 12.3.
- .2 Warranty: include coverage of installed sealant and sheet materials which:
  - .1 Fail to achieve air tight and watertight seal.
  - .2 Exhibit loss of adhesion or cohesion.
  - .3 Do not cure.

## **PART 2 - PRODUCTS**

### **2.1 AIR/VAPOUR BARRIER SYSTEMS**

- .1 Obtain air/vapour barrier membrane components and accessories as a single-source from the membrane manufacturer to ensure total system compatibility and integrity.
- .2 Use one of the following wall air/vapour barrier that best suits the application as per manufacturers written recommendations:
  - .1 Self-Adhered Sheet Membrane.
  - .2

### **2.2 SELF-ADHERED SHEET MEMBRANE**

- .1 Primary sheet air/vapour barrier membrane, a SBS modified bitumen, self-adhering sheet membrane complete with a cross-laminated polyethylene film to the following physical properties:
  - .1 Thickness: 40 mils.
  - .2 Air leakage:  $<0.005 \text{ L/s.m}^2$  @ 75 Pa to ASTM E283-91.
  - .3 Tested to ASTM E 2357 for the air barrier assembly.
  - .4 Water vapour permeance:  $1.6 \text{ ng/Pa.m}^2.\text{s}/0.03 \text{ perms}$  to ASTM E96.
  - .5 Low temperature flexibility:  $-30^\circ\text{C}$  to CGSB 37-GP-56M.
  - .6 Elongation: 200% to ASTM D412-modified.
  - .7 Acceptable material:
    - .1 For temperatures  $4^\circ$  and greater: 'Blueskin SA' as manufactured by Henry Bakor or approved alternate.
    - .2 For temperatures  $>4^\circ\text{C}$  to  $-12^\circ\text{C}$ : for application temperatures down to  $-12^\circ\text{C}$  use Blueskin SA LT by Henry Bakor, or approved alternate.

### **2.3 TRANSITION SHEET MEMBRANE**

- .1 Transition Sheet Membrane (for use with spray polyurethane insulation, refer to Section 07 21 29 - Sprayed Insulation - Polyurethane Foam):
  - .1 Thickness: 40 mils.
  - .2 Air leakage:  $<0.005 \text{ L/s.m}^2$  @ 75 Pa to ASTM E283-91.

- .3 Tested to ASTM E 2357 for the air barrier assembly.
- .4 Water vapour permeance: 1.6 ng/Pa.m<sup>2</sup>.s/0.03 perms to ASTM E96.
- .5 Low temperature flexibility: -30°C to CGSB 37-GP-56M.
- .6 Elongation: 200% to ASTM D412-modified.
- .7 Acceptable product: 'Blueskin SA', by Bakor or approved alternate.

## **2.4 THROUGH-WALL FLASHING MEMBRANE**

- .1 Through-Wall Flashing Membrane:
  - .1 Rubberized reinforced asphalt compound, self-adhered membrane, width to suite application.
  - .2 Thickness: 40 mils.
  - .3 Puncture Resistance - Membrane to ASTM E154: 180N minimum/40 lbf.
  - .4 Tear resistance: 200N /13 lbs. MD, to ASTM D1004.
  - .5 Tested to ASTM E 2357 for the air barrier assembly.
  - .6 Water vapour permeance: 1.6 ng/Pa.m<sup>2</sup>.s/0.03 perms to ASTM E96 Method B.
  - .7 Low temperature flexibility: -30°C to CGSB 37-GP-56M.
  - .8 Lap Peel Strength at -4°C to (ASTM D1876): 8.75N/cm/5 lbf/in width.
  - .9 Adhesion to Concrete to ASTM D903: 8.75N/cm/5.0 lb/in. width
  - .10 Elongation: 200% to ASTM D412-modified.
  - .11 Acceptable Product: "Blueskin TWF" by Bakor, or approved alternate.

## **2.5 PRIMERS AND ADHESIVES**

- .1 Adhesives and Primers: as recommended by air/vapour barrier manufacturer to suit application.

## **2.6 SEALANTS**

- .1 Sealants in accordance with Section 07 92 00 – Joint Sealants unless otherwise indicated.
- .2 Termination Sealant in exposed locations: a sealing compound having the following physical properties:
  - .1 Compatible with sheet air barrier, roofing and waterproofing membranes and substrate.
  - .2 Complies with Fed. Spec. TT-S-00230C, Type II, Class A.
  - .3 Complies with ASTM C 920, Type S, Grade NS, Class 25.
  - .4 Elongation: 450 – 550%.
  - .5 Remains flexible with aging.
  - .6 Seals construction joints up to 1" wide.
  - .7 Colour: as later selected by Consultant from manufacture's standard colour range.
  - .8 Acceptable material: 'HE925 BES Sealant' manufactured by Henry Bakor, or approved alternate.
- .3 Termination Sealant in locations concealed from UV exposure: a sealing compound having the following characteristics:
  - .1 Compatible with sheet waterproofing membrane and substrate.
  - .2 Solids by volume: 70%.
  - .3 Vapour permeance: 2.9 ng/Pa.m<sup>2</sup>.s, ASTM E96.

- .4 Complies with CGSB 37.29.
- .5 Remains flexible with ageing.
- .6 Adheres to wet surfaces.
- .7 Chemical resistance: Alkalies, calcium chloride, mild acid and salt solutions.
- .8 Colour: black.
- .9 Acceptable material: 'Polybitume 570-05' Polymer Modified Sealing Compound manufactured by
- .10 Henry Baker, or approved alternate.

## **2.7 ACCESSORIES**

- .1 Thinner and cleaner for Butyl and Neoprene Sheet: recommended by sheet material manufacturer.
- .2 Attachments: galvanized steel bars and anchors, as recommended by membrane manufacturer.

## **PART 3 - EXECUTION**

### **3.1 MANUFACTURER'S INSTRUCTIONS**

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.

### **3.2 GENERAL**

- .1 Perform Work in accordance with Sealant and Waterproofer's Institute - Sealant and Caulking Guide Specification requirements for materials and installation.
- .2 Perform Work in accordance with National Air Barrier Association - Professional Contractor Quality Assurance Program and requirements for materials and installation.
- .3 Perform Work in accordance with Canadian Urethane Foam Contractor's Association - Professional Contractor Quality Assurance Program and requirements for materials and installation.

### **3.3 EXAMINATION**

- .1 Verify that surfaces and conditions are ready to accept work of this section.
- .2 Ensure surfaces are clean, dry, sound, smooth, continuous and comply with air barrier manufacturer's requirements.
- .3 Report unsatisfactory conditions to Consultant in writing.
- .4 Do not start work until deficiencies have been corrected.
  - .1 Beginning of Work implies acceptance of conditions.

### **3.4 PREPARATION**

- .1 Remove loose or foreign matter, which might impair adhesion of materials.
- .2 Ensure substrates are clean of oil or excess dust; masonry joints struck flush, and open joints filled;

and concrete surfaces free of large voids, spalled areas or sharp protrusions.

- .3 Ensure substrates are free of surface moisture prior to application of self-adhesive membrane and primer.
- .4 Ensure metal closures are free of sharp edges and burrs.
- .5 Prime substrate surfaces to receive adhesive and sealants in accordance with manufacturer's instructions.

### **3.5 AIR/VAPOUR BARRIER VOID COVERINGS**

- .1 At open joints in substrate exceeding 319 mm/3/4" in width, and at other locations shown to receive air/vapour barrier membranes, provide 26 ga. galvanized metal backing for air barrier membrane, securely fastened to each side of joint.
  - .1 Examples of gaps and voids required to be covered, but not limited to are:
    - .1 Control joints.
    - .2 Expansion joints.
    - .3 Gaps between dissimilar materials.
    - .4 Gaps resulting from structural steel erection.
    - .5 Other similar gaps and voids.

### **3.6 SELF-ADHERED SHEET MEMBRANE**

- .1 Adhesive or Primer for Transition and Through-wall Flashing Membrane (Self-Adhering):
  - .1 Apply adhesive or primer for self-adhering membranes at rate recommended by manufacturer.
  - .2 Apply to all areas to receive air/vapour barrier membrane, transition sheet and through-wall flashing membrane, as indicated on drawings by roller or spray and allow minimum 30 minute open time. Surfaces not covered by self-adhering transition membrane or self-adhering through-wall flashing membrane during the same working day must be re-applied.
- .2 Through-Wall Flashing Membrane (Self-Adhering):
  - .1 Apply through-wall flashing membrane to prepared surfaces as indicated.
  - .2 Apply through-wall flashing membrane to masonry surfaces in accordance with CSA A371 Masonry Construction for Buildings
  - .3 Apply through-wall flashing onto exterior wall substrate membrane and lap over prefinished metal drip plates or flashings:
    - .1 on top of foundation walls,
    - .2 along the base of masonry veneer walls,
    - .3 over windows, doors, louvers and other wall openings required to be protected,
    - .4 other locations as indicated.
  - .4 Form flashing membrane applications continuous and extend up exterior wall substrate a minimum 200 mm/8" and to edge of edge of prefinished metal drip plate or flashing.
  - .5 At the end of each day's work seal the top edge of the membrane where it meets the substrate using liquid air seal mastic. Trowel apply a feathered edge to seal termination and shed water.
  - .6 Align and position leading edge of through-wall flashing membrane with the front horizontal edge of prefinished metal drip plate or flashing to the exterior face of the exterior masonry veneer and other exterior finishes to Consultant approval. Trim all material back from drip plate or flashing so as it is not visible after installation of exterior finishes.
  - .7 At locations where flashing terminates or intersects wall openings including door frames, seal

- over "end dam" flashing to protect openings and redirect water out. Trim off excess material so as it is not visible after installation of exterior finishes to Consultant approval.
- .8 Partially remove protective film and roll membrane over surface and up vertically.
  - .9 Press firmly into place. Ensure minimum 2" overlap at all end and side laps. Promptly roll all laps and membrane to a positive seal.
  - .10 Ensure all preparatory work is complete prior to applying self-adhering through-wall flashing membrane.
- .3 Transition Membrane (Self-Adhering):
- .1 Apply transition membranes in accordance with spray polyurethane foam insulation and air/vapour manufactures' written recommendations as required to provide a complete building air/vapour system.
  - .2 Apply transition sheet membrane to prepared surfaces as indicated.
  - .3 Apply transition sheet membrane over all adjoining dissimilar substrate materials such as but not limited to connections of existing masonry block to steel or concrete; drywall or plywood to steel or concrete and all beams, columns, window and door frames etc. using strips as required, lapped a minimum of 3" on both substrates and centered over joint.
  - .4 Align and position self-adhering transition membrane, remove protective film and press firmly into place. Ensure minimum 2" overlap at all end and side laps.
  - .5 Tie-in to window frames, aluminum screens, hollow metal doorframes, spandrel panels, roofing system and at the interface of dissimilar materials as indicated on drawings.
  - .6 At tops of foundation walls, lap transition sheet membrane onto vertical wall substrate 8" minimum, and over top of foundation wall to outside edge. Trim all overhanging material.
  - .7 Promptly roll all laps and membrane with a counter top roller to effect seal.
  - .8 Ensure all preparatory work is complete prior to applying liquid applied air/vapour barrier membrane.
- .4 Air/Vapour Barrier Membrane:
- .1 Apply self-adhering membrane complete and continuous to prepared and primed substrate in an overlapping shingle fashion and in accordance with manufacturer's recommendations and written instructions. Stagger all vertical joints.
  - .2 Align and position self-adhering membrane, remove protective film and press firmly into place. Ensure minimum 2" overlap at all end and side laps. Promptly roll all laps and membrane with a counter top roller to provide a positive seal.
  - .3 At the end of each day's work seal the top edge of the membrane where it meets the substrate using liquid air seal mastic or termination sealant to seal termination and shed water.
  - .4 Tie-in to window frames, aluminum screens, hollow metal doorframes, spandrel panels, roofing system and at the interface of dissimilar materials as indicated on drawings. Refer also to manufacturers' standard details.
  - .5 Ensure all projections, including wall ties, are properly sealed with a caulk application of liquid air seal mastic.
  - .6 Mechanically fasten membrane through securement bars to all window, door, louvers and curtain wall sections as recommended by membrane manufacturer where proper adhesion and bonding cannot be maintained.
  - .7 For membrane to be applied to underside of substrate surfaces provide special attention to ensure maximum surface area adhesion is obtained.

### **3.7 FIELD QUALITY CONTROL**

- .1 Manufacturer's Field Services:
  - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.
  - .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, as directed in PART 1 - QUALITY ASSURANCE.

### **3.8 CLEANING**

- .1 Proceed in accordance with Section 01 74 11 – Cleaning.
- .2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

### **3.9 PROTECTION OF WORK**

- .1 Protect finished work in accordance with Section 01 61 00 – Common Product Requirements.
- .2 Do not permit adjacent work to damage work of this section.
- .3 Ensure finished work is protected from climatic conditions.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 REFERENCES**

- .1 The Aluminum Association, Inc. (AA)
  - .1 AA DAF45-03, Designation System for Aluminum Finishes.
- .2 American Society for Testing and Materials International (ASTM)
  - .1 ASTM A 240/A 240M-15a, Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
  - .2 ASTM A 480/A 480M-15, Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip.
  - .3 ASTM A 653/A 653M-15, Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc Iron Alloy Coated (Galvannealed) by the Hot Dip Process.
  - .4 ASTM B 209-14, Standard Specification for Aluminum and Aluminum Alloy Sheet and Plate.
  - .5 ASTM B 211-12e1, Standard Specification for Aluminum and Aluminum Alloy Rolled or Cold Finished Bar, Rod, and Wire.
  - .6 ASTM B 221-14, Standard for Aluminum and Aluminum Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
  - .7 ASTM C 1166-06(2011), Standard Test Method for Flame Propagation of Dense and Cellular Elastomeric Gaskets and Accessories.
  - .8 ASTM D 395-14, Standard Test Methods for Rubber Property Compression Set.
  - .9 ASTM D 412-06a (2013), Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers Tension.
  - .10 ASTM D 523-14, Standard Test Method for Specular Gloss.
  - .11 ASTM D 624-00(2012), Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers
  - .12 ASTM D 822-13, Standard Practice for Filtered Open-Flame Carbon-Arc Exposures of Paint and Related Coatings.
  - .13 ASTM D 1149-07(2012), Standard Test Methods for Rubber Deterioration Cracking in an Ozone Controlled Environment.
  - .14 ASTM D 2240-05(2010), Standard Test Method for Rubber Property Durometer Hardness.
  - .15 ASTM D 2395-14, Standard Test Methods for Specific Gravity of Wood and Wood Based Materials.
  - .16 ASTM D 4442-15, Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood Based Materials.
  - .17 ASTM E 84-15a, Standard Test Method for Surface Burning Characteristics of Building Materials.
- .3 Canadian General Standards Board (CGSB)
  - .1 CGSB 19-GP-14M-76(R1984), Sealing Compound, One Component, Butyl-Polyisobutylene Polymer Base, Solvent Curing.
- .4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).

- .5 Underwriter Laboratories of Canada (ULC):
  - .1 CAN/ULC-S102-10, Surface Burning Characteristics of Building Materials and Assemblies
  - .2 ULC-S114-05, Standard Method of Test for Determination of Non-combustibility in Building Materials
  - .3 CAN/ULC-S134-92, Fire Test for Exterior Wall Assemblies
  - .4 ULC-S135-04, Standard Test Method for the Determination of Combustibility Parameters of Building Materials Using an Oxygen Consumption Calorimeter (Cone Calorimeter), Includes Amendment 1.

## 1.2 DESIGN REQUIREMENTS

- .1 Design composite , and aluminum cladding panels to allow for thermal movement of component materials caused by variation in ambient temperature range of 80 degrees C without causing buckling, failure of joint seals, undue stress on fasteners or other detrimental effects.
- .2 Maximum deviation from vertical and horizontal alignment of erected panels: 1 to 1000.

## 1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's printed product literature for cladding system materials, specifications, and datasheet and include product characteristics, performance criteria, physical size, finish, and limitations.
  - .2 Submit two copies WHMIS MSDS - Material Safety Data Sheets in accordance with Section 01 35 29 – Health and Safety Requirements and Manufacturer's Instructions.
- .3 Shop Drawings:
  - .1 Indicate dimensions and thickness of panels, fastening and anchoring methods, detail, and location of joints and gaskets, thermal movement provision, wall openings, head, jamb, and sill details, materials and finish, compliance with design criteria and requirements of related work. Provide engineering stamped drawings for the design of anchoring structure and installation.
- .4 Samples:
  - .1 Submit duplicate 100 x 100 mm samples of wall and soffit system, representative of materials, finishes, and colours.
- .5 Quality assurance submittals: submit following in accordance with Section 01 45 00 - Quality Control.
  - .1 Certificates: submit certificates signed by manufacturer certifying that composite wall panels comply with specified performance characteristics and physical properties.
  - .2 Manufacturer's Instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence and cleaning procedures.
  - .3 Manufacturer's Field Reports: submit to manufacturer's written reports within 3 days of review, verifying compliance of Work, as described in PART 3 - FIELD QUALITY CONTROL.

## 1.4 QUALITY ASSURANCE

- .1 Manufacturer: company specializing in producing composite wall panels with 5 years documented experience with sufficient capacity to produce and deliver required units without causing delay in work.
- .2 Installer: person specializing in composite wall panel installations with 5 years documented experience approved by manufacturer.
- .3 Mock-ups: construct mock-ups in accordance with Section 01 45 00 - Quality Control and to requirements supplemented as follows:
  - .1 Provide mock-up for evaluation of surface finishes and workmanship.
  - .2 Provide initial production units for job-site assembly with other materials for review.
  - .3 Coordinate type and location of mock-ups with project requirements.
  - .4 Accepted units will be used as standard for acceptance of production units.
  - .5 Remove and replace units which are not accepted.
  - .6 Do not proceed with remaining work until workmanship, colour, and finish are reviewed by Consultant.
  - .7 Refinish mock-up area as required to produce acceptable work.
  - .8 When accepted, mock-up will demonstrate minimum standard of quality required for this work.
- .4 Approved mock-up may remain as part of finished work to Consultant approval. Pre-Installation Meetings: convene pre-installation meeting one week prior to beginning work of this Section and on-site installation], with contractor's representative and with other trades affected by the work in accordance with Section 01 32 16 - Construction Progress Schedule - Bar (GANTT) Chart to:
  - .1 Verify project requirements.
  - .2 Review installation and substrate conditions.
  - .3 Coordination with other building subtrades.
  - .4 Review [manufacturer's] installation instructions and warranty requirements.
- .5 Site Meetings: as part of Manufacturer's Services described in PART 3 - FIELD QUALITY CONTROL, schedule site visits, to review Work, at stages listed.
  - .1 After delivery and storage of products, and when preparatory Work is complete, but before installation begins.
  - .2 Twice during progress of Work at 25% and 60% complete.
  - .3 Upon completion of Work, after cleaning is carried out.

## 1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 – Common Product Requirements.
- .2 Deliver, store and protect material in accordance with panel manufacturer's recommendations.
- .3 Deliver Materials to site in Manufacturer's original, unopened packaging, with labels clearly identifying product name and manufacturer.
- .4 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 composite panel materials from nicks, scratches, and blemishes.
- .3 Replace defective or damaged materials with new.
- .5 Handling: Open crate within 72 hours of material delivery. Remove extra top panel and inspect contents by lifting each panel vertically to prevent chafing of the decorative face. Protect materials during handling to prevent damage.
- .6 Do not expose panels with strippable film to direct sunlight or extreme heat. Protective strippable peel-off film must be removed immediately after panel is installed.

## **1.6 PROJECT CONDITIONS**

- .1 Do not install composite wall materials under environmental conditions where it is likely to be immersed in water or where the temperature is likely to exceed 50 degrees C for extended periods of time.

## **1.7 WARRANTY**

- .1 Manufacturer's Warranty: Furnish panel manufacturer's standard limited warranty document executed by an authorized company official. Manufacturer's warranty is in addition to and not a limitation of other rights Owner may have under the Contract Documents.
- .2 Panel Lamination Warranty: Provide manufacturer's extended ten (10) year warranty commencing on Date of Substantial Completion to maintain the mechanical qualities, water tightness and frost resistance, providing the panels are correctly installed on a ventilated construction according to the installation procedures of the manufacturer.
- .3 Finish Warranty: Thirty (30) years.
- .4 Manufacturer's Warranty: Submit, for Owner's acceptance, manufacturer's standard warranty document executed by authorized company official. Manufacturer's warranty is in addition to, and not a limitation of, other rights Owners may have under Contract Documents.

## **1.8 PERFORMANCE REQUIREMENTS**

- .1 Provide 25 mm / 1" minimum air space at top and bottom of building, or each wall termination, to facilitate airflow from behind the panels. Do not block vertical airflow at windows, doors, eaves, or at the base of the building. Provide continuous airflow from bottom to top to permit air movement behind each panel. Air flow behind the panels is critical to the performance of the Rear Ventilated Rain Screen design.
- .2 Perforated aluminum bird screen to allow minimum 50% free airflow.
- .3 Provide fasteners that will accommodate thermal expansion/ contraction without excessive stress to the panel. Provide each panel with central lock points to support gravity loads.
- .4 Design and install cladding system to allow for thermal movement of local climate with at least 60 degrees C ambient or panel temperature fluctuations, without causing undue stress on fasteners or panel or other detrimental effects.

- .5 Design to accommodate, by means of control joints, movement in wall system and between wall system and building structure, caused by structural movements, without permanent distortion, damage to in fills or racking of joints.
- .6 Design members and suspension system to withstand gravity load, live loads, including negative loads, as calculated in accordance with the Ontario building code.
- .7 Provide structural panel supports to provide minimum L/300 deflection stiffness as required by panel manufacturer. Panels themselves shall not reflect more than L/180 maximum at serviceability limit states.

## **PART 2 - PRODUCTS**

### **2.1 COMPOSITE ALUMINUM PANELS**

- .1 Acceptable Product: Citadel Architectural Products or approved equal.
- .2 Thickness: 0.236".
- .3 Product Performance:
  - .1 Bond Integrity: When tested for bond integrity, in accordance with ASTM D1781 (simulating resistance to panel delamination), there shall be no adhesive failure of the bond a) between the core and the skin nor b) cohesive failure of the core itself below the following values:
    - .1 Peel Strength:
      - .1 115 N mm/mm (22.5 in lb/in) as manufactured.
      - .2 115 N mm/mm (22.5 in lb/in) after 21 days soaking in water at 70°F.
  - .2 Fire Performance:
    - .1 ASTM E 84 Flame Spread Index must be less than 25, Smoke Developed Index must be less than 450.
    - .2 ASTM D 1929 A self ignition temperature of 650°F or greater.
    - .3 ASTM D-635 Requires a CC1 classification.
- .4 Finishes:
  - .1 Coil coated KYNAR® 500 or HYLAR® 5000 based Polyvinylidene Fluoride (PVDF) or Fluoro Ethylene – Alkyl Vinyl Ether (FEVE) resin in conformance with the following general requirements of AAMA 2605.
    - .1 Colour:
      - .1 Colour as selected by the Consultant from manufacturer's full colour palette in Standard Metallic, Standard Kynar, and Premium Kynar. Allow for up to five (5) colours.
      - .2 Custom colour to match Pantone RGB colour R 225, G 100, B 30.
        - .1 Provide sample for approval by Consultant.
    - .2 Coating Thickness:
      - .1 Colours: 1.0 mil (±0.2 mil).
    - .3 Hardness: ASTM D-3363; HB minimum using Eagle Turquoise Pencil.
    - .4 Impact:
      - .1 Test method: ASTM D-2794; Gardner Variable Impact Tester with 5/8" mandrel.
      - .2 Coating shall withstand reverse impact of 1.5"/pounds per mil substrate thickness.
      - .3 Coating shall adhere tightly to metal when subjected to #600 Scotch Tape pick-off test. Slight minute cracking permissible. No removal of film to substrate.

- .5 Adhesion:
  - .1 Test Method: ASTM D-3359.
  - .2 Coating shall not pick off when subjected to an 11" x 11" x 1/16" grid and taped with #600 Scotch Tape.
- .6 Humidity Resistance:
  - .1 Test Method: ASTM D-2247.
  - .2 No formation of blisters when subject to condensing water fog at 100% relative humidity and 100°F for 4000 hours.
- .7 Salt Spray Resistance:
  - .1 Test Method: ASTM B-117: Expose coating system to 4000 hours, using 5% NaCl solution.
  - .2 Corrosion creepage from scribe line: 1/16" max.
  - .3 Minimum blister rating of 8 within the test specimen field.
- .8 Weather Exposure:
  - .1 Outdoor:
    - .1 Ten-year exposure at 45° angle facing south Florida exposure.
    - .2 Maximum colour change of 5 Delta E units as calculated in accordance with ASTM D-2244.
    - .3 Maximum chalk rating of 8 in accordance with ASTM D-4214.
    - .4 No checking, crazing, adhesion loss.
- .9 Chemical Resistance:
  - .1 ASTM D-1308 utilizing 10% Muriatic Acid for an exposure time of 15 minutes. No loss of film adhesion or visual change when viewed by the unaided eye.
  - .2 ASTM D-1308 utilizing 20% Sulfuric Acid for an exposure time of 18 hours. No loss of film adhesion or visual change when viewed by the unaided eye.
  - .3 AAMA 2605 utilizing 70% reagent grade Nitric Acid vapor for an exposure time of 30 minutes. Maximum colour change of 5 Delta E units as calculated in accordance with ASTM D-2244.

## 2.2 PANEL FABRICATION

- .1 Composition: Two sheets of aluminum sandwiching a solid core of extruded thermoplastic material formed in a continuous process with no glues or adhesives between dissimilar materials. The core material shall be free of voids and/or air spaces and not contain foamed insulation material. Products laminated sheet by sheet in a batch process using glues or adhesives between materials shall not be acceptable.
- .2 Aluminum Face Sheets:
  - .1 Thickness: 0.0197" (nominal).
- .3 Panel Weight:
  - .1 0.236": 1.59 lbs./ft².
- .4 Tolerances:
  - .1 Panel Bow: Maximum 0.8% of any 72" panel dimension.
  - .2 Panel Dimensions: Field fabrication shall be allowed where necessary, but shall be kept to an absolute minimum. All fabrication shall be done under controlled shop conditions when possible.
  - .3 Panel lines, breaks, and angles shall be sharp, true, and surfaces free from warp and buckle.

## 2.3 COMPOSITE WOOD VENEER PANELS

- .1 Acceptable Manufacturer:
  - .1 'Prodema' as distributed by Sound Solution, Inc., Deerhurst, ON, phone: 800-667-2776, or 416-740-0303, email [mail@soundsolutions.ca](mailto:mail@soundsolutions.ca), web site [www.soundsolutions.ca](http://www.soundsolutions.ca). Equivalent systems, single sourced from the following manufacturers are also acceptable for use:
    - .1 'Parklex Façade' as manufactured by Composites Gurea, S.A. and distributed by SRP Building Products Inc. phone 705-495-0927, web site [www.srpinc.ca](http://www.srpinc.ca). or approved alternate.
- .2 Composite Wood Veneer Exterior Wall Panels:
- .3 Panels: laminated wood panel, single-face surfacing, outer ply Ayous or Boak wood coated with phenolic resins, inner core paper fibers treated with thermo-hardened resins.
  - .1 Exposed Finish: Not more than one (1) colour as later selected by Consultant from panel manufacturer's complete range.
  - .2 Total panel thickness: 8 mm / 5/16" thick.
  - .3 Panel size: As indicated on the drawings.
  - .4 Fire Rating: Class A in accordance with:
    - .1 Meet requirements of ULC S-134-92.
    - .2 ULC S102 – FSC1 of 14 and Smoke development of 24.
  - .5 Flame Spread Rating: ASTM E-84 criteria for flame spread 0 and smoke development 125.
- .4 Panel Fixation System:
  - .1 Factory mounted, fully adhered to panel, die cast aluminum extruded HF (Hidden Fastener) top and bottom clips by Engineered Assemblies.
  - .2 Die cast aluminum extruded HF horizontal receiver rail locations as determined and approved by structural engineer, to align with factory mounted die cast aluminum extruded HF top and bottom clips.
  - .3 Receiver rail to start and terminate 10 mm / 3/8" from all vertical panel reveals to conceal rails from view.

## 2.4 FRAMING SYSTEM

- .1 Sub-girt System: structural quality steel with Z275 zinc coating to ASTM A653/A653M, capable of accepting exterior sheet, with structural attachment to building frame, minimum base metal thickness and spacing as required for a complete system to withstand required wind loading/uplift.
  - .1 Attachment System: Mechanical Concealed Fasteners with colour matched caps to an Aluminum Subframe by Prodema. Continuous Horizontal Z-girts: width as indicated on drawings, minimum 1.2 mm / 18 gauge thick, galvanized zinc-coated steel to ASTM A653 with Grade A coating Z275.
  - .2 Continuous Vertical Hat Bar: 80 mm / 3 1/4" wide x 22 mm deep, minimum 1.2 mm / 18 gauge thick, galvanized zinc-coated steel to ASTM A653 with Grade A coating Z275, painted black. Perforated at horizontal applications.
  - .3 Locations and spacing for framing system members as determined by shop drawing structural engineer, to align with modular panel fasteners spaced based on manufacturer's panel load data.
  - .4 Cavity behind panel: Minimum 25 mm / 1" of unrestricted space.
  - .5 Gap between panels: Minimum of 8 mm / 5/16" to allow for expansion and contraction.

- .6 Plans, elevations, details, characteristics, and other requirements indicated are based upon standards by one manufacturer. It is intended that other manufacturers, receiving prior approval, may be acceptable, provided their details and characteristics comply with size and profile requirements, and material/performance standards.
  - .7 System must not generally have any visible fasteners, telegraphing or fastening on the panel faces or any other compromise of a neat and flat appearance.
  - .8 System shall comply with the applicable provisions of the "Metal Curtain Wall, Window, Storefront, and Entrance Guide Specifications Manual" by AAMA and ANSI/AAMA 302.9 requirements for aluminum windows.
  - .9 Fabricate panel system to dimension, size, and profile indicated on the drawings based on a design temperature of 70°F.
  - .10 Fabricate panel system so that no restraints can be placed on the panel, which might result in compressive skin stresses. The installation detailing shall be such that the panels remain flat regardless of temperature change and at all times remain air and water tight.
  - .11 The finish side of the panel shall have a removable plastic film applied prior to fabrication, which shall remain on the panel during fabrication, shipping, and erection to protect the surface from damage.
- .2 System Type:
- .1 Rear Ventilated Rain Screen:
    - .1 System must provide a reveal joint as detailed on drawings. Provide moisture barrier and sheathing as shown on drawings.
- .3 System Performance:
- .1 Wind Load:
    - .1 If system tests are not available, mock-ups shall be constructed and tests performed under the direction of an independent third party laboratory, which show compliance to the following minimum standards:
      - .1 Panels shall be designed to withstand the Design Wind Load based upon the local building code, but in no case less than 20 pounds per square foot (psf) and 30 psf on parapet and corner panels. Wind load testing shall be conducted in accordance with ASTM E330 to obtain the following results.
      - .2 Normal to the plane of the wall between supports, deflection of the secured perimeter-framing members shall not exceed  $L/175$  or  $3/4"$ , whichever is less.
      - .3 Normal to the plane of the wall, the maximum panel deflection shall not exceed  $L/60$  of the full span.
      - .4 Maximum anchor deflection shall not exceed  $1/16"$ .
      - .5 At 1-1/2 times design pressure, permanent deflections of framing members shall not exceed  $L/100$  of span length and components shall not experience failure or gross permanent distortion. At connection points of framing members to anchors, permanent set shall not exceed  $1/16"$ .
    - .2
    - .3 Air/Water System Test
      - .1 If system tests are not available, mock-ups shall be constructed and tests performed under the direction of an independent third party laboratory, which show compliance to the following minimum standards:
        - .1 Air Infiltration - When tested in accordance with ASTM E283, air infiltration at 1.57 psf must not exceed 0.06 cfm/ft<sup>2</sup> of wall area.

- .2 Water Infiltration - Water infiltration is defined as uncontrolled water leakage through the exterior face of the assembly. Systems not using a construction sealant at the panel joints (i.e. Rout and Return Dry and Rear Ventilated Systems) shall be designed to drain any water leakage occurring at the joints. No water infiltration shall occur in any system under a differential static pressure of 6.24 psf after 15 minutes of exposure in accordance with ASTM E331.
- .3 Pressure Equalized Rain Screen Systems shall comply with AAMA 508-05 Voluntary Test Method and Specification for Pressure Equalized Rain Screen Wall Cladding Systems.

## **2.5 ACCESSORIES**

- .1 Concealed fasteners and moldings as required for panel system's design by panel system manufacturer stainless steel.
- .2 Bird and Vent Screen:
  - .1 Continuous vent screen, with minimum 50% free air flow, from perforated 0.012" thick aluminum, painted black located at top and bottom of panel system, where opening is minimum 1" wide.
    - .1 Finish: colour and finish to match composite wall panel.
- .3 Flashings: refer to Section 0 762 00 Sheet Metal Flashing and Trim.
- .4 Insulation: Refer to Section 07 21 13 Board Insulation 07 21 29 Sprayed Insulation - Polyurethane Foam
- .5 Air/Vapour Barrier Transition Membranes: Refer to Section 07 27 00 Air-Vapour Barriers.
- .6 Gypsum Sheathing: Refer to Section 09 21 16 Gypsum Board Assemblies.
- .7 Adhesive: in accordance with manufacturers written recommendations.
- .8 Thermal Tape: low to medium pressure gasket from neoprene rubber and cork blend with a high-strength acrylic adhesive on one side, protected by siliconized liner, with anti-skid properties, 38 mm / 1 1/2" wide x length to suit.
- .9 Scupper: same material as composite panels. [Size and profile as indicated on drawings].
- .10 Exposed sealants: as recommended by manufacturer in accordance with Section 07 92 00 – Joint Sealants, colour to match panel.

## **PART 3 - EXECUTION**

### **3.1 MANUFACTURER'S INSTRUCTIONS**

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.

### 3.2 EXAMINATION

- .1 Prior to installation:
  - .1 Examine alignment of substrate.
  - .2 Verify dimensions by field measurements before fabrication and indicate measurements on Shop Drawings where materials outlined in this Section are indicated to fit walls and other construction.
  - .3 Establish dimensions and proceed with materials outlined in this Section where field measurements cannot be made without delaying the work; allow for site trimming and fitting.
  - .4 Notify Consultant in writing if substrate does not comply with requirements of panel installer.
  - .5 Do not start work until deficiencies have been corrected.
    - .1 Beginning of Work implies acceptance of conditions.

### 3.3 PREPARATION - GENERAL PREPARATION

- .1 Prepare substrate surfaces using the methods recommended by the manufacturer.
- .2 Field measure and verify dimensions as required.
- .3 Protect adjacent areas or surfaces from damage as a result of the Work of this Section.
- .4 Air Barrier Membrane System for Open Joint Cladding: Install air barrier membrane system for open joint cladding system where indicated complete with all purpose made accessories such as, but not limited to sheathing tape, washers, fasteners, flashings and 'rain screen' design components, as required for a complete installation system in accordance with manufacturer's written instructions.
- .5 Metal furring and Metal Furring and Sub-girt System: Erect metal furring and sub-girt system plumb, aligned and securely attached building framing:
  - .1 Minimum thickness metal furring and sub-girt steel - 1.6 mm / .060" (16 ga.).
  - .2 Provide flat black finished sub-girt framing with matching fasteners in locations to receive open joint cladding systems.
- .6 Thermal Tape: install thermal tape between metal subgirt clips and metal framing members as required to prevent cold bridging from exterior to interior building surfaces.
- .7 Protect metal surfaces in contact with concrete, masonry mortar, plaster or other cementitious surfaces with isolation coating.
- .8 Do not use caulking, gaskets or sealants on panel face or edges.

### 3.4 INSTALLATION OF COMPOSITE ALUMINUM WALL PANELS

- .1 Install composite panels in accordance with manufacturer's written instructions and approved shop drawings.
- .2 Erect panels plumb, level, and true.
- .3 Attachment system shall allow for the free and noiseless vertical and horizontal thermal movement due to expansion and contraction for a material temperature range of -20°F to +180°F. Buckling of panels, opening of joints, undue stress on fasteners, failure of sealants or any other detrimental effects due to thermal movement will not be permitted. Fabrication, assembly, and erection procedure shall account for the ambient temperature at the time of the respective operation.

- .4 Anchor panels securely per engineering recommendations and in accordance with approved shop drawings to allow for necessary thermal movement and structural support.
- .5 Conform to panel fabricator's instructions for installation of concealed fasteners.
- .6 Do not install component parts that are observed to be defective, including warped, bowed, dented, abraided, and broken members.
- .7 Do not cut, trim, weld, or braze component parts during erection in a manner which would damage the finish, decrease strength, or result in visual imperfection or a failure in performance. Return component parts which require alteration to shop for refabrication, if possible, or for replacement with new parts.
- .8 Separate dissimilar metals and use gasketed fasteners where needed to eliminate the possibility of corrosive or electrolytic action between metals.

### 3.5 INSTALLATION OF COMPOSITE WOOD VENEER WALL PANELS

- .1 Install composite wood veneer framing system to 'rainscreen principals' [as detailed] in accordance with manufacturer's written instructions and shop drawings. Provide:
  - .1 25 mm / 1" minimum airspace [as indicated between substrate and the back surface of the composite wood veneer panels.
  - .2 9 mm / 3/8" minimum gap between panels and along perimeter edges.
  - .3 20 mm / 0.8" at base and top to all ventilated facades.
- .2 Centre vertical panel joints over black vertical girt framing members.
- .3 Prior to mounting, pre-drill [14 mm diameter holes for metal furring. Install composite wood veneer panels with purposed made screws as supplied by panel manufacturer.
  - .1 Place holes in consistent pattern to Consultant approval within 15 mm / 0.6" to 38 mm / 1.5" from the panel edge.
  - .2 Do not over tighten fasteners to prevent thermal expansion and damage to outer coating.
- .4 Holes to be filled with manufacturer supplied silicone sealant and colour matched cap.
- .5 Maximum distances between fasteners to suit panel thickness as follows:

Panel Thickness	Distance Between Fasteners
8 mm / 5/16"	600 mm / 24"
10 mm / 3/8"	600 mm / 24"
12 mm / 7/16"	800 mm / 32"
14 mm / 9/16"	1000 mm / 40"
16 mm / 5/8"	1000 mm / 40"
18 mm / 11/16"	1000 mm / 40"
20 mm / 13/16"	1000 mm / 40"
22 mm / 7/8"	1000 mm / 40"

- .6 Erect composite wood panels in straight lines, true, level and plumb. Maintain dimensions required by manufacturer for minimum distances from edge for holes and penetrations with minimum unobstructed vertical airspace to ensure proper air circulation.

- .7 Space at top and bottom of each wall minimum 25 mm / 1", as per manufacturer's details.
- .8 Install continuous bird/insect and vent screen located at top and bottom of panel system and in any open openings/spaces exceeding 2mm in panel system.
- .9 Obtain manufacturer's written instructions should cutting of composite wood veneer panels be required.
- .10 Remove strippable coating from panels as they are erected.

### **3.6 FIELD QUALITY CONTROL**

- .1 Manufacturer's Field Services:
  - .1 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.

### **3.7 CLEANING**

- .1 Proceed in accordance with Section 01 74 11 – Cleaning.
- .2 Progress Cleaning: Leave work area clean at the end of each work day, ensuring safe movement of passing pedestrians.
- .3 Restore panels and accessory components damaged during installation and construction so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by the Consultant, remove and replace damaged panels with new at no additional cost to the Owner.
- .4 Ensure weep holes and drainage channels are unobstructed and free of dirt and sealants.
- .5 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.
- .6 Leave work areas clean, free from grease, finger marks and stains.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 REFERENCES**

- .1 American Society of Mechanical Engineers (ASME).
  - .1 ANSI/ASME B18.6.3-2013, Machine Screws, Tapping Screws, and Metallic Drive Screws.
- .2 American Society for Testing and Materials International, (ASTM).
  - .1 ASTM D2369-10e1, Standard Test Method for Volatile Content of Coatings.
  - .2 ASTM D 2832-92(2011), Guide for Determining Volatile and Nonvolatile Content of Paint and Related Coatings.
  - .3 ASTM D 5116-10, Guide For Small-Scale Environmental Chamber Determinations of Organic Emissions From Indoor Materials/Products.
- .3 Canadian General Standards Board (CGSB).
  - .1 CAN/CGSB-51.32-M77, Sheathing, Membrane, Breather Type.
  - .2 CAN/CGSB-93.2-M91, Prefinished Aluminum Siding, Soffits and Fascia, for Residential Use.
  - .3 CAN/CGSB-93.3-M91, Prefinished Galvanized and Aluminum-Zinc Alloy Steel Sheet for Residential Use.
  - .4 CAN/CGSB-93.4-92, Galvanized and Aluminum-Zinc Alloy Coated Steel Siding Soffits and Fascia, Prefinished, Residential.
  - .5 CGSB 93.5-92, Installation of Metal Residential Siding, Soffits and Fascia.
- .4 Canadian Standards Association (CSA International).
  - .1 CSA B111-1974(R2003), Wire Nails, Spikes and Staples.
- .5 Underwriters' Laboratories of Canada (ULC).
  - .1 CAN/ULC-S706-09, Wood Fibre Thermal Insulation for Buildings.

### **1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for metal siding and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2 Submit 2 copies of WHMIS MSDS in accordance with Section 01 35 29 – Health and Safety Requirements.
- .3 Shop Drawings:
  - .1 Indicate dimensions, profiles, attachment methods, schedule of wall elevations, trim and closure pieces, soffits, fascia, metal furring, and related work.
  - .2 Include anchorage details for each metal cladding wall, framing system, framing member sizes, spacing, material thickness exclusive of coatings and wind loading / uplift.
- .4 Samples:
  - .1 Submit duplicate 300 x 300 mm / 12" x 12" samples of siding material, of colour and profile specified.

### 1.3 QUALITY ASSURANCE

- .1 Test Reports: submit certified test reports showing compliance with specified performance characteristics and physical properties.
- .2 Certificates: submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.
- .3 Pre-Installation Meetings: conduct pre-installation meeting to verify project requirements, manufacturer's installation instructions and manufacturer's warranty requirements.
- .4 Mock-ups:
  - .1 Construct mock-up in accordance with Section 01 45 00 – Quality Control for each cladding profile.
  - .2 Construct mock-up 100 sq. ft. minimum size showing typical lap joint, one inside corner and one outside corner. Accepted mock-up may form part of complete work.
  - .3 Allow 48 hours for inspection of mock-up by Consultant before proceeding with siding and roofing work.

### 1.4 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 – Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: 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 metal siding from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.

### 1.5 WARRANTY

- .1 Provide a five (5) year manufacturer's warranty complete with lawsuit liability insurance against snow and ice retention system failure, commencing from the date of Substantial Performance. Warranty to include:
  - .1 Design, defects in materials and workmanship.
  - .2 At no cost to Owner, full replacement including substrate, damaged system resulting from failure of snow and ice retention system, stops, trims, paint, caulking, sealants, and other snow and ice retention system components.
- .2 Provide manufacturer's written warranty commencing from the date of Substantial Performance. Warranty to include:
  - .1 Failure of factory-applied exterior finish for 40 years warranty period as follows:
    - .1 Will not crack, chip, or peel (lose adhesion).
    - .2 Will not chalk in excess of a number six (6) rating, in accordance With ASTM D-4214-98 method D659 at any time.
    - .3 Will not change colour more than eight (8.0) Hunter  $\Delta E$  units as determined by ASTM method D-2244-02.
    - .4 Warranty excludes minute fracturing that may occur during the normal fabrication process.

## **PART 2 - PRODUCTS**

### **2.1 METAL WALLCLADDING COMPONENTS**

- .1 Horizontal Steel Sub-Girts:
  - .1 Minimum 1.21 mm / 18 ga. thick formed galvanized steel, ASTM A653M Grade 230 with Z275 zinc coating. Full depth of wall system, factory notched and formed to match liner.
- .2 Preformed Metal Wall Cladding: Prefinished, to CAN/CGSB 93.4, Type A vertical, Class Plain, as follows:
  - .1 Metal Cladding:
    - .1 Profile AD300 by Vicwest.
    - .2 Fabricated from Z275 galvanized sheet steel conforming to ASTM A653M grade 230 or AZ150 galvalume, sheet steel conforming to ASTM A792M grade 230, having a nominal core thickness of 22 gauge.
  - .2 Acceptable Finish: 'Weather X' by Vicwest.
  - .3 Colour:
    - .1 Not more than one (1) colours as later selected by Consultant from manufacturer's standard colour range.
- .3 Galvanized Metal Liner Panel:
  - .1 Acceptable Product: 'Channel Wall' by VicWest.

### **2.2 METAL FRAMING**

- .1 Continuous Vertical Z-girts: width as indicated on drawings, minimum 1.2 m / 18ga. thick, galvanized zinc-coated steel to ASTM A653 with Grade A coating Z275.
- .2 Continuous Vertical Hat Bar: 80 mm / 3 1/4" wide x 22 mm deep, minimum 1.2 mm / 18 gauge thick, galvanized zinc-coated steel to ASTM A653 with Grade A coating Z275, painted black. Perforated at horizontal applications.
- .3 Locations and spacing for framing system members as determined by shop drawing structural engineer, to align with modular panel fasteners spaced based on manufacturer's panel load data.
- .4 Provide thermal tape on building substrate side of z-girt.

### **2.3 ACCESSORIES**

- .1 Exposed trim: inside corners, outside corners, cap strip, drip cap, undersill trim, starter strip and window/door trim of same material, colour and gloss as cladding, with fastener holes pre-punched.
  - .1 In addition to manufacturer's standard, provide custom shapes to suit profiles as indicated.
- .2 Non-exposed accessories: galvanized sheet metal.
- .3 Thermal Tape: low to medium pressure gasket from neoprene rubber and cork blend with a high-strength acrylic adhesive on one side, protected by siliconized liner, with anti-skid properties, 38 mm / 1 1/2" x length to suit.

## **2.4 METAL FLASHINGS**

- .1 Metal Flashings: Refer to Section 07 62 00 – Sheet Metal Flashing and Trim.

## **2.5 INSULATION**

- .1 Insulation: Refer to Section 07 21 13 – Board Insulation, 07 21 29 Sprayed Insulation – Polyurethane Foam.

## **2.6 FASTENERS**

- .1 Screws: ANSI B18.6.4. Purpose made, self-drilling fasteners #12-14 c/w galvanized heads and neoprene washers, colour to match cladding.

## **2.7 CAULKING**

- .1 Sealants: Refer to Section 07 92 00 – Joint Sealants

## **2.8 AIR / VAPOUR BARRIER**

- .1 Refer to Section 07 27 00 Air Barriers.

## **PART 3 – EXECUTION**

### **3.1 MANUFACTURER'S INSTRUCTIONS**

- .1 Compliance: comply with manufacturer's written data, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.

### **3.2 EXAMINATION**

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable in accordance with manufacturer's written instructions.
  - .1 Visually inspect substrate in.
  - .2 Inform Consultant of unacceptable conditions immediately upon discovery.
- .2 Examine exterior cladding sheets to be installed. Cull out and remove from site all damaged or marred surfaces and sheets with exposed cut raw edges.
- .3 Proceed with installation only after unacceptable conditions have been remedied.

### **3.3 FLASHINGS**

- .1 Install continuous starter flashings, drips and other flashings as indicated.

### 3.4 SUB-GIRT FRAMING SYSTEM

- .1 Install metal sub-girt framing system level, plumb and tight to substrate over air/vapour barrier transition membrane as follows, using approved fasteners:
  - .1 Install cleats (clip angles) over substrate and air / vapour barrier transition membrane as indicated to accommodate adjustability of second layer of continuous metal angle.
  - .2 Mechanically fasten front section of continuous angle to clip angles to form an adjustable z-girt system. Install and adjust to ensure finished siding is plumb and level and fully supported.

### 3.5 INSTALLATION

- .1 Install cladding in accordance with CGSB 93.5, and manufacturer's written instructions
- .2 Install continuous starter strips, inside and outside corners, edgings, soffit, drip, cap, sill and window/door opening flashings as indicated.
- .3 Install outside corners, fillers and closure strips with carefully formed and profiled work.
- .4 Install exterior finish cladding to continuous subgirt with coloured fasteners to match exterior finish.
- .5 Provide both notched and formed top neoprene and prefinished metal closures, sealed to arrest direct weather penetration at vertical profiles for exterior cladding.
- .6 Install preformed metal cladding system using 'rain screen principals to drain out moisture penetration and to ensure continuity of "pressure equalization".
- .7 Provide U-bars, alignment bars, brackets, clips, inserts, shims as required to securely and permanently fasten exterior cladding to building structure.
- .8 Install soffit and fascia cladding as indicated.
- .9 Maintain joints in exterior cladding, true to line, tight fitting, hairline joints.
- .10 Attach components in manner not restricting thermal movement.
- .11 Caulk junctions with adjoining work with sealant. Do work in accordance with Section 07 92 00 – Joint Sealants.

### 3.6 CLEANING

- .1 Proceed in accordance with Section 01 74 11 – Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: Upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 – Cleaning.

### 3.7 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by preformed metal siding installation.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 REFERENCES**

- .1 American National Standards Institute (ANSI)
  - .1 ANSI A135.6-06, Hardwood Wood Siding and Trim.
- .2 ASTM International
  - .1 ASTM C1185-08(2012), Standard Test Methods for Sampling and Testing Non-Asbestos Fibre-Cement Flat Sheet, Roofing and Siding Shingles, and Clapboards.
  - .2 ASTM C1186-08(2012), Standard Specification for Flat Fibre-Cement Sheets.
  - .3 ASTM D3359-09e2, Standard Test Methods for Measuring Adhesion by Tape Test.
  - .4 ASTM E72-15, Standard Test Methods of Conducting Strength Tests of Panels for Building Construction.
  - .5 ASTM E84-15a, Standard Test Method for Surface Burning Characteristics of Building Materials
  - .6 ASTM E136-12, Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750 deg. C.
- .3 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-51.32-M77, Sheathing, Membrane, Breather Type.
- .4 CSA International
  - .1 CSA B111-1974(R2003), Wire Nails, Spikes and Staples.
  - .2 CSA O121-08(R2013), Douglas Fir Plywood.
  - .3 CSA O151-09 (R2014), Canadian Softwood Plywood.
  - .4 CAN/CSA-Z809-08, Sustainable Forest Management.
- .5 National Lumber Grading Authority (NLGA)
  - .1 NLGA Standard Grading Rules for Canadian Lumber 2010.

### **1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for extruded concrete cladding and include product characteristics, performance criteria, physical size, finish and limitations, preparation instructions, storage and handling requirements and installation methods.
  - .2 Submit electronic copy of WHMIS MSDS in accordance with Section 01 35 29 - Health and Safety Requirements.
- .3 Shop Drawings:
  - .1 Provide detailed drawings of atypical non-standard applications of cementitious siding materials which are outside the scope of the standard details and specifications provided by the manufacturer.
  - .2 Indicate dimensions, profiles, attachment methods, schedule of wall elevations, trim and closure pieces, metal furring, and related work.
- .4 Samples:
  - .1 Submit duplicate 12" x 12" size for each profile specified.

### 1.3 QUALITY ASSURANCE

- .1 Test Reports: submit certified test reports showing compliance with specified performance characteristics and physical properties.
- .2 Certificates: submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.
- .3 Installer Qualifications: Minimum of five (5) years' experience with installation of similar products.
- .4 Pre-Installation Meetings: conduct pre-installation meeting to verify project requirements, manufacturer's installation instructions, and manufacturer's warranty requirements.
- .5 Mock-Up:
  - .1 Construct mock-up in accordance with Section 01 45 00 - Quality Control.
  - .2 Locate where directed by Consultant.
  - .3 Construct mock-up 100 ft<sup>2</sup> minimum size showing typical lap joint, one inside corner and one outside corner.
  - .4 Allow 48 hours for inspection of mock-up by Consultant before proceeding with siding work.
  - .5 Accepted mock-up may form part of complete work to Consultant approval.

### 1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store, and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: 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 extruded concrete cladding from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.
- .4 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.

### 1.5 WARRANTY

- .1 Provide non-pro-rated product warranty for 30 years for extruded concrete cladding material and trim.
- .2 Finish:
  - .1 Provide product warranty against manufacturing finish defects for a period of 15 years from the date of substantial performance.
  - .2 Warranty to include:
    - .1 Cladding will not peel, crack or chip.
    - .2 Labour and material.
- .3 Workmanship Warranty: warranty labour and material application for two (2) years.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURER**

- .1 Acceptable Manufacturers:
  - .1 'fibreC' by Rieder Smart Elements GmbH as distributed by Sound Solutions.  
Tel: 1-800-667-2776  
www.soundsolutions.ca  
Contact: Jadranka Maradin

### **2.2 MATERIALS**

- .1 'fibreC' extruded, fibre reinforced concrete panel
  - .1 Panels: Glass fibre concrete panels made from pure mineral raw materials, (sand, cement, aggregate, water). Reinforced through AR( alkali-resistant) glass fibre matt and short fibres in matrix. Concrete matrix to be extruded.
  - .2 Colour: Off-White.
- .2 Surface types
  - .1 Unless otherwise noted, surface will be 'MA' Matt/brushes/smooth surface.
- .3 Panel Size: as indicated.
  - .1 L-formpart profile: where indicated.
- .4 Mounting: Concealed Fasteners to a Galvanized Steel Subframe. Continuous perforated hate bar in horizontal applications.
- .5 Pattern: as indicated.
- .6 Air Barrier Membrane System for Open Joint Cladding: Purpose made black, UV stable, water resistive, vapor permeable air barrier membrane system for use with open joint cladding systems.
  - .1 Accessories: purpose made sheathing tape, washers, fasteners, flashings and 'rain screen' design components from same manufacturer as air barrier, as required for a complete installation system.
  - .2 Colour: black.
  - .3 Acceptable product: 'Reveal Shield' as manufactured by Vapro Shield Canada.
- .7 Prefinished metal Flashings: refer to Section 07 62 00 Sheet Metal Flashing and Trim.
- .8 Accessories:
  - .1 Thermal break membrane: EPDM Rubber, UV resistant, width to suit width of applicable sub-girt system where being applied, colour flat black.
- .9 Fasteners: to CSA B111, stainless steel, type and size as required and as recommended by manufacturer for intended use.
- .10 Sealants: Refer to Section 07 92 00 – Joint Sealing.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable in accordance with manufacturer's written instructions.
  - .1 Visually inspect substrate in presence of Consultant.
  - .2 Inform Consultant of unacceptable conditions immediately upon discovery.
  - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Consultant.

### **3.2 MANUFACTURER'S INSTRUCTIONS**

- .1 Compliance: comply with manufacturer's written data, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.

### **3.3 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.

### **3.4 INSTALLATION**

- .1 Protect all sub-surfaces with specified air barrier prior to mounting the rainscreen subframe.
- .2 A ventilated minimum airspace of 3/4" is required between the structural wall and the back surface of the panels. A minimum gap of 3/8" between panels is also required along all perimeter edges.

### **3.5 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 – Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 – Cleaning.

### **3.6 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by fibre cement siding installation.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 REFERENCES**

- .1 ASTM International Inc.:
  - .1 ASTM A 312/A312M-15, Standard Specification for Asphalt Used in Roofing.
  - .2 ASTM C 726-12, Standard Specification for Mineral Fibre Roof Insulation Board.
  - .3 ASTM C 728-05, Standard Specification for Perlite Thermal Insulation Board.
  - .4 ASTM C 931/931M-01: Standard Specification for Exterior Gypsum Soffit Board.
  - .5 ASTM C1177/C1177M-17, Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing.
  - .6 ASTM C 1186-12, Standard Specification for Flat Fibre-Cement Sheets.
  - .7 ASTM C 1396/C1396M-17, Standard Specification for Gypsum Board.
  - .8 ASTM D 41/D41M-11, Standard Specification for Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing.
  - .9 ASTM D 226-06, Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing
  - .10 ASTM D 448-12, Standard Classification for Sizes of Aggregate for Road and Bridge Construction.
  - .11 ASTM D 450-07, Standard Specification for Coal-Tar Pitch Used in Roofing, Dampproofing, and Waterproofing.
  - .12 ASTM D 1863-05, Standard Specification for Mineral Aggregate Used on Built-Up Roofs.
  - .13 ASTM D 1970 / D1970M-17a, Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dame Protection
  - .14 ASTM D 2178/D2178M-15, Standard Specification for Asphalt Glass Felt Used in Roofing and Waterproofing.
  - .15 ASTM D 3273 Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber
  - .16 ASTM D 4601-98, Standard Specification for Asphalt-Coated Glass Fiber Base Sheet Used in Roofing.
  - .17 ASTM D 6380-03, Standard Specification for Asphalt Roll Roofing (Organic Felt).
  - .18 ASTM E 84-15a, Standard Test Method for Surface Burning Characteristics of Building Materials.
- .2 Canadian General Standards Board (CGSB):
  - .1 CGSB 37-GP-9Ma, Primer, Asphalt, Unfilled, for Asphalt Roofing, Dampproofing and Waterproofing.
  - .2 CAN/CGSB-51.33-[M89], Vapour Barrier Sheet, Excluding Polyethylene, for Use in Building Construction.
- .3 Canadian Roofing Contractors Association (CRCA):
  - .1 CRCA Roofing Specifications Manual-1997.
- .4 Canadian Standards Association (CSA International):
  - .1 CAN/ULC S102-10, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
  - .2 CAN/ULC-S704-2001: Standard for Thermal Insulation, Polyurethane and Polyisocyanurate Boards, Faced.
  - .3 CAN/ULC-S706-02: Standard for Wood Fibre Thermal Insulation for Buildings.
  - .4 CGSB 37-GP-52M: Roofing and Waterproofing Membrane, Sheet Applied, Elastomeric.
  - .5 CSA A123.2-03, Asphalt-Coated Roofing Sheets.
  - .6 CSA-A123.3-[05](2010), Asphalt Saturated Organic Roofing Felt.

- .7 CAN/CSA A123.4-04 (R2008), Asphalt for Constructing Built-Up Roof Coverings and Waterproofing Systems.
- .8 CSA A123.3-05, Asphalt Saturated Organic Roofing Felt.
- .9 CSA A123.16-04, Asphalt-Coated Glass Base Sheet.
- .10 CSA A123.17-05, Asphalt Glass Felt Used for Roofing and Waterproofing.
- .11 CSA A123.21-10, Standard Test Method for the Dynamic Wind Uplift Resistance of Mechanically Attached Membrane-Roofing Systems
- .12 CSA A123.4-M1979: Bitumen for Use in Construction of Built-Up Roof Coverings and Dampproofing and Waterproofing Systems.
- .13 CSA A231.1-06/A231.2-06 (R2010), Precast Concrete Paving Slabs/Precast Concrete Pavers.
- .14 CSA O121-[08], Douglas Fir Plywood.
- .15 CSA O151-09, Canadian Softwood Plywood.
- .16 CAN/CSA-ISO 9001-00, Quality Management Systems - Requirements.
- .5 Factory Mutual (FM Global):
  - .1 FM Approvals - Roofing Products.
  - .2 FM APPROVALS 4470, Single-Ply, Polymer-Modified Bitumen Sheet, Built-Up Roof (BUR) and Liquid Applied Roof Assemblies for use in Class 1 and Non-combustible Roof Deck Construction.
- .6 Health Canada / Workplace Hazardous Materials Information System (WHMIS):
  - .1 Material Safety Data Sheets (MSDS).
- .7 National Fire Protection Association:
  - .1 NFPA (FIRE) 276, Standard Method of Fire Test for Determining the Heat Release Rate of Roofing Assemblies with Combustible Above-Deck Roofing Components, 2011 Edition.
- .8 National Research Council Canada (NRC) - Canadian Construction Materials Centre (CCMC)
  - .1 CCMC Registry of Product Evaluations.
- .9 Underwriters Laboratories' of Canada (ULC):
  - .1 CAN/ULC S102-10, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
  - .2 CAN/ULC S107-10, Methods of Fire Tests of Roof Coverings.
  - .3 CAN/ULC S114-05, Standard Method of Test for Determination of Non-Combustibility in Building Materials.
  - .4 CAN/ULC S701-11, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.
  - .5 CAN/ULC S702-09-AM1, Standard for Thermal Insulation Mineral Fibre for Buildings.
  - .6 CAN/ULC-S704-11, Standard for Thermal Insulation, Polyurethane and Polyisocyanurate, Boards, Faced.
  - .7 CAN/ULC-S706-09, Standard for Wood Fibre Thermal Insulation for Buildings.
  - .8 CAN/ULC S126-14, Standard Method of Test for Fire Spread under Roof-Deck Assemblies.

## 1.2 ADMINISTRATIVE REQUIREMENTS

- .1 Convene pre-installation meeting one week prior to beginning roofing Work, with the Authorized representatives of the Contractor, Construction Manager, Owner, Consultant, roofing Subcontractor, roofing manufacturer, and installers of roof accessories and roof-mounted equipment. Establish a report for this meeting.

- .2 The Manufacturer is to conduct pre-installation meeting in accordance with Section 01 32 16 - Construction Progress Schedules - Bar (GANTT) Chart to:
  - .1 Verify project requirements.
  - .2 Review installation and substrate conditions.
  - .3 Co-ordination with other building subtrades.
  - .4 Review structural loading conditions and limitations of roof deck both during and after roofing application.
  - .5 Review manufacturer's installation instructions and warranty requirements.
  - .6 Review construction schedule and confirm availability of Products, Subcontractor personnel, equipment and facilities.
  - .7 Review deck installation criteria and finishes for conformance with roofing system criteria, including issues of flatness and fastening.
  - .8 Review flashing details, special roofing details, roof drainage, roof penetrations, equipment curbs, and other conditions affecting roofing installation.
  - .9 Review governing regulatory requirements, and requirements for insurance and certificates as applicable.
  - .10 Review safety requirements, including temporary fall-arrest measures.
  - .11 Review field quality control procedures.

### **1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product Data:
  - .1 Provide electronic copies of most recent technical roofing components data sheets describing materials' physical properties and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2 Provide electronic copies of WHMIS MSDS in accordance with Section 01 35 29 – Health and Safety Requirements, 01 35 43- Environmental Procedures, and indicate VOC content for:
    - .1 Primers.
    - .2 Asphalt.
    - .3 Sealers.
    - .4 Filter fabric.
- .3 Provide shop drawings:
  - .1 Indicate flashing, control joints, tapered insulation details.
  - .2 Include plans, sections, details in accordance with performance requirements, and for attachment to other portions of the Work.
  - .3 Provide layout for tapered insulation. Indicate degree of slope and layout of sloping insulation on roof surfaces. Ensure positive drainage to roof drains.
- .4 Manufacturer's Certificate: certify that products meet or exceed specified requirements.
- .5 Test and Evaluation Reports: submit laboratory test reports certifying compliance of bitumen and roofing felts and membrane with specification requirements.
- .6 Manufacturer's Installation Instructions: indicate special precautions required for seaming the membrane.
- .7 Manufacturer's field report: in accordance with Section 01 45 00 – Quality Control.
- .8 Reports: indicate procedures followed and ambient temperatures and wind velocity during application.

## 1.4 QUALITY ASSURANCE

- .1 Installer qualifications: company or person specializing in application of modified bituminous roofing systems with 5 years documented experience approved by manufacturer.
- .2 Conform to CRCA Roofing Specifications and roofing membrane manufacturer's instructions.
- .3 Only qualified, certified installers employed by a company with the appropriate equipment may execute roofing work.
- .4 The manufacturer of elastomeric bitumen products will provide proof of ISO 9001 and ISO 14001 Certifications.
- .5 Manufacturer: qualified manufacturer having roofing systems listed by UL/ULC.
- .6 Mock-ups:
  - .1 Construct mock-up in accordance with Section 01 45 00 – Quality Control.
  - .2 Construct mock-up 10 m<sup>2</sup> minimum size showing typical lap joint, one inside corner] [and] [one outside corner]..
  - .3 Accepted mock-up may form part of complete work.
  - .4 Allow 48 hours for inspection of mock-up by Consultant before proceeding with roofing work.
- .7 Manufacturer's Field Services: as part of Manufacturer's Services described in PART 3 - FIELD QUALITY CONTROL, schedule site visits with manufacturer's representative, to review Work, at stages listed.
  - .1 After delivery and storage of products, and when preparatory Work and mock-up is complete, but before installation begins.
  - .2 As required by membrane manufacture to obtain roof warranty, but as a minimum twice during progress of Work at 25% and 60% complete.
  - .3 Upon completion of Work, after cleaning is carried out.
- .8 Third-Party Inspection: In addition to Manufacturer's Field Services, site inspections to ensure conformance with this Section to be conducted by a third-party inspection firm engaged and paid for by the Contractor.
  - .1 Third-party site inspections to be performed only by a firm registered and in good standing with the Roof Consultants Institute (RCI Inc.) and experienced in the inspection of similar roof systems.
  - .2 Third-party site inspections shall be conducted to verify and visually inspect the roof system installation. The third-party site inspections shall include review of operational details including set-up, safety requirements, work schedules, crew deployment and general housekeeping items. Third-party inspections of the roof system installation shall also include inspection of deck substrate prior to start of installation, membrane and flashing installation, insulation, and roofing installation
  - .3 Allow for a minimum of fifteen (15) site visits by the third-part inspection firm. Additional site visits may be required to suit the Contractor's planned sequence of Work and are to be accounted for in the Contract price.
  - .4 Provide copy of Third-Party Inspection report to the Consultant within 48 hours of inspection being carried out.

## 1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions and Section 01 61 00 - Common Product Requirements.

- .2 All materials must remain in their original packaging, displaying the manufacturer's name, product name, weight, and reference standards, as well as all other indications or references considered standard.
- .3 Storage and Handling Requirements:
  - .1 Safety: comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of asphalt, sealing compounds, primers and caulking materials.
  - .2 At all times, materials will be adequately protected and stored in a dry, off-ground, weatherproof and properly ventilated area, away from any welding flame or spark and sheltered from the elements or any harmful substance. Only materials destined for same-day use can be removed from this storage area. In cold weather, these materials should be stored in a heated area at a minimum temperature of 5°C and removed prior to application. If rolls cannot be stored in a heated environment, they may be pre-conditioned before installation. For precise description, consult material manufacturers specifications on membrane application procedures.
  - .3 Store adhesives and emulsion-based waterproofing mastics at a minimum 5°C. Store adhesives and solvent-based mastics at sufficiently high temperatures to ensure ease of application.
  - .4 Materials delivered in rolls will be carefully stored upright; flashing will be stored to avoid creasing, buckling, scratches or any other possible damage.
  - .5 Avoid material overloads which may affect the structural integrity of specific roof areas.
  - .6 Store rolls of felt and membrane in upright position. Store membrane rolls with salvage edge up.
  - .7 Remove only in quantities required for same day use.
  - .8 Place plywood runways over completed Work to enable movement of material and other traffic.
  - .9 Store materials unless otherwise indicated in accordance with manufacturer's written instructions.
  - .10 Store insulation protected from daylight and weather and deleterious materials.
  - .11 Collect and separate plastic, paper packaging and corrugated cardboard in accordance with Waste Management Plan.
  - .12 Fold up metal banding, flatten and place in designated area for recycling.

## 1.6 SITE CONDITIONS

- .1 Ambient Conditions
  - .1 Temperatures during application shall not be less than the minimum recommended by the material manufacturers. Work shall not be carried out during inclement weather conditions.
  - .2 Do not install roofing when temperature remains below -18°C for torch application, or -5°C to manufacturers' recommendations for mop application.
  - .3 Minimum temperature for solvent-based adhesive is -5°C.
  - .4 Or as specified by the manufacturer.
- .2 Install roofing on dry deck, free of snow and ice, use only dry materials and apply only during weather that will not introduce moisture into roofing system.
- .3 Before commencing work each day, ensure that all surfaces to receive material or underlayment are clean, smooth, solid and dry.
- .4 Use only dry materials and apply only during weather that will not introduce moisture into roofing system.

## **1.7 CONTRACTOR QUALIFICATIONS**

- .1 Roofing contractors and sub-contractors must, when tendering or performing work, possess a roofing contractor operating license.
- .2 If material manufactures warranty (Systems & Workmanship) is required, Roofing contractors and sub-contractors must be an approved applicator and registered with Material Manufacturer and provide the Owner with applicable documentation to this effect before beginning any roofing work.
- .3 Only qualified, certified installers employed by a company with the appropriate equipment may execute the roofing work.
- .4 Contractors tendering this project must be approved by the University of Guelph.

## **1.8 MANUFACTURER'S FIELD SERVICES**

- .1 The roofing product manufacturer must provide a designated technical representative to visit the work site at the start of roofing installation and during the progress of the installation on a daily basis. Arrange for initial job start-up site attendance, periodic site attendance of membrane manufacturer's technical representative during installation work, together with written report.
- .2 The Contractor must at all times enable and facilitate access to the work site by said representative.
- .3 Notify Consultant of date and time of inspection, a minimum of 24 hours prior to inspection. Provide one copy of manufacturer's report to the Consultant within 48 hours of inspection being carried out.

## **1.9 WARRANTY**

- .1 Installers Extended Warranty: Standard two (2) years following the date of Substantial Performance.
  - .1 Prior to the expiration of the 2 Year Contractor Warranty, the Manufacturer shall conduct an Infra-Red Analysis of the warranted roof at no additional cost to the University.
- .2 At no cost to Owner, Contractor shall remedy any defects in Work, including Work of this and other Sections, due to faults in materials or workmanship provided under this Section of Specifications appearing within a period of two (2) years from date of Substantial Performance. CRCA Standard Form of Guarantee is not acceptable.
- .3 Manufacturer's Extended Warranty: A written guarantee that the manufacturer will replace, at no cost to the Owner, any portion or all of the roofing system down to the existing roof deck including watertightness for a minimum period of twenty (20) years, commencing from the date of Substantial Performance of the Work. This warranty shall be non-prorated.

## **1.10 MAINTENANCE**

- .1 The Manufacturer shall issue a non-prorated warranty for a period of Twenty (20) Years. All components of the roof system (not including the deck) shall be covered under this warranty. Perimeter metal edge details shall also be included in this warranty.

- .2 Manufacturer to provide inspections and maintenance of the roofing system in years 2, 5, 10 and 15 of the warranty period.
  - .1 The following duties, at a minimum, shall be carried out at no extra cost to the Owner as required, by a qualified contractor retained by the Manufacturer:
    - .1 Sealing of flashing seams
    - .2 Filling of pitch pockets
    - .3 Repairs to blisters and ridges
    - .4 Caulking at metal details as required
    - .5 Written inspection report
    - .6 Removal of vegetation and debris from the roof and premises
    - .7 Cleaning of drain screens
  - .2 Documentation shall be provided that the manufacturer has personnel to carry out above noted warranty requirements and has a history of providing these services for a minimum of 5 years.
  - .3 Manufacturer shall update the University's Online Roof Management Program with all new information upon satisfactory completion of the roofing project at no charge to the University.
- .3 Roofing/Waterproofing contractor must include with his tender, proof from the manufacturer that they can supply specified manufacturers material and workmanship warranty. Failure to submit may result in tender disqualification.
- .4 Upon satisfactory completion, the warranty and all construction information regarding the roof installation shall be placed on an Online Roof Management Program at no additional cost to the Owner. This Online Roof Management Program shall have the following features;
  - .1 Store roof plans, roof dimensional information, roof assembly types, roof inspection reports, roofing budgets, roof specs, etc. all per building
  - .2 Generate roof replacement budgets and capital plans
  - .3 Schedule inspections and recommended roof replacements
  - .4 Provide designated University of Guelph employees secure access to this inventory system through a username and password. Once access is granted, all information and functions should be accessible and retrievable to the U of G employee.
  - .5 Provide training to the U of G employee to use the Online Roof Management Program.
  - .6 The supplier must provide examples of web-based roof inventory systems they have created for other clients.
- .5 The Online Roof Management Program must be able to provide the following:
  - .1 Roof condition by category
  - .2 Accurate future budgetary reports for a minimum of 20 years
  - .3 Condition photos on a per roof basis
  - .4 Aerial images via Google Satellite
  - .5 Service Activity – what was done and by whom
  - .6 Warranty information
  - .7 Leak history/sensitivity
  - .8 Leak reporting service
  - .9 Square footage reports of all roof areas
  - .10 CAD Drawings
  - .11 Specifics on drainage, perimeter and interior projection flashings, slope and drainage.
  - .12 Supporting documents.
  - .13 Emergency Leak call service.
  - .14 Infra-Red analysis by means of Drone.
  - .15 Hand Held Infra-red analysis reports.

## 1.11 ADDITIONAL REQUIREMENTS

- .1 Roofing to be supplied and installed in conformance with the University's Roofing Standard.
- .2 Provide Products that are compatible with one another under field conditions, as demonstrated by roofing manufacturer.
- .3 Provide watertight roofing system capable of resisting specified uplift pressures, thermally induced movement and exposure to weather without failing during the specified warranty period.
- .4 Where reroofing work is to take place, the replacement roof system must be compatible with any adjacent roofing that is presently under warranty to the University of Guelph. Should an existing warranty be rendered void, the warranty liabilities shall become the burden and responsibility of the Contractor and their chosen Manufacturer.
- .5 Prior to fastening roof sheathing and or other roof system components, inspect underside of deck for conduit locations, fire-proofing material and other potential hazards.
  - .1 If mechanical fastening is not specified, utilize specified insulation adhesive in these areas. Where adhesive is not specified, utilize adhesive as recommended by the manufacturer of the material being adhered.
  - .2 If mechanical fastening is specified, assume full responsibility to avoid damaging existing conduits within the interior space, and utilize all available means to ensure continued uninterrupted function of electrical/electronic items, including visual reviews and available electronic detection devices.
  - .3 Assume full responsibility for damages occurring as a result of fastening through the deck and shall make good all such damages at no additional cost to the Owner.
- .6 Disconnect and temporarily relocate all existing mechanical and electrical work including existing conduits, cables, wiring, piping, gas lines and similar items to facilitate roof replacement and to re-instate to original working condition and in accordance with Contract Documents.
- .7 Remove and dispose existing sheet metal flashings, sleeves, pitch pans, redundant equipment, ballast, roof membrane and flashings, insulation and vapour retarder and all other roofing components not required to remain as part of the new work.
- .8 Remove all debris and sweep clean existing substrate.
- .9 Supply and install roof drain inserts, roof drain sleeves, collars, pitch pans, gas line support, concrete pavers and miscellaneous items in accordance with Contract Documents.
- .10 Reinstall and connect all mechanical and electrical equipment to original function.
- .11 Supply and install all pre-finished sheet metal flashings in accordance with Contract Documents. Colour and profile samples to match existing.
- .12 Supply and install joint sealants in accordance with Section 079200 Joint Sealants.
- .13 Seal air intakes as required to Owner approval to ensure no smoke or fume entry.
- .14 Utilize only single source supplier of membrane and related primary materials.
- .15 Ensure proper tie-ins as indicated.
- .16 Dispose of all debris/ waste in approved containers and transfer to approved municipal and/or provincial disposal site(s).
- .17 Install walkways at all roof access and ladder locations.

- .18 Provide tapered insulation as noted according to Contract Documents.
- .19 Remove all unused/redundant equipment as shown on roof plans and as identified by the Owner. Provide metal deck closures prior to roofing over.

## **PART 2 - PRODUCTS**

### **2.1 PERFORMANCE CRITERIA**

- .1 A minimum 2% slope must be maintained to all roof drains, unless otherwise noted
- .2 Installed built-up roofing and base flashings shall withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Built-up roofing and base flashings shall remain watertight.
- .3 Provide base flashings, perimeter flashings, detail flashings and component materials and installation techniques that comply with the requirements and recommendations of the most current addition of the NRCA Roofing and Waterproofing Manual.
- .4 Compatibility between components of roofing system is an essential requirement of the contract for the purpose of obtaining a manufacturer's system warranty.
  - .1 Provide written declaration to Consultant stating that materials and components, as assembled in system to existing conditions, meet this requirement.
  - .2 Products specified within this specification section by Tremco, unless otherwise noted are to be used for this project.
- .5 Provide a roofing membrane identical to component systems that have been successfully tested by a qualified independent testing and inspecting agency to meet the following minimum load-strain properties at membrane failure when tested according to ASTM D 2523:
  - .1 Tensile strength at failure, at -18 deg. C (0 deg. F): 78.8 kN/m (450 lb./in) machine direction, minimum; 3.0 percent elongation, maximum.
  - .2 Tensile strength at failure, at -18 deg. C. (0 deg. F. 70.1 kN/m (400 lb. /in) cross machine direction, minimum; 2.7 percent elongation, maximum.
- .6 Roofing System: to CSA A123.21 for wind uplift resistance.

### **2.2 DESCRIPTION – ROOFING SYSTEM**

- .1 Roofing System: Three (3) ply cold-applied built-up roofing system with peel and stick vapor barrier, rigid board insulation, mineral wool tapered insulation, composite ply roofing membranes, roof pavers and aggregate surfacing.

### **2.3 DECK SHEATHING**

- .1 Fibreglass mat-faced gypsum board sheathing: to ASTM C 117/C1177M, Standard thickness as indicated.
  - .1 Acceptable product: GP Gypsum, "Dens-Deck Roofboard" by Georgia Pacific, or "Securock Roof Board" by CGC, or "GlasRoc Roof Board" by Certainteed, or approved alternate.

## 2.4 DECK PRIMER

- .1 Asphalt primer: to CGSB 37-GP-9M.
  - .1 Primer: non-fibrated, asbestos free, water-based, low-VOC formulation; to CGSB 37-GP-9Ma.
    - .1 Asbestos Content: None Ref , ASTM D276-87
    - .2 Viscosity 25°C: 50Ku , ASTM D562-87
    - .3 Density 25°C: 1.018 g/cc(8.5 lb/gal), ASTM D1475-85
    - .4 Nonvolatile Content: 32%, ASTM D2823-90
    - .5 Flash Point : Not Applicable, ASTM D3278-82
    - .6 pH: 9.2, ASTM E70-97
    - .7 VOC: 65g/l, ASTM D3960-98
    - .8 Colour: Brown/Black
  - .2 Acceptable product: as recommended by the manufacturer.

## 2.5 VAPOUR BARRIER/RETARDER

- .1 Vapour Barrier / Vapour Retarder definition: the terms vapour barrier and vapour retarder are to be considered as one in the same throughout these documents.
- .2 Self-adhesive Vapour Barrier: composed of SBS rubberized asphalt laminated to slip-resistant, cross-laminated polyethylene surface film, with release-paper backing.
  - .1 Thickness: 1 mm.
  - .2 Compliance: ASTM D 1970/ D 1970M-17a.
  - .3 Permeance: ASTM E96, 0.5 perm.
  - .4 Tensile Strength at 0 deg. F (-18 deg. C), minimum, ASTM D2523: 25 lbf/in (43 kN/m).
  - .5 Adhesion (to plywood), minimum, ASTM D903: 6lbf/in (1000N/m).
  - .6 Elongation, ASTM D412: 250%
- .3 Provide substrate primer when recommended by vapour-retarder manufacturer.
- .4 Acceptable product: 'AVC Membrane' by Tremco.

## 2.6 POLYISOCYANURATE INSULATION AND TAPERED INSULATION

- .1 Refer to Section 07 21 13 – Board Insulation.
- .2 Accessories:
  - .1 General: Roof insulation accessories recommended by insulation manufacturer for intended use and compatible with built-up roofing.
  - .2 Insulation Cant Strips: ASTM C 208, Type II, Grade 1, cellulosic-fiber insulation board.
  - .3 Tapered Edge Strips: ASTM C 208, Type II, Grade 1, cellulosic-fiber insulation board.
  - .4 Cover Board/Overlay Board: ASTM C726, non-combustible, single layer, mineral wool insulation board with a bitumen coated upper surface:
    - .1 Mineral Wool, CAN/ULC S704-01, Mineral wool fiber with bitumen saturated surfacing.
    - .2 Fire Rating: UL790 (CAN/ULC S107), Class A
    - .3 Compressive Strength: ASTM C165, 28 psi (190 kPa) @ 25%
    - .4 Thermal Resistance: RSI value/ 25.4mm, 0.77 m²K/W @ -4° C
    - .5 Thickness: 25mm (R-value, 3.8)
  - .5 Substrate Joint Tape: 200-mm / 6" wide, coated, self-adhereing, glass fiber.

## 2.7 BITUMEN MATERIALS

- .1 General: Adhesive and sealant materials recommended by roofing manufacturer for intended use and compatible with built-up roofing.
- .2 Liquid-type materials shall comply with VOC limits of authorities having jurisdiction.
- .3 Adhesives and sealants that are on the interior side of weather barrier shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
  - .1 Plastic Foam Adhesives: 50 g/L.
  - .2 Gypsum Board and Panel Adhesives: 50 g/L.
  - .3 Multipurpose Construction Adhesives: 70 g/L.
  - .4 Fiberglas Adhesives: 80 g/L.
  - .5 Contact Adhesives: 80 g/L.
  - .6 Other Adhesives: 250 g/L.
  - .7 None membrane Roof Sealants: 300 g/L.
  - .8 Sealant Primers for Nonporous Substrates: 250 g/L.
  - .9 Sealant Primers for Porous Substrates: 775 g/L.

## 2.8 GLASS-FIBER FABRIC

- .1 Woven glass-fiber cloth, treated with asphalt, complying with ASTM D 1668, Type I.

## 2.9 ROOFING MEMBRANE PLIES

- .1 Burmastic Composite Ply: Non-perforated, asphalt-coated, polyester/fiberglass/polyester tri-laminated reinforced asphalt-coated sheet dusted with fine mineral surfacing on both sides which meets the requirements of ASTM D 4601, Type II, suitable for application method specified, and as follows:
  - .1 Breaking Strength: minimum, ASTM D 146: machine direction, 22 kN/m (130 lb./in); cross machine direction, 22 kN/m (130 lb./in).
  - .2 Resistance to Puncture 530 N, ASTM E154
  - .3 Tear Strength: minimum, ASTM D 4073: machine direction, 979 N (220 lb.); cross machine direction, 930 N (210 lb.).
  - .4 Pliability: 12.7 mm (1/2-inch) radius bend, ASTM D 146: No failures.
  - .5 Thickness: minimum, ASTM D 146: 1.4 mm (0.050 inch).
  - .6 Weight: minimum, ASTM D 228: 1.5 kg/sq. m. (30 lb./100 sq. ft.)
  - .7 Mass of desaturated polyester/glass/polyester mat: ASTM D 228: 107 g/sq. m. (2.2 lb./100 sq. ft.)
  - .8 Asphalt: minimum, ASTM D 228: 488 g/sq. m. (10 lb./100 sq. ft.).
- .2 Acceptable product: Tremco, Burmastic Composite Ply.

## 2.10 BASE FLASHING SHEET MATERIALS

- .1 Flashing Sheet: TRA Elastomeric Sheeting: Elastomeric, polyester-reinforced sheet with EPDM and SBR elastomers and the following physical properties:
  - .1 Breaking Strength: minimum, ASTM D 751: machine direction 43 kN (250 lb.); cross machine direction 26 kN (150 lb.).
  - .2 Tear Strength: minimum, ASTM D 751: machine direction 400 N (90 lb.); cross machine direction 220 N (50 lb.).

- .3 Elongation at Failure: ASTM D 751: 25 percent minimum.
  - .4 Low Temperature Flexibility: minimum, ASTM D 2136: -40 deg. C (-40 deg. F).
  - .5 Thickness: minimum, ASTM D 751: 1.0 mm (0.040 inch).
  - .6 Weight: ASTM D228: 1.3 kg/sq. m. (4.5 oz. /sq. ft.)
- .2 Flashing membrane adhesive as recommended by the manufacturer.
  - .3 Acceptable product: Tremco TRA Elastomeric Sheeting.

## 2.11 COLD-APPLIED ADHESIVES

- .1 Cold Applied Adhesive (Type 1):
  - .1 One-part, asbestos-free, cold-applied adhesive specially formulated for compatibility and use with specified roofing membranes and flashings, with the following physical properties:
    - .1 Asbestos Content: EPA 600 R-93/116: None.
    - .2 Volatile Organic Compounds (VOC): maximum, ASTM D 6511: 340 g/L.
    - .3 Nonvolatile Content: minimum, ASTM D 6511: 65 percent.
    - .4 Flash Point: minimum ASTM D 93: 38 deg. C (100 deg. F).
    - .5 Density at 25 deg. C (77 deg. F): minimum, ASTM D 6511: 1.0 kg/L (8.0 lb./gal).
    - .6 Uniformity and Consistency: ASTM D 6511: Pass.
    - .7 Asphalt Content: minimum, ASTM D 6511: 40 percent.
  - .2 Acceptable product: Tremco, Burmastic Adhesive.
- .2 Cold-Applied Adhesive (Type 2):
  - .1 One-part, cold-applied bitumen modified polyurethane waterproofing adhesive specifically formulated for adhering TRA/elastomeric membrane sheet, with the following physical properties:
    - .1 Tensile Strength: ASTM D 412: 2060 map 1.7MPa (250 psi).
    - .2 Low Temperature Elongation at -20 deg. C (29 deg. F): ASTM D 412: 500 percent.
    - .3 Elongation: ASTM D 412: 700 percent.
    - .4 Asbestos Content: ASTM D276, None.
    - .5 Viscosity at 25 deg. C (77 deg. F): ASTM D2196-86, 400-1760pa-s
    - .6 Density at 25 deg. C (77 deg. F): ASTM D2196-86, 1042 kg/m3
  - .2 Acceptable product: Tremco, Tremlar/TP-60 Vertical Grade.
- .3 Cold-Applied Adhesive (Type 3):
  - .1 One-part, Solvent Free Rubberized Elastomer
    - .1 Asbestos Content: EPA 600/R-93/116, None
    - .2 Viscosity at 25 deg. C (77 deg. F): ASTM D2196-86, 600-2000pa/s
    - .3 Elongation: ASTM D412-87, 1000%
    - .4 Tensile Strength: ASTM D412-87, 207-345kPa
- .4 Cold Applied Adhesive (Type 4):
  - .1 Adhesive for Roofing Felts: Asbestos-free, cold-process asphalt adhesive.
    - .1 Viscosity at 25 deg. C (77 deg. F): ASTM D2196-86, 25,000cp – 75,000cp
    - .2 Non Volatile Content: ASTM D6511-00, 67%
    - .3 Density at 25 deg. C (77 deg. F): ASTM D6511-00, 1.0kg/l
    - .4 Flash Point: ASTM D93, >60°C

## 2.12 ADHESIVE FOR AGGREGATE BALLAST

- .1 Asbestos-free, cold-process asphalt adhesive.
  - .1 Viscosity at 25 deg. C (77 deg. F): ASTM D2196-86, 25,000cp – 75,000cp
  - .2 Non Volatile Content: ASTM D6511-00, 67%
  - .3 Density at 25 deg. C (77 deg. F): ASTM D6511-00, 1.0kg/l
  - .4 Flash Point: ASTM D93, >60oC

## 2.13 INSULATION ADHESIVE

- .1 Single compound, solvent-free, moisture curing, low VOC, asphaltic urethane cold fluid applied bituminous-urethane adhesive formulated to adhere roof insulation to substrate, with the following physical properties:
  - .1 Asbestos Content: EPA 600/R13/116: None.
  - .2 Volatile Organic Compounds (VOC): maximum, ASTM D 3960: 20 g/L.
  - .3 Viscosity: ASTM D2556-69, at 25 deg. C (77 deg. F): 70.0 Pa/s
  - .4 Non-Volatile Content: minimum, ASTM D 1644: 99 percent.
  - .5 Density at 25 deg. C (77 deg. F): minimum: ASTM D 1875: 1.01 kg/L (8.5 lb./gal).
  - .6 Tensile Strength at 25 deg. C (77 deg. F): ASTM D412-87 1.4MPa
  - .7 Elongation at 25 deg. C (77 deg. F): minimum, ASTM D 412: 1200 percent.
  - .8 T-Peel Strength at 25 deg. C (77 deg. F): minimum: ASTM D 1876: 66 N (15 lab).
  - .9 Adhesion Strength in Shear at 25 deg. C (77 deg. F): minimum, ASTM D 816: 552 kPa. (80 psi).
  - .10 Low-Temperature Flexibility: maximum, ASTM D 816: -51 deg. C (-60 deg. F), pass.
- .2 Acceptable product: Tremco, Fas-n-Free Adhesive.

## 2.14 SEALERS

- .1 Sealants: asbestos-free sealant, compatible with systems materials, recommended by system manufacturer. In accordance with Section 07 92 00 - Joint Sealants.

## 2.15 WALKWAYS

- .1 Walkways and Splash Pads at Ballasted Membranes:
  - .1 Precast Concrete Pavers: 45 mm / 1 3/4" thick, 55 MPa / 8,000 psi, water absorption less than 5%, "Standard Diamond Texture Roof Ballasts" by Brooklyn Concrete or approved alternate, colour and texture as later selected by [Departmental Representative] [DCC Representative] [Consultant]] [from manufacturer's standard products, size as follows:
    - .1 At walkways, access ladders and doors: 610 mm x 610 mm / 24" x 24".
    - .2 At Splash Pads at Downspout locations: 610 mm x 610 mm x 610 mm / 24" x 24".
    - .3 Acceptable Product: "Roof Ballast Slabs" by Brooklyn Concrete or approved alternate.

Set pavers on prefabricated, adjustable plastic pavers pads, approximately 100mm x 100mm size rigid extruded polystyrene pads, 25 mm thick; having a minimum compressive strength of 210 kPa.

## **2.16 CARPENTRY**

- .1 Refer to Section 06 10 00 - Rough Carpentry.

## **2.17 CANT AND TAPERED EDGE STRIPS**

- .1 Cant to be 38 mm / 1 1/2" thick factory formed, asphalt impregnated wood fibreboard preformed to 45 deg angle, to measure 110 mm on slope.
- .2 Tapered edge strips to be preformed asphalt impregnated wood fibreboard, sizes as indicated.

## **2.18 BALLAST**

- .1 Stone: gravel ballast to ASTM D 448, Gradation 57 opaque, non-porous, washed, free from fines, long splinters, moisture, ice and snow.
  - .1 Acceptable product: white dolomite gravel, 600# per square.
- .2 Set in BURmastic adhesive by Tremco

## **2.19 ACCESSORIES**

- .1 Aluminum Sleeves and Collars:
  - .1 16 ga. / 0.051" pre-spun aluminum as required.
  - .2 Sized to suite application.
  - .3 Acceptable manufacturers:
    - .1 National Roofing Supply.
    - .2 Lexcor Canada.
    - .3 Thaler Metal Industries.
    - .4 Altra Metal Specialties Inc.
- .2 B-Vent Flashing:
  - .1 Prefabricated from heavy gauge aluminum or stainless steel, complete with wide base flange.  
Accepted products:
    - .1 "MEF-4A" by Thaler Metal Industries Ltd.
    - .2 "Flash-Tite" by Lexcor.
    - .3 "ME-TC" by National Roofing Supply.
    - .4 "BVF" by Altra Metal Specialties Inc.
- .3 Soil Pipe Flashings:
  - .1 Prefabricated from heavy gauge spun aluminum, complete with wide base flange, telescoping cap and pre-insulated. Minimum 305 mm (12") above roof surface. Accepted products:
    - .1 "PVP-1 series" by National Roofing Supply; complete with cap.
    - .2 "SJ-26 series" by Thaler Metal Industries
    - .3 "Flash-Tite SC-S Series" by Lexcor
    - .4 "AVS-1" by Altra Metal Specialties.

- .4 Gooseneck Type Conduit Flashing:
  - .1 Prefabricated from heavy gauge aluminum or stainless steel, complete with wide base flange.  
Accepted products:
    - .1 MEF-2A series by Thaler Metal Industries Ltd.,
    - .2 Flash-Tite series by Lexcor,
    - .3 ME-GN series by National Roofing Supply.
    - .4 "MEFA" by Altra Metal Specialties Inc.
- .5 Stripping Membrane: Vinyl-coated fibreglass mesh.
- .6 Stripping Adhesive: One-part solvent free rubberized elastomer or Single-component bitumen modified polyurethane, vertical grade as specified by Manufacturer.
- .7 Pitch Pan: premanufactured type; 0.61 mm thick galvanized steel sheet, height to suite application, minimum 100 mm high.
- .8 Termination Bar: 3 mm thick aluminum bar, 25 mm wide profile, pre-drilled for mechanical attachment.
- .9 Prefabricated Control or Expansion Joint Flashing: Sheet butyl reinforced with closed cell urethane foam backing, seamed into metal flashing flanges, including sheet butyl counter flashing each side.
- .10 Roof Drains:
  - .1 Refer to Division 23.
- .11 Scuppers:
  - .1 0.80 mm / 22 ga. pre-finished metal with 127 mm / 5" flanges and soldered seams.
- .12 Deck Closures:
  - .1 3 mm / 1/8" galvanized metal plate, size to suit opening and as detailed.
- .13 Pipe Supports for roof mounted gas pipes, pipes, electrical conduit, ducts and other mechanical piping:
  - .1 Refer to Division 23.
- .14 Expansion Joints:
  - .1 Exterior cover: of 1.5 mm thick neoprene with joint width to suit application for roof to roof and roof to wall construction, preformed end caps and change in direction components.
  - .2 Flanges, Edge frame, and flashing: galvanized steel to suit application.
  - .3 Acceptable product: Soprajoint by Soprema or approved equivalent.

### **PART 3- EXECUTION**

#### **3.1 QUALITY OF WORK**

- .1 Do examination, preparation and roofing Work in accordance with Roofing Manufacturer's Specification Manual, CRCA Roofing Specification Manual, and Ontario Roofing Association Manual.
- .2 Do priming in accordance with manufacturers written recommendations.
- .3 Provide interface between walls and roof assemblies with durable rigid sheet metal as required to provide connection point for continuity of air barrier.

- .4 Provide assembly, component and material connections in consideration of appropriate design loads.
- .5 Maintain equipment in good working order to ensure control of roofing operations and protection of work.

### **3.2 GENERAL**

- .1 Apply roofing in accordance with drawings, specifications and requirements of authorities having jurisdiction and the Canadian Roofing Contractors' Association Roofing Manual.
- .2 Use manufacturer's printed recommendations and specifications as minimum requirements for materials, methods and quality of work not otherwise specified herein.
- .3 Make adjustments to specified roofing procedures caused by weather and site conditions to Consultant approval.
- .4 Ensure watertight junctions of roof drains, vents and other items passing through the roof.
- .5 Install plywood and lumber nailer plates to deck, walls and parapets where required and as indicated.
- .6 Install vapour retarder and all field membrane beginning at low point and at right angles to the slope or from roof drain.
- .7 At manufacturer's recommended rate, prime all existing surfaces that are to receive roof membrane.
- .8 Install tapered insulation in accordance with manufactured instructions and reviewed shop drawings.
- .9 Soften and shim edges of tapered insulation as required to provide smooth transition from one level to the next.
- .10 Ensure all edges of insulation and cover boards, are structurally supported. Stagger joints of insulation boards both horizontally and vertically. Stagger end joints. Butt joints with no gaps or broken boards. Cut and fit neatly at all projections.
- .11 Apply adhesives in accordance with manufacturer's instructions and recommendations.
- .12 Use only manufacturer approved torches as per manufacturer's recommendations.

### **3.3 EXAMINATION OF ROOF DECKS**

- .1 Verification of Conditions: inspect deck conditions including parapets, construction joints, roof drains, plumbing vents and ventilation outlets to determine readiness to proceed.
- .2 Surface examination and preparation must be completed in conformance with recommendations in accordance with the material manufactures specifications, particularly for fire safety precautions.
- .3 Evaluation and Assessment: Prior to fastening deck sheathing and/or other roof system components, inspect underside of the deck for conduit locations, fire-proofing material and other potential hazards.
- .4 If fastening is specified, assume full responsibility to avoid damaging existing conduits within the interior space. Utilize all available means to ensure the continued uninterrupted function of electrical/electronic items, including visual reviews and available electronic detection devices.

- .5 Ensure decks are firm, straight, smooth, dry, free of snow, ice or frost, and swept clean of dust and debris. Do not use calcium or salt for ice or snow removal.
- .6 Ensure curbs have been built.
- .7 Ensure roof drains have been installed at proper elevations relative to finished roof surface.
- .8 Assume full responsibility for damages occurring as a result of fastening through the deck and make good all such damages at no additional cost to the Owner.
- .9 Do not install roofing materials during rain or snowfall.
- .10 Remove all existing roof membrane components down to the deck and remove from the roof surface.

### **3.4 PROTECTION OF IN-PLACE CONDITIONS**

- .1 Cover walls, walks, and adjacent work where materials hoisted or used.
- .2 Use warning signs and barriers. Maintain in good order until completion of Work.
- .3 Clean off drips and smears of bituminous material immediately.
- .4 Dispose of rain water off roof and away from face of building until roof drains or hoppers installed and connected.
- .5 Protect roof from traffic and damage.
- .6 At end of each day's work or when stoppage occurs due to inclement weather, provide protection for completed Work and materials out of storage.
- .7 Seal and ballast exposed edges.

### **3.5 PREPARATION OF STEEL DECK**

- .1 Install sound absorbing insulation in flutes of acoustical steel roof deck in accordance with deck manufacturer's instructions and Section 05 31 00 - Steel Decking.
- .2 When installing vapour retardant directly on the steel deck, place a thin sheet of metal under the end lap of the vapour barrier.

### **3.6 PRIMING DECK AND OTHER SURFACES**

- .1 Apply deck primer to deck roofing substrate at the rate recommended by manufacturer.
- .2 Prime metal and concrete surfaces designated to be covered with asphaltic products.
- .3 Allow to cure.
- .4 Ensure primer does not enter building through cracks and other openings.

### 3.7 VAPOUR RETARDER

- .1 Prime surfaces to receive vapour retarder membrane. Apply membrane only once primer coat is dry.
- .2 Install applicable roof vapour retarder to the approved assembly in accordance with Manufactures specification.
- .3 Over exposed substrate and without adhering, unroll modified bitumen membrane to relax and for alignment.
- .4 Once relaxed and aligned, reroll membrane from both ends. Peel back one end of the silicone release sheet and adhere this part of the membrane to the substrate. Peel back the remaining release sheet at a 45° angle to avoid wrinkles in the membrane.
- .5 If the membrane is not properly aligned, do not try to adjust. Instead, cut the roll and start again, making sure that it is properly aligned and that it overlaps the end of the misaligned piece by 150 mm / 6".
- .6 Overlap each preceding sheet by 100mm / 4" lengthwise following the reference line and by 150mm / 6" at each end. Stagger end laps by at least 300mm / 12".
- .7 Extend vapour retarder under cant strips and blocking. Extend to perimeter and deck protrusions.
- .8 Seal roof vapour retarder to wall air/vapour barrier system with flexible flashing membranes to ensure continuity of building air/vapour barrier envelope.
- .9 Use a 34 kg roller to press down along each membrane strip, including the laps. Finish by aligning the edge of the roller with the lower end of the side laps and rolling up the membrane. Do not cut the membrane to remove air bubbles trapped below the laps, but rather push the roller to the edge of the joint to squeeze them out.

### 3.8 INSULATION INSTALLATION

- .1 Insulation Application - General:
  - .1 Install roof insulation boards, cut and trimmed to provide plain butt joints at perimeters, parapets, curbs, etc.
  - .2 Lay insulation boards in parallel courses, butted together tightly in firm contact with one another, without gaps, complete with staggered end joints.
  - .3 Place boards in parallel rows with ends staggered, and in firm contact with one another.
  - .4 Cut end pieces to suit.
  - .5 Install second layer with joints placed offset and perpendicular from underlying layer.
  - .6 Install insulation boards to maintain continuity of thermal envelope. Minimize joints.
  - .7 Fit insulation tight to roof penetrations.
  - .8 Firmly butt insulation boards. Do not jam or deform boards.
  - .9 Minimize lipping between adjacent boards.
  - .10 Stagger joints minimum 300mm.
- .2 Insulation – Cold Adhesive Application:
  - .1 Mop first layer of insulation to vapour retarder and upper layers of insulation to bottom layer with cold applied adhesive as specified and as per adhesive manufacturer's instructions.
  - .2 Install additional layers of insulation and tapered insulation to vapour retarder with adhesive in conformance with manufacturer's written recommendations.

- .3 Install insulation panels by butting edges snugly and without warping. Stagger all joints between layers
- .4 Install only as much insulation as can be covered in the same day.
- .5 Around the drains lower insulation by 25 mm / 1" to create a sump 1200 mm x 1200 mm / 4' X 4' in area. Bevel edge of 75 mm / 3" insulation on a 45° angle.

### **3.9 OVERLAY BOARD**

- .1 General Application Method:
  - .1 Stagger all vertical joints between boards and insulation.
  - .2 Connect panels in perfect connection, without any differences in level and completely adhered all surfaces.
  - .3 Apply only as many boards as can be covered in the same day.
- .2 Cold Applied Adhesive Application: Over completed layer(s) of insulation, and with board joints offset from insulation joints, install overlay board in cold applied adhesive as specified and as per adhesive manufacturer's instructions. Walk-in to ensure 100% of surface is adhered.
- .3 Adhere single layer of overlay board over roof insulation with approved adhesive at manufacturer's recommended rate.
- .4 Stagger overlay board seams with insulation board seams.

### **3.10 CANT STRIPS**

- .1 Install cant strips at intersections of roofing and vertical surfaces.
- .2 Embed in a continuous bed of approved adhesive applied to overlay boards.
- .3 Lay true to line, level and with flush, butt joints and accurately mitred corners.

### **3.11 BASE SHEET**

- .1 Installation of Cold Applied Adhesive Base Sheet:
  - .1 Beginning at the drain and perpendicular to the slope, install the membrane base sheet in a full bed of adhesive applied at the rate of 6 to 8 litres per 10 square metres of roofing area using a notched 5 mm / 3/16". neoprene squeegee.
  - .2 Apply base sheet in parallel strips. Lap side joints 100 mm / 4" and end joints 150 mm / 6". Stagger end joints a minimum of 300 mm / 12".
  - .3 After placement in the adhesive, roll the surface of the installed membrane with a 27 kg. steel roller to smooth the membrane to ensure complete and uniform embedment.
  - .4 Always seal the lap joints of the base sheet at the end of the workday. Perform the work without interruption to avoid tears and the formation of fishmouths, air pockets, and wrinkles.
  - .5 Cut off corners at end laps to be covered by the next roll.
  - .6 Provide a smooth application free of wrinkles, fishmouths, air pockets or tears.
  - .7 Terminate the base sheet 40 mm / 1 1/2" above top of the cant or at the perimeter.

### 3.12 ROOF MEMBRANE

- .1 Install three plies of roof membrane in shingle fashion, starting at roof low point. Apply membrane perpendicular to overlay board joints. Conform to manufacturer's recommended method.
- .2 Overlap starter strips 660 mm with first ply, then overlap each succeeding ply 625 mm.
- .3 Place ply sheets to ensure water will flow over or parallel to, but not against, exposed edges.
- .4 Shingle in direction to shed water. Extend ply membranes over and terminate beyond cants and cut evenly.
- .5 Embed plies in approved adhesive, at a minimum rate of 1.2 L/m<sup>2</sup>, and solidly coating each ply for full width.
- .6 Ensure complete and continuous seal and contact between adhesive and ply membranes, including ends, edges and laps without wrinkles, fish mouths or blisters.
- .7 Do not step or walk on felts during or immediately after application until adhesive has set.
- .8 Install each ply so that it shall be firmly and uniformly set, without voids, into adhesive. Thoroughly and effectively broom or roll each membrane application to ensure full adhesion.
- .9 Lap ply membrane ends 150 mm. Stagger end laps 1.0 metres minimum.
- .10 Overlap previous day's work 600 mm, as required.
- .11 Terminate all ply layers to outer edge of roof perimeter.

### 3.13 FLASHINGS

- .1 Complete installation of flashing base sheet stripping prior to installing membrane cap sheet.
- .2 Install flashings to ensure the roof is watertight at the end of each Working Day.
- .3 Apply base and cap sheet onto substrate in 1 metre / 3'-3" x 3'-3" wide strips using same method as base and cap sheet applications.
- .4 Lap flashing base sheet to membrane base sheet minimum 150 mm / 6" and seal by using same method as base and cap sheet applications.
- .5 Lap flashing cap sheet to membrane cap sheet 250 mm / 10" minimum using same method as base and cap sheet applications.
- .6 Provide 75 mm / 3" minimum side lap and seal.
- .7 Extend flashing membranes minimum 200 mm up vertical surfaces.
- .8 Secure flashings at 200 mm OC. Secure vertical flashings through termination bar.
- .9 Properly secure flashings to their support, without sags, blisters, fishmouths or wrinkles.
- .10 Overcoat lap edges with end lap stripping adhesive and membrane.

- .11 Do work in accordance with manufacturer's recommendations and Section 07 62 00 - Sheet Metal Flashing and Trim.
- .12 Tie-in leading edge of elastomeric sheet flashing with stripping ply membrane embedded between alternate courses of stripping ply adhesive.
- .13 Low Parapet Wall Flashing
  - .1 Seal exposed joint between the wall and roof deck for airtight seal.
  - .2 Adhere elastomeric sheeting completely to flashing surface, cant, and roofing with flashing adhesive.
  - .3 Ensure complete bond and continuity without wrinkles or voids. Lap sheeting ends 100 mm and adhere with flashing adhesive.
  - .4 Extend elastomeric sheeting up and over parapet at least 38 mm and face nail with 38 mm common roofing nails, 200 mm OC.
- .14 Gravel Stop
  - .1 Prior to setting and nailing horizontal flanges of edge flashings, uniformly trowel a 1.5 mm thick layer of cold flashing adhesive to roofing surface designated to receive metal flange.
  - .2 Install metal gravel stop with formed drip edge, incorporating lock-type joints to allow expansion and contraction. Set flange in cold flashing adhesive.
  - .3 Nail interior portion of flange to wood blocking 75 mm OC, staggered.
  - .4 Prime metal flange with asphaltic primer.
  - .5 Fully adhere a sufficiently wide strip of elastomeric sheeting to flashing with flashing adhesive. Ensure complete bond and continuity without wrinkles or voids lap sheeting ends 100 mm and adhere with flashing adhesive. Elastomeric sheeting to cover gravel stop completely and overlapping onto adjacent roof minimum 150 mm.
  - .6 Seal edge of flashing membrane at metal upturn as specified in Section 07 92 00.
- .15 Flashing At Edges and Gutters
  - .1 Fabricate and install new one-piece edge and/or gutter with downspouts. Slope gutter to downspouts.
  - .2 Prior to setting and nailing horizontal flanges of gutter, uniformly trowel a 1.5 mm thick layer of cold flashing adhesive to roofing surface designated to receive metal flange.
  - .3 Nail flange to wood blocking 75 mm OC, staggered.
  - .4 Prime metal flange with asphaltic primer.
  - .5 Adhere sufficiently wide strip of elastomeric sheeting completely to flashing surface with flashing adhesive. Ensure complete bond and continuity without wrinkles or voids lap sheeting ends 100 mm and adhere with flashing adhesive. Elastomeric sheeting to cover gravel stop completely and overlap onto adjacent roof a minimum of 150 mm.
  - .6 Seal edge of flashing membrane at metal upturn as specified in Section 07 92 00.
- .16 Wall Flashing
  - .1 Seal exposed joint between the wall and roof deck for airtight seal.
  - .2 Adhere elastomeric sheeting completely to flashing surface, cant and roofing with flashing adhesive.
  - .3 Ensure complete bond and continuity without wrinkles or voids. Lap sheeting ends 100 mm and adhere with flashing adhesive.
  - .4 Elastomeric sheeting width: sufficient to extend at least 150 mm beyond toe of cant onto roof surface and 200 mm above the roof surface.
  - .5 Secure top of elastomeric sheeting to vertical plane with termination bar. Mechanically fasten 300 mm OC. Overcoat bar with end lap stripping adhesive and membrane.

.17 Building Expansion Joints

- .1 Fill joint with loose insulation.
- .2 Provide plywood to top of wood blocking, secured one side only; as indicated in drawings.
- .3 Apply foam rubber or 25 mm thick mineral fibre insulation to top of plywood.
- .4 Install elastomeric sheeting centered over expansion joint.
- .5 Fully adhere sheeting to horizontal and vertical blocking surfaces with flashing adhesive. Press sheeting into adhesive. Ensure complete bond and continuity without wrinkles or voids.
- .6 Elastomeric Sheeting Width: Sufficient to extend onto adjacent roofing minimum 150 mm.
- .7 Lap sheeting ends 100 mm and adhere with flashing adhesive.

.18 Expansion Joint at Wall

- .1 Extend vapour retarder from deck level up wall sufficiently and secure to wall.
- .2 Fill joint with loose insulation.
- .3 Install blocking, sheathing and compressible insulation as detailed on drawings.
- .4 Adhere elastomeric sheeting completely to flashing surface, cant and roofing with flashing adhesive.
- .5 Ensure complete bond and continuity without wrinkles or voids. Lap sheeting ends 100 mm and adhere with flashing adhesive.
- .6 Elastomeric Sheeting Width: sufficient to extend at least 150 mm beyond toe of cant onto roof surface and 200 mm above the roof surface.
- .7 Secure top of elastomeric sheeting to vertical plane with a termination bar. Mechanically fasten 300 mm OC. Overcoat bar with end lap stripping adhesive and membrane.

.19 Control Joint

- .1 Install elastomeric sheeting centred over joint.
- .2 Fully adhere sheeting to horizontal and vertical blocking surfaces with flashing adhesive. Press sheeting into adhesive. Ensure complete bond and continuity without wrinkles or voids.
- .3 Flashing Width: Sufficient to extend onto adjacent roofing minimum 150 mm.
- .4 Lap sheeting ends 100 mm and adhere with flashing adhesive.

.20 Curb Flashing

- .1 Fully adhere sheeting to horizontal and vertical blocking surfaces with flashing adhesive. Press sheeting into adhesive. Ensure complete bond and continuity without wrinkles or voids.
- .2 Elastomeric Sheeting Width: Sufficient to extend from top of curb down onto adjacent roofing minimum 150 mm. Mechanically fasten sheeting on top face of curb.
- .3 Lap sheeting ends 100 mm and adhere with flashing adhesive.
- .4 If membrane does not completely cover sleeper, secure top edge with a termination bar. Mechanically fasten 300 mm OC. Overcoat bar with end lap stripping adhesive and membrane.

.21 Projection Flashing

- .1 Apply flashing adhesive to prepared area and Provide aluminium base over pipe and set into the flashing adhesive.
- .2 Select proper step of rubber cap and cut off above index ring.
- .3 Install cap onto base collar and press edge to ensure proper seal.
- .4 Provide clamp around pipe and rubber cap. Prime flange.
- .5 Install elastomeric sheeting with stripping ply adhesive and membrane.
- .6 Cover flange completely. Extend flashing minimum 100 mm onto adjacent roofing. Remove wrinkles and voids. Lap flashing ply ends 100 mm.

.22 Lead Plumbing Vents

- .1 Provide lead plumbing vent flashing.
- .2 Flange: minimum 100 mm wide; extend completely around periphery of vent flashing. Set flange into flashing adhesive. Neatly dress flange with wood blocking.
- .3 Prime lead flange with asphaltic primer.
- .4 Pipe Greater Than 50 Mm OD: Bend lead inside pipe minimum 25 mm; replace cracked lead.
- .5 Pipe 50 mm OD or Less: Cut lead at vent top. Provide integral lead cap.

.23 Cartwheel and Collar: Provide cartwheel and collar flashing around projection using elastomeric sheeting and flashing adhesive.

.24 Coping

- .1 Test mortar bond of coping units. Remove loose mortar from bell joint and clean surfaces.
- .2 Pack flashing adhesive into bell joint and extend up onto bell approximately 75 mm and down onto shank of adjoining unit a similar distance.
- .3 Cut proper lengths of 150 mm wide reinforcement membrane and dry trowel membrane into flashing adhesive; tight and wrinkle-free.
- .4 Overcoat reinforcing membrane with flashing adhesive.

.25 Pitch Pans

- .1 Uniformly apply a 3 mm thick layer of flashing adhesive to surfaces designated to receive metal flange.
- .2 Install pre-manufactured pitch pan into adhesive. Prime flange prior to installation.
- .3 Ensure minimum 50 mm clearance between projection and side wall.
- .4 Fully adhere elastomeric sheeting to flashing surface with flashing adhesive. Cover flange completely. Extend flashing at least 100 mm onto adjacent roofing. Ensure complete bond and continuity without wrinkles and voids. Lap sheeting ends minimum 100 mm.
- .5 Fill pitch pan 25 mm from top with pitch pan base filler.
- .6 Fill remainder with rubberized elastomer mastic. Crown top of mastic to ensure water run-off.

.26 Equipment Stands (Pipe)

- .1 Provide 200 mm high sleeve flashing with 100 mm wide flange. Flange to extend completely around flashing periphery. Solder joints. Double solder vertical joints.
- .2 Nail flange to wood blocking minimum 75 mm OC; staggered.
- .3 Prime flange with asphaltic primer.
- .4 Install elastomeric sheeting to stand and roofing with continuous 1.5 mm thick application of flashing adhesive.
- .5 Sandwich top edge of sheeting between two layers flashing tape.
- .6 Secure top of sheeting with stainless steel drawband. Seal top of drawband and sheeting-to-pipe interface. Provide watershed and tool neatly.
- .7 Fabricate umbrella and install drawband; cover sleeve flashing minimum 75 mm. Install immediately above sleeve flashing. Tighten drawband.
- .8 Wipe clean top of umbrella and projection with metal cleaner. Prime surface with metal primer.
- .9 Seal projection-to-sheet metal interface. Provide watershed and tool neatly.

.27 Piping through Roof Boxes

- .1 Install wood blocking as specified in Section 06 10 00 and indicated on drawings.
- .2 Provide two-piece pipe box. Fabricate bottom portion with 100 mm flange. Notch top section to fit over piping. Provide openings 200 mm above the roof surface.
- .3 Set flange in mastic, nail flange to wood blocking at 75 mm OC. Prime flange.

- .4 Fill box interior with mineral fibre insulation.
- .5 Fasten top and closure detail to bottom.
- .6 Clean surfaces of box and piping with metal cleaner and then prime. Seal joint between box and piping.
- .7 Install elastomeric sheeting with flashing adhesive and membrane.

### **3.14 ROOF PENETRATIONS**

- .1 Install roof drain pans, vent stack covers and other roof penetration flashings and seal to membrane in accordance with manufacturer's recommendations and details.
- .2 Ensure substrate is clear of loose granules and all foreign substances that can impair adhesion.
- .3 Place prefabricated curbs in the desired location and mark outside edge for reference. Place curbs at least 25 mm / 1" away from the penetration.
- .4 Wire brush area around penetration to remove loose materials and contaminants
- .5 Seal base of penetration with specified sealant to prevent the mastic from flowing through openings.
- .6 Apply a bead of sealant to the substrate where curbs will be placed.
- .7 Apply a bead of sealant to locking joint of the curb.
- .8 Set the curbs in place and apply equal pressure to assure positive contact with roof membrane. Strike away excess sealant.
- .9 Dispense a small amount of mastic to ensure proper mix, and fill inside prefabricated curb until full.

### **3.15 WALKWAYS**

- .1 Install walkway membrane in accordance with manufacturer's instructions and as indicated.
  - .1 Apply an additional layer of cap sheet membrane fully adhered in the areas in location to receive walkway mat.
  - .2 Apply primer to cap sheet membrane and cold apply walkway membrane ensuring selvage edge is not removed.
  - .3 Install walkway with gaps of at least 13 mm / 1/2" between panels to allow for expansion.

### **3.16 DRAINS**

- .1 Prior to proceeding with drain installation, ensure all rain water leaders are properly secured. Inspect underside of deck as required.
- .2 Neatly cut down top of existing drain bowl to below top of new insulation as required to ensure new drain insert sits at the lowest point possible.
- .3 Plug and seal drain to prevent water entry until service connection is completed.
- .4 Make opening water and vapour tight at vapour retarder. Apply spray foam insulation to fill voids between existing drain bowl and new insulation. Fill voids within existing drain bowl with mineral wool batt insulation.

- .5 Install drains and seals in accordance with the manufacturer's printed instructions.
- .6 Provide 600 x 600 mm size elastomeric sheeting reinforcement, centered over drain; and fully adhered with flashing adhesive. Remove wrinkles and entrapped air.
- .7 Apply mastic to exposed edge of membrane inside the drain opening.
- .8 Re-clamp flashing collar to drain in bed of flashing adhesive.
- .9 Trim excess sheeting within drain.
- .10 Stop membrane flashing 25mm / 1" from strainer ensuring drainage openings at base of strainer are kept clear.
- .11 Ensure strainer dome is in place and secure.
- .12 Install drain assembly in accordance with manufacturer's written installation guidelines.

### **3.17 PIPE SUPPORTS**

- .1 Install pipe supports where indicated.
- .2 Place one additional cold applied cap sheet membrane below pipe supports supporting heavy loads, colour different from field membrane as later selected by Consultant from manufacturer's standard colour range.
- .3 Centre support below conduits pipes and ducts squarely over pipe stand.
- .4 Adjust supports level and plumb as required to ensure uniform load with other supports.
- .5 Place pipe and ducts on support without dropping or causing undue impact.

### **3.18 FIELD QUALITY CONTROL**

- .1 Manufacturer's Field Services:
  - .1 Obtain written reports from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 – SUBMITTALS.
  - .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, as directed in PART 1 – QUALITY ASSURANCE.

### **3.19 CLEANING**

- .1 Proceed in accordance with Section 01 74 11 – Cleaning.
- .2 Remove bituminous markings from finished surfaces.
- .3 In areas where finished surfaces are soiled caused by work of this section, consult manufacturer of surfaces for cleaning advice and complying with their documented instructions.

- .4 Repair or replace defaced or disfigured finishes caused by work of this section.
- .5 Perform daily clean up to collect all wrappings, empty containers, and other debris from the project site.
- .6 Upon completion, all debris must be disposed of in a legally acceptable manner.
- .7 Prior to the final inspection, perform pre-inspection to review all work and to verify completion of all flashings and sealant applications.
- .8 Leave roof clean of debris, spills, etc.

### **3.20 MAINTENANCE MATERIAL**

- .1 Granules:
  - .1 As supplied by membrane manufacturer, colour to match membrane granule, provide to Owner one full pail of granules at end of project.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 REFERENCES**

- .1 The Aluminum Association Inc. (AAI)
  - .1 AAI-Aluminum Sheet Metal Work in Building Construction-2002.
  - .2 AAI DAF45-03, Designation System for Aluminum Finishes.
- .2 American Society for Testing and Materials International (ASTM)
  - .1 ASTM A 167-15, Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
  - .2 ASTM A 240/A 240M-15a, Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
  - .3 ASTM A 606/A606M-09a, Standard Specification for Steel, Sheet and Strip, High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, with Improved Atmospheric Corrosion Resistance.
  - .4 ASTM A 653/A 653M-15, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
  - .5 ASTM A 792/A 792M-10, Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.
  - .6 ASTM B 32-08(2014), Standard Specification for Solder Metal.
  - .7 ASTM B 370-14, Standard Specification for Copper Sheet and Strip for Building Construction.
  - .8 ASTM D 523-14, Standard Test Method for Specular Gloss.
  - .9 ASTM D 822/D822M-13, Standard Practice for Filtered Open-Flame Carbon-Arc Exposures of Paint and Related Coatings.
- .3 Canadian Roofing Contractors Association (CRCA)
  - .1 Roofing Specifications Manual 1997.
- .4 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-51.32-M77, Sheathing, Membrane, Breather Type.
  - .2 CAN/CGSB-93.1-M85, Sheet Aluminum Alloy, Prefinished, Residential.
- .5 Canadian Standards Association (CSA International)
  - .1 CSA A123.3-05(R2015), Asphalt Saturated Organic Roofing Felt.
  - .2 CSA A440-11, Standard/Specification for Windows, Doors, and Skylights.
  - .3 CSA B111-1974(R2003), Wire Nails, Spikes and Staples.
- .6 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).

### **1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's printed product literature for sheet metal flashing systems materials, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2 Submit two copies WHMIS MSDS - Material Safety Data Sheets in accordance with Section 01 35 29 – Health and Safety Requirements 01 35 43 – Environmental Procedures.

- .3 Shop Drawings:
  - .1 Submit shop drawings in accordance with Section 01 33 00 – Submittal Procedures.
- .4 Samples:
  - .1 Submit duplicate 50 x 50mm / 2" x 2" samples of each type of sheet metal material, finishes and colours.
- .5 Quality assurance submittals: submit following in accordance with Section 01 45 00 – Quality Control.
  - .1 Manufacturer's Instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence, and cleaning procedures.

### **1.3 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.

## **PART 2 - PRODUCTS**

### **2.1 PREFINISHED METAL FLASHINGS, SILLS AND DRIP PLATES**

- .1 Prefinished Metal Flashing and Drip Plates (Flat Stock):
  - .1 Prefinished Metal Flashing: galvanized steel, minimum temper rolled accordance with ASTM A446, to profiles indicated, type, colour and thickness to match metal cladding. Factory applied silicone modified polyester finish shall be Series 5000 precoat by Dominion Foundaries and Steel Limited or the Steel Company of Canada Limited.
  - .2 Prefinished Metal Drip Plates: 4", of size and profile indicated, 26 gauge metal c/w drip and anchoring devices.
  - .3 Class F1S.
  - .4 Prefinished 'Standard' and 'Extended' Colour Ranges series:
    - .1 Colour to later select by consultant, up to three (3) colours.
    - .2 Acceptable product: 'Colorite' by Vicwest, or equivalent by Agway, or Ideal Roofing.

### **2.2 ALUMINUM SILLS**

- .1 Aluminum sills, extruded aluminum, full length, of type and size and profile indicated, 0.125" thick anodized aluminum c/w drip, chairs, anchoring devices and cast end dams.

### **2.3 PREFINISHED METAL EAVESTROUGHS COMPLETE WITH INTEGRAL SCUPPER DOWNPIPE**

- .1 Form eaves troughs c/w integral scuppers and downpipes, 0.91 mm / 20 gauge, prefinished sheet metal.
- .2 Form 'U' bracket from 1.9 mm / 14 gauge, prefinished sheet metal.
- .3 Sizes and profiles as indicated.
- .4 Fabricate eaves troughs complete with integral scupper, downpipes and necessary fastenings as indicated.

## **2.4 ACCESSORIES**

- .1 Isolation coating: alkali resistant bituminous paint.
- .2 Plastic cement: to CAN/CGSB 37.5.
- .3 Underlay for metal flashing and Drip Plates: No. 15 perforated asphalt felt to CSA A123.3.
- .4 Sealants: Refer to Section 07 92 00 – Sealants.
- .5 Cleats: of same material, and temper as sheet metal, minimum 2" wide. Thickness same as sheet metal being secured.
- .6 Fasteners: of same material as sheet metal, to CSA B111, ring thread flat head roofing nails of length and thickness suitable for metal flashing application.
- .7 Washers: of same material as sheet metal, 0.039" thick with rubber packings.
- .8 Touch-up paint: as recommended by prefinished material manufacturer.

## **2.5 FABRICATION**

- .1 Form flashings, copings and fascias to sizes and profiles indicated.
- .2 Fabricate metal flashings, drip plates, sills and other sheet metal work as indicated.
- .3 Fabricate aluminum flashings, sills and other sheet aluminum work in accordance with AAI-Aluminum Sheet Metal Work in Building Construction.
- .4 Form pieces in 8'-0" minimum lengths.
  - .1 Make allowance for expansion at joints.
- .5 Form sills in full window width pieces, in profiles as indicated, c/w end caps and end dams. Round off all sharp edges within 6'-6" off ground level.
- .6 Hem exposed edges on underside 1/2".
  - .1 Mitre and seal corners with sealant.
- .7 Form sections square, true and accurate to size, free from distortion and other defects detrimental to appearance or performance.
- .8 Apply isolation coating to metal surfaces to be embedded in concrete or mortar.

## **2.6 REGLETS AND CAP FLASHINGS**

- .1 Form surface mounted reglets and metal cap flashing as detailed.
  - .1 Provide slotted fixing holes and steel/plastic washer fasteners.
  - .2 Return open ends of metal flashings to cover voids. Ensure all sharp edges are rounded and made safe.

## **PART 3 - EXECUTION**

### **3.1 MANUFACTURER'S INSTRUCTIONS**

- .1 Compliance: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.

### **3.2 INSTALLATION**

- .1 Install sheet metal work in accordance with CRCA FL series details and as detailed.
- .2 Use concealed fastenings except where approved before installation.
- .3 Provide underlay under sheet metal.
  - .1 Secure in place and lap joints 4".
- .4 Counterflash bituminous flashings at intersections of roof with vertical surfaces and curbs.
  - .1 Flash joints using S-lock standing seams forming tight fit over hook strips, as detailed.
- .5 Lock end joints and caulk with sealant.
- .6 Install through wall flashings true and level to top of foundation walls with mechanical fasteners at 16" o/c maximum.
  - .1 Return and close exposed ends of through wall flashings and make watertight complete with drip. Angle and chamfer edges and corners as required to eliminate all sharp edges.
- .7 Install surface mounted reglets true and level, and caulk top of reglet with sealant.
- .8 Insert metal flashing into reglets and under cap flashing to form weathertight junction.
- .9 Turn top edge of flashing into recessed reglet or mortar joint minimum of 25 mm / 1". Lead wedge flashing securely into joint.
- .10 Caulk flashing at cap flashings with sealant. Do not seal where water is intended to drain from the building system / components.
- .11 Install pans, where shown around items projecting through roof membrane.

### **3.3 SILL INSTALLATION**

- .1 Provide mock-up of window sill conditions where directed by Consultant. Do not proceed with installation of window sills until approved in writing by the Consultant.
- .2 Fabricate sills to suit individual window openings and to accommodate concealed end dams where possible to Consultant approval. Set sills with uniform design drainage slope to exterior, level in length. Where possible extend sills past jambs as required to conceal end dams behind adjacent exterior wall finish and provide watertight joint with sealant concealed from the elements.
  - .1 At masonry locations fit sills to provide snug fit. Set end dams and against masonry in bed of sealant in accordance with Section 07 92 00 – Joint Sealants and provide watertight joint concealed from the elements.
- .3 Set sills with uniform design drainage slope to exterior, level in length. Extend sills past jambs and provide watertight joint concealed from the elements.

- .4 Secure sills in place with anchoring devices located at ends and joints and evenly spaced at maximum 610 mm / 2'-0" maximum between.
- .5 Provide one-piece sill flashing where practicable.
  - .1 Where joints are required, keep joints to a minimum and locate to provide equal sill lengths. Provide a 200 mm / 8" long sill piece below windowsill on solid backing and embed exposed sill fully into bed of sealant over sill piece for a watertight connection. Do not surface caulk joints.
- .6 Provide adequate space between butt ends of sill lengths to allow for thermal expansion. For sills over 1220 mm / 4'-0" in length, maintain 3 to 5 mm / 1/8" to 3/16" expansion space at each end. Provide securely fastened concealed flashing below exposed sill and make watertight with sealant concealed from the elements for longevity.
- .7 Return and close exposed ends of sill flashings watertight complete with drip, angled and chamfered as required to eliminate all sharp edges.

### **3.4 PREFINISHED METAL EAVESTROUGHS COMPLETE WITH INTEGRAL SCUPPER DOWNPIPE**

- .1 Install eaves troughs complete with integral scupper and secure to building at 400 mm / 16" on centre maximum with concealed anchoring.
  - .1 Slope eaves troughs to downpipes as indicated.
  - .2 Seal joints watertight.
- .2 Install scuppers as indicated.
- .3 Install downpipes and provide goosenecks back to wall.
  - .1 Secure downpipes to wall with straps at 1830 mm / 6'-0" on centre; minimum two straps per downpipe.
  - .2 Connect downpipes to drainage system and seal joint with plastic cement.
- .4 Install downpipe extension a minimum 610 mm beyond face of adjacent wall.
- .5 Install splash pans at termination of all downpipes and extensions.

### **3.5 FIELD QUALITY CONTROL**

- .1 Manufacturer's Field Services:
  - .1 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.

### **3.6 CLEANING**

- .1 Proceed in accordance with Section 01 74 11 – Cleaning.
- .2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.
- .3 Leave work areas clean, free from grease, finger marks and stains.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 REFERENCES**

- .1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).
- .2 Underwriter's Laboratories of Canada (ULC)
  - .2 ULC-S115-11, Fire Tests of Fire stop Systems.

### **1.2 DEFINITIONS**

- .1 Fire Stop Material: device intended to close off opening or penetration during fire or materials that fill openings in wall or floor assembly where penetration is by cables, cable trays, conduits, ducts and pipes and poke-through termination devices, including electrical outlet boxes along with their means of support through wall or floor openings.
- .2 Single Component Fire Stop System: fire stop material that has Listed Systems Design and is used individually without use of high temperature insulation or other materials to create fire stop system.
- .3 Multiple Component Fire Stop System: exact group of fire stop materials that are identified within Listed Systems Design to create on site fire stop system.
- .4 Tightly Fitted; (ref: NBC Part 3.1.9.1.1 and 9.10.9.6.1): penetrating items that are cast in place in buildings of non-combustible construction or have "0" annular space in buildings of combustible construction.
  - .1 Words "tightly fitted" should ensure that integrity of fire separation is such that it prevents passage of smoke and hot gases to unexposed side of fire separation.

### **1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2 Submit two copies of WHMIS MSDS - Material Safety Data Sheets in accordance with Section 01 35 29– Health and Safety Requirements and manufacturer's instructions.
- .3 Shop Drawings:
  - .1 Submit shop drawings to show proposed material, reinforcement, anchorage, fastenings and method of installation.
  - .2 Construction details should accurately reflect actual job conditions.
  - .3 Submit manufacturer's product data to show proposed material, rating and application of material for use in rated separation, reinforcement, anchorage, fastenings and method of installation, compliance with listed standards. Construction details should accurately reflect actual job conditions.
  - .4 Submit manufacturer's product data for materials and prefabricated devices, providing descriptions are sufficient for identification at job site. Include manufacturer's printed instructions for installation.

- .5 Prior to submitting data, review with Authority having Jurisdiction to confirm acceptability of proposed materials and assemblies.
- .4 Samples:
  - .1 Submit duplicate 300 x 300 mm / 12' x 12' samples showing actual fire stop material proposed for project.
- .5 Quality assurance submittals: submit following as per Section 01 45 00 – Quality Control.
  - .1 Test reports: in accordance with CAN-ULC-S101 for fire endurance and CAN-ULC-S102 for surface burning characteristics.
    - .1 Submit certified test reports from approved independent testing laboratories, indicating compliance of applied fire stopping with specifications for specified performance characteristics and physical properties.
  - .2 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
  - .3 Manufacturer's Instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence, and cleaning procedures.
  - .4 Manufacturer's Field Reports: submit to manufacturer's written reports within 3 days of review, verifying compliance of Work, as described in PART 3 - FIELD QUALITY CONTROL.

#### 1.4 QUALITY ASSURANCE

- .1 Qualifications:
- .2 Installer: company and person specializing in fire stopping installations with 5 years documented experience approved by Manufacturer's Field Services: as part of Manufacturer's Services described in PART 3 - FIELD QUALITY CONTROL, schedule site visits with manufacturer's representative, to review Work, at stages listed.
  - .1 After delivery and storage of products, and when preparatory Work and mock-up is complete, but before installation begins.
  - .2 Twice during progress of Work at 25% and 60% complete.
  - .3 Upon completion of Work, after cleaning is carried out.

#### 1.5 DELIVERY, STORAGE AND HANDLING

- .1 Packing, shipping, handling and unloading:
  - .1 Deliver, store and handle materials in accordance with Section 01 61 00 – Common Product Requirements.
  - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
  - .3 Deliver materials to the site in undamaged condition and in original unopened containers, marked to indicate brand name, manufacturer, ULC markings.
- .2 Storage and Protection:
  - .1 Store materials indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Replace defective or damaged materials with new.

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS**

- .1 Fire stopping and smoke seal systems: in accordance with CAN-ULC-S115.
  - .1 Asbestos-free materials and systems capable of maintaining effective barrier against flame, smoke and gases in compliance with requirements of CAN- ULC-S115 and not to exceed opening sizes for which they are intended and conforming to specified special requirements described in PART 3.
  - .2 Fire stops system rating: to correspond with tested assemblies, or acceptable calculation procedures to provide fire resistance ratings as indicated.
  - .3 Fire stop system rating for sealing junction of rated walls to rated floors and ceilings: to suit Ontario Building Code.
- .2 Service penetration assemblies: systems tested to CAN-ULC-S115.
- .3 Service penetration fire stop components: certified by test laboratory to CAN-ULC-S115 and listed in ULC Guide No. 40 U19.13 and ULC Guide No. 40 U19.15 under the Label Service of ULC.
- .4 Fire-resistance rating of installed fire stopping assembly in accordance with OBC.
- .5 Fire stopping and smoke seals at openings intended for ease of re-entry such as cables: elastomeric seal.
- .6 Fire stopping and smoke seals at openings around penetrations for pipes, ductwork and other mechanical items requiring sound and vibration control: elastomeric seal.
- .7 Primers: to manufacturer's recommendation for specific material, substrate, and end use.
- .8 Water (if applicable): potable, clean and free from injurious amounts of deleterious substances.
- .9 Damming and backup materials, supports and anchoring devices: to manufacturer's recommendations, and in accordance with tested assembly being installed as acceptable to authorities having jurisdiction.
- .10 Sealants for vertical joints: non-sagging.
- .11 Sealants:
  - .1 Sealants / Silicone: to manufacturer's recommendations, and in accordance with tested assembly being installed as acceptable to authorities having jurisdiction, colour as later selected by Consultant from manufacturer's complete colour range.
  - .2 Sealants / Water-based Acrylic Dispersion (Paintable):to manufacturer's recommendations, and in accordance with tested assembly being installed as acceptable to authorities having jurisdiction, colour as later selected by Consultant from manufacturer's complete colour range.
- .12 Fire Stop Insulation: Mineral wool insulation as per sealant manufacturer written recommendations for intended use.
- .13 Fire Stop Mortar: Non-combustible, fibre reinforced, foamed cement mortar, ULC labelled.
  - .1 Acceptable material: 'A/D Fire barrier Mortar', by A/D Fire Protection Systems Inc, or equivalent by Hilti or approved alternate.

- .14 Sheet Metal Fire stopping in accordance with OBC 3.1.11.7(2).
  - .1 Sheet Metal Fire stopping: min 0.38 mm / 28 gauge sheet metal size and shape to suit opening. Provide continuous supports to all joints.
- .15 Gypsum Board: Refer to Section 09 21 16 – Gypsum Board Assemblies.
- .16 Identification Labels: Purpose made by manufacturer for permanent attachment to fire stop substrate area. Clearly identify manufacturer, product name, maximum hour rating, ULC rating number, installation date, approved installer name and company c/w phone and fax number, and location number.

### **PART 3- EXECUTION**

#### **3.1 MANUFACTURER'S INSTRUCTIONS**

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.

#### **3.2 PREPARATION**

- .1 Examine sizes and conditions of voids to be filled to establish correct thicknesses and installation of materials.
  - .1 Ensure that substrates and surfaces are clean, dry and frost free.
- .2 Prepare surfaces in contact with fire stopping materials and smoke seals to manufacturer's instructions.
- .3 Maintain insulation around pipes and ducts penetrating fire separation without interruption to vapour barrier.
- .4 Mask where necessary to avoid spillage and over coating onto adjoining surfaces; remove stains on adjacent surfaces.

#### **3.3 INSTALLATION**

- .1 Install fire stopping and smoke seal material and components in accordance with manufacturer's certified tested system listing.
- .2 Seal holes or voids made by through penetrations, poke-through termination devices, and unpenetrated openings or joints to ensure continuity and integrity of fire separation are maintained.
- .3 Provide temporary forming as required and remove forming only after materials have gained sufficient strength and after initial curing.
- .4 Fire Stop Sealant:
  - .1 Provide silicone fire stop sealant in concealed locations as determined in writing by Consultant.
  - .2 Provide water-based paintable acrylic fire stop sealant at all exposed to view locations.
  - .3 Provide fire stop sealant over fire stop insulation.
  - .4 Tool or trowel exposed sealant surfaces to a smooth, neat finish.

- .5 Remove excess compound promptly as work progresses and upon completion.
- .6 As the Work progresses, permanently mark all penetration seals with identification plate in visible locations next to seal. Review all exposed to view locations with Consultant prior to installing identification plates.

### **3.4 SEQUENCES OF OPERATION**

- .1 Proceed with installation only when submittals have been reviewed by Consultant.
- .2 Install floor fire stopping before interior partition erections.
- .3 Metal deck bonding: fire stopping to precede spray applied fireproofing to ensure required bonding.
- .4 Mechanical pipe insulation: certified fire stop system component.
  - .1 Ensure pipe insulation installation precedes fire stopping.

### **3.5 FIELD QUALITY CONTROL**

- .1 Inspections: notify Consultant when ready for inspection and prior to concealing or enclosing fire stopping materials and service penetration assemblies.
- .2 Manufacturer's Field Services:
  - .1 Obtain written reports from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.
  - .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, as directed in PART 1 - QUALITY ASSURANCE.

### **3.6 CLEANING**

- .1 Proceed in accordance with Section 01 74 11 – Cleaning.
- .2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.
- .3 Remove temporary dams after initial set of fire stopping and smoke seal materials.

### **3.7 SCHEDULE**

- .1 Fire stop and smoke seal including but not limited to:
  - .1 Penetrations through fire-resistance rated masonry, concrete, and gypsum board partitions and walls.
  - .2 Edge of floor slabs at curtain wall and precast concrete panels.
  - .3 Top of fire-resistance rated masonry and gypsum board partitions.
  - .4 Intersection of fire-resistance rated masonry and gypsum board partitions.
  - .5 Control and sway joints in fire-resistance rated masonry and gypsum board partitions and walls.
  - .6 Penetrations through fire-resistance rated floor slabs, ceilings and roofs.

- .7 Openings and sleeves installed for future use through fire separations.
- .8 Around mechanical and electrical assemblies penetrating fire separations.
- .9 Rigid ducts greater than 129 cm<sup>2</sup>/20in<sup>2</sup>: fire stopping to consist of bead of fire stopping material between retaining angle and fire separation and between retaining angle and duct, on each side of fire separation.
- .10 At other locations as indicated on drawings.

### **3.8 INDEPENDENT TESTING AND INSPECTION**

- .1 Arrange independent inspection and testing of work of this Section. Pay costs from cash allowance established in Section 01 21 01 – Allowances for this purpose.
- .2 Independent inspection agency shall:
  - .1 Inspect representative examples of each type of fire stops and smoke seals prior to being enclosed or covered.
  - .2 Make representative tests and investigations of completed work of this Section to ascertain conformance with manufacturer's requirements and performance criteria. Contractor shall make and repair test openings. Cost of making and repairing test openings shall be in Contract Price and not in Cash Allowance.
- .3 Contractor shall schedule and arrange inspections, providing sufficient advance notice to independent inspection and testing agency. Uncover any work of this Section that has not been subject to independent inspection and testing.
- .4 Independent inspection and testing agency shall issue written reports, copied to Owner, Building Dept., Contractor and Consultant.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 REFERENCES**

- .1 ASTM International:
  - .1 ASTM C834-14, Standard Specification for Latex Sealants.
  - .2 ASTM C 919-12, Standard Practice for Use of Sealants in Acoustical Applications.
- .2 Canadian General Standards Board (CGSB):
  - .1 CGSB 19-GP-5M-1984, Sealing Compound, One Component, Acrylic Base, Solvent Curing (Issue of 1976 reaffirmed, incorporating Amendment No. 1).
  - .2 CAN/CGSB-19.13-M87, Sealing Compound, One-component, Elastomeric, Chemical Curing.
  - .3 CGSB 19-GP-14M-1984, Sealing Compound, One Component, Butyl-Polyisobutylene Polymer Base, Solvent Curing (Reaffirmation of April 1976).
  - .4 CAN/CGSB-19.17-M90, One-Component Acrylic Emulsion Base Sealing Compound.
  - .5 CAN/CGSB-19.24-M90, Multi-component, Chemical Curing Sealing Compound.
- .3 General Services Administration (GSA) - Federal Specifications (FS):
  - .1 FS-SS-S-200-E (2)1993, Sealants, Joint, Two-Component, Jet-Blast-Resistant, Cold Applied, for Portland cement Concrete Pavement.
- .4 Health Canada/Workplace Hazardous Materials Information System (WHMIS):
  - .1 Material Safety Data Sheets (MSDS).

### **1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for joint sealants and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2 Manufacturer's product to describe:
    - .1 Caulking compound.
    - .2 Primers.
    - .3 Sealing compound, each type, including compatibility when different sealants are in contact with each other.
  - .3 Submit two (2) copies of WHMIS MSDS in accordance with Section 01 35 29 – Health and Safety Requirements 01 35 43 – Environmental Procedures.
- .3 Samples:
  - .1 Submit two (2) samples of each type of material and colour.
  - .2 Cured samples of exposed sealants for each colour where required to match adjacent material.
- .4 Manufacturer's Instructions:
  - .1 Submit instructions to include installation instructions for each product used.

### 1.3 QUALITY ASSURANCE

- .1 Qualifications:
  - .1 Subcontractor: Possess a copy of and be familiar with all standards specified. A person specializing in work specified with minimum five (5) years documented experience approved by Manufacturer.
  - .2 Installer: A person specializing in installing sealants in exposed joints with minimum one (1) year documented experience approved by Manufacturer.
- .2 Mock-ups:
  - .1 Construct mock-up in accordance with Section 01 45 00 – Quality Control.
  - .2 Construct mock-up to show location, size, shape and depth of joint(s) complete with back up material, primer, caulking and sealant.
  - .3 Mock-up will be used to judge workmanship, substrate preparation, operation of equipment and material application.
  - .4 Locate where directed by Consultant.
  - .5 Allow forty eight (48) hours for inspection of mock-up by Consultant before proceeding with sealant work.
  - .6 When accepted, mock-up will demonstrate minimum standard of quality required for this Work. Approved mock-up may remain as part of finished Work if deemed acceptable by Consultant.
- .3 Acoustic Testing:
  - .1 Refer to Section 09 21 16 Gypsum Board Assemblies.

### 1.4 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 – Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for incorporation into manual.

### 1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 – Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials off ground, indoors, in dry location, and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect joint sealants from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.

## 1.6 SITE CONDITIONS

- .1 Ambient Conditions:
  - .1 Proceed with installation of joint sealants only when:
    - .1 Ambient and substrate temperature conditions are within limits permitted by joint sealant manufacturer or are above 4.4 degrees C.
    - .2 Joint substrates are dry.
    - .3 Conform to manufacturer's recommended temperatures, relative humidity, and substrate moisture content for application and curing of sealants including special conditions governing use.
- .2 Joint-Width Conditions:
  - .1 Proceed with installation of joint sealants only where joint widths do not exceed those allowed by joint sealant manufacturer for applications indicated.
- .3 Joint-Substrate Conditions:
  - .1 Proceed with installation of joint sealants only after contaminants capable of interfering with adhesion are removed from joint substrates.

## 1.7 ENVIRONMENTAL REQUIREMENTS

- .1 Comply with 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 (MSDS) acceptable to Health Canada.

## 1.8 WARRANTY

- .1 Provide a written warrantee signed and issued in the name of the Owner, stating that caulking work of this section is guaranteed against leakage, cracking, crumbling, melting, shrinkage, running, loss of adhesion and staining adjacent surfaces, for a period of two (2) years from date of Consultant's Certificate of Substantial Performance.

## **PART 2 - PRODUCTS**

### 2.1 SEALANT MATERIALS

- .1 Do not use caulking that emits strong odours, contains toxic chemicals or is not certified as mould resistant in air handling units.
- .2 When low toxicity caulks are not possible, confine usage to areas which off gas to exterior, are contained behind air barriers, or are applied several months before occupancy to maximize off gas time.
- .3 Where sealants are qualified with primers use only primers as recommended by sealant manufacturer for type of surface and conditions being primed.
- .4 Joint Filler and Back-Up: Circular cross section unless shown as slab or sheet, minimum 25% wider than joint, semi-rigid: closed cell polyethylene or polyurethane product, rubber tubing or non-migrating plasticized vinyl having a shore "A" hardness of 20 and tensile strength of 130-200 kPa, compatible with sealant and as recommended by sealant manufacturer.
  - .1 Acceptable material: 'Ethafoam', by Dow Chemical of Canada Ltd, or product of Hercules Inc., Delaware USA.

- .5 Bond Breaker: As recommended for use by sealant manufacturer.
- .6 Vent Tubes: Rigid clear extruded plastic, min. 6 mm ID and 9 mm OD.
- .7 Preformed compressible and non-compressible back-up materials:
  - .1 Polyethylene, urethane, neoprene or vinyl foam:
    - .1 Extruded closed cell foam backer rod.
    - .2 Size: oversize 30 to 50 %.
  - .2 Neoprene or butyl rubber:
    - .1 Round solid rod, Shore A hardness 70.
  - .3 High density foam:
    - .1 Extruded closed cell polyvinyl chloride (PVC), extruded polyethylene, closed cell, Shore A hardness 20, tensile strength 140 to 200 kPa, extruded polyolefin foam, 32 kg/m<sup>3</sup> density, or neoprene foam backer, size as recommended by manufacturer.
  - .4 Bond breaker tape:
    - .1 Polyethylene bond breaker tape which will not bond to sealant.
- .8 Sealant Colours: Colours of exposed sealants as later selected by Consultant from manufacturer's standard colour range.

## 2.2 SEALANT MATERIAL/DESIGNATIONS

- .1 Exterior Use:
  - .1 All areas unless specified otherwise: One Part moisture curing polyurethane, Self-Leveling to CAN/CGSB-19.13, class MC-2-25-B-N:
    - .1 Acceptable Product: "Dymonic" by Tremco Ltd, or approved alternate.
  - .2 Prefinished Metal to Prefinished Metal: one part blend of synthetic rubber and resin, self leveling to CAN/CGSB 7.1:
    - .1 Acceptable Product: "Gutter Seal" by Tremco or approved alternate.
  - .3 Glass to glass, glass to metal and metal to metal curtain wall joints: Medium modulus, moisture curing, one part silicone sealant. Meeting the specified requirements of specification CAN/CGSB-19.13-M87, Classification MCG-2-25-A-L:
    - .1 Acceptable Product: 'Spectrem 2' by Tremco Ltd. or approved alternate.
  - .4 Sealants in contact with air/ vapour barrier membranes: a moisture cure, medium modulus polymer modified sealing compound to ASTM C920 Type S, Grade NS, Class 25.
    - .1 Acceptable Products: 'HE925 BES Sealant' manufactured by Henry Baker, or 'Sopramastic ALU' by Soprema, or approved alternate.
- .2 Interior Use:
  - .1 Lap Joints in Plastic Sheet Vapour Barrier and around mechanical piping and conduit in concealed to view spaces in partitions identified with an STC rating: Non-skinning, non-hardening, non-oxidizing, non-bleeding synthetic rubber sealant sealing and bedding compound for acoustical purposes and concealed joints conforming to CAN/CGSB 19-GP-21M87:
    - .1 Acceptable Product: "Acoustical Sealant", by Tremco or approved alternate.
  - .2 Joints around holes or voids made by through penetrations including but limited to mechanical piping and conduit in exposed to view spaces in partitions identified with an STC rating: easy gunning, non-staining, paintable acrylic polymer conforming to ASTM C834:
    - .1 Acceptable Product: "Tremflex 834", by Tremco, or approved alternate.
  - .3 Interior General Application (all areas unless specified otherwise): to CAN/CGSB-19.14M:
    - .1 Acceptable Product: "Tremflex 834" by Tremco or approved alternate.

- .4 Wet Areas and Washroom Fixtures: Mildew resistant, one component neutral cure silicone sealant to CGSB-19GP22M:
  - .1 Acceptable Product: "Tremsil 200" by Tremco or approved alternate.
- .5 Interior non-moving joint applications to be painted: One component, paintable acrylic latex sealant to CGSB-19-GP-17M:
  - .1 "Tremflex 834" by Tremco or approved alternate.
- .6 Interior Fire Stop application:
  - .1 All locations unless otherwise noted:
    - .1 Acceptable Product: to CAN4-S115M "Tremstop Acrylic (GG)" by Tremco or approved alternate.
    - .2 For ULC rated systems: Refer to Section 07840 – Fire Stopping and Smoke Seals.

### **2.3 JOINT CLEANER**

- .1 Non-corrosive and non-staining type, compatible with joint forming materials and sealant in accordance with sealant manufacturer's written recommendations.
- .2 Primer: in accordance with sealant manufacturer's written recommendations.

## **PART 3 – EXECUTION**

### **3.1 EXAMINATION**

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for joint sealants installation in accordance with manufacturer's written instructions.
  - .1 Visually inspect substrate.
  - .2 Inform Consultant of unacceptable conditions immediately upon discovery.
  - .3 Proceed with installation only after unacceptable conditions have been remedied.

### **3.2 SURFACE PREPARATION**

- .1 Examine joint sizes and conditions to establish correct depth to width relationship for installation of back-up materials and sealants.
- .2 Clean bonding joint surfaces of harmful matter substances including dust, rust, oil grease, and other matter which may impair Work.
- .3 Do not apply sealants to joint surfaces treated with sealer, curing compound, water repellent, or other coatings unless tests have been performed to ensure compatibility of materials. Remove coatings as required.
- .4 Ensure joint surfaces are dry and frost free.
- .5 Prepare surfaces in accordance with manufacturer's directions.

### 3.3 PRIMING

- .1 Where necessary to prevent staining, mask adjacent surfaces prior to priming and caulking.
- .2 Prime sides of joints in accordance with sealant manufacturer's instructions immediately prior to caulking.

### 3.4 BACK-UP MATERIAL

- .1 Apply bond breaker tape where required to manufacturer's instructions.
- .2 Install joint filler to achieve correct joint depth and shape, with approximately 30% compression.

### 3.5 MIXING

- .1 Mix materials in strict accordance with sealant manufacturer's instructions.

### 3.6 APPLICATION

- .1 Sealant:
  - .1 Apply sealant in accordance with manufacturer's written instructions.
  - .2 Mask edges of joint where irregular surface or sensitive joint border exists to provide neat joint.
  - .3 Apply sealant in continuous beads.
  - .4 Apply sealant using gun with proper size nozzle.
  - .5 Use sufficient pressure to fill voids and joints solid.
  - .6 Form surface of sealant with full bead, smooth, free from ridges, wrinkles, sags, air pockets, embedded impurities.
  - .7 Tool exposed surfaces before skinning begins to give slightly concave shape.
  - .8 Remove excess compound promptly as work progresses and upon completion.
- .2 Curing:
  - .1 Cure sealants in accordance with sealant manufacturer's instructions.
  - .2 Do not cover up sealants until proper curing has taken place.

### 3.7 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 – Cleaning.
  - .1 Leave Work area clean at end of each day.
  - .2 Clean adjacent surfaces immediately.
  - .3 Remove excess and droppings, using recommended cleaners as work progresses.
  - .4 Remove masking tape after initial set of sealant.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 – Cleaning.

### 3.8 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by joint sealants installation.

### 3.9 SCHEDULE

- .1 Apply sealant at the following exterior locations:
  - .1 Between dissimilar materials in locations except where specifically indicated otherwise.
  - .2 Control joints in masonry elements.
  - .3 Joints between precast elements and between precast concrete elements and adjacent Work.
  - .4 Below thresholds (double bead).
  - .5 At perimeter of door, screen and louver frames.
  - .6 At penetrations through exterior building elements.
  - .7 Where indicated.
- .2 Apply sealant at the following interior locations:
  - .1 Between dissimilar materials in exposed locations except where specifically indicated otherwise.
  - .2 Perimeter of exterior door, louver and screen frames.
  - .3 Between interior door frames and wall.
  - .4 Control joints in masonry elements, and joints between bearing and non-bearing masonry walls.
  - .5 Building expansion joints, except where expansion joint covers are required.
  - .6 At ceramic tile control joints.
  - .7 Perimeter of firehose cabinets, access panels, and control panels.
  - .8 Between vanities / countertops / underside of window stools and walls.
  - .9 Between interior door frame and flooring.
  - .10 Seal holes or voids made by through penetrations, poke-through termination devices, and unpenetrated openings or joints to ensure continuity and integrity of sound ratings are maintained in partitions identified with STC ratings.
  - .11 Where shown.
- .3 At interior locations use acrylic emulsion sealant except:
  - .1 At floor control joints use self leveling polyurethane.
  - .2 At vanities / countertops and at ceramic wall tile control joints use silicone sealant.
  - .3 Where expected joint movement exceeds movement capacity of acrylic emulsion sealant, use sealant specified for exterior use, as directed by Consultant

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 REFERENCES**

- .1 American Society for Testing and Materials International (ASTM)
  - .1 ASTM A 653/A 653M-15, Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
  - .2 ASTM B 29-14, Standard Specification for Refined Lead.
  - .3 ASTM B 749-14, Standard Specification for Lead and Lead Alloy Strip, Sheet and Plate Products.
- .2 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-1.181-99, Ready-Mixed Organic Zinc-Rich Coating.
  - .2 CGSB 41-GP-19Ma-84, Rigid Vinyl Extrusions for Windows and Doors.
- .3 Canadian Standards Association (CSA International)
  - .1 CSA G40.20-13/G40.21-13, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
  - .2 CSA W59-13, Welded Steel Construction (Metal Arc Welding).
  - .3 CSA A440-11, AAMA/WDMA/CSA 101/I.S.2/A440-11, North American Fenestration Standards/Specification for Windows, Doors and Skylights.
  - .4 CSA A440S1-09, Canadian Supplement to AAMA/WDMA/CSA 101/I.S.2/A440,NAFS # North American Fenestration Standard/Specification for windows, doors, and skylights, Includes Update No. 1 (2013).
- .4 Canadian Steel Door Manufacturers' Association (CSDMA)
  - .1 CSDMA, Recommended Specifications for Commercial Steel Doors and Frames, 2000.
  - .2 CSDMA, Selection and Usage Guide for Commercial Steel Doors, 1990.
- .5 National Fire Protection Association (NFPA)
  - .1 NFPA 80-2016 Edition, Standard for Fire Doors and Other Opening Protectives.
  - .2 NFPA 252-(2012), Standard Methods of Fire Tests of Door Assemblies.
- .6 Underwriters' Laboratories of Canada (ULC)
  - .1 CAN/ULC-S701-11, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.
  - .2 CAN/ULC-S702-14, Standard for Thermal Insulation, Mineral Fibre, for Buildings.
  - .3 CAN/ULC-S704-11, Standard for Thermal Insulation, Polyurethane and Polyisocyanurate Boards, Faced.
  - .4 CAN/ULC4-S104-10, Standard Method for Fire Tests of Door Assemblies.
  - .5 CAN4-S105-09, Standard Specification for Fire Door Frames Meeting the Performance Required by CAN4-S104.

### **1.2 SYSTEM DESCRIPTION**

- .1 Design Requirements:
  - .1 Design exterior frame assembly to accommodate to expansion and contraction when subjected to minimum and maximum surface temperature of -35 degrees C to 35 degrees C.
  - .2 Maximum deflection for exterior steel entrance screens under wind load of 1.2 kPa not to exceed 1/175th of span.

- .3 Steel fire rated doors and frames: labelled and listed by an organization accredited by Standards Council of Canada in conformance with CAN4-S104 NFPA 252 for ratings specified or indicated.
- .4 Provide fire labelled frames for openings requiring fire protection ratings. Test products in conformance with CAN4-S104, ASTM E 152 or NFPA 252 and listed by nationally recognized agency having factory inspection services.
- .5 Fenestration performance grades for doors:
  - .1 In accordance with the CSA A440SI Canadian Supplement, Clause (1)(b) appropriate for the conditions and geographic location in which the doors will be installed.
  - .2 Conform to performance grades selected under CSA A440SI Canadian Supplement, Sentence (2) when tested in accordance with the standard referenced in Clause (1)(a).

### 1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Provide product data: in accordance with Section 01 33 00 – Submittal Procedures.
- .3 Provide shop drawings: in accordance with Section 01 33 00 – Submittal Procedures.
  - .1 Indicate each type of door, material, steel core thicknesses, mortises, reinforcements, location of exposed fasteners, openings, glazed, louvred, arrangement of hardware and fire rating and finishes.
  - .2 Indicate each type frame material, core thickness, reinforcements, glazing stops, location of anchors and exposed fastenings and reinforcing fire rating finishes.
  - .3 Include schedule identifying each unit, with door marks and numbers relating to numbering on drawings and door schedule.
  - .4 Submit test and engineering data, and installation instructions.
  - .5 Verify actual opening sizes and field conditions by field measurement before fabrication. Shop drawings to reflect measurements and conditions provided, and product shall be manufactured accordingly. Coordinate field measurements with fabrication and construction schedules to avoid delays.
- .4 Provide samples in accordance with Section 01 33 00 – Submittal Procedures.
- .5 Submit one 305 x 305 mm / 12" x 12" corner sample of each type of frame.
  - .1 Show butt cutout glazing stops 12" long removable mullion connection snap-on trim with clips.

### 1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 – Common Product Requirements.
- .2 Storage and Handling Requirements:
  - .1 Store materials off floor, in well ventilated room, indoors in dry location and in accordance with manufacturer's recommendations in clean, dry area.
  - .2 Store and protect metal doors and frames from dents, nicks, scratches, and blemishes, well-ventilated area.
  - .3 Replace defective or damaged materials with new.

## 1.5 QUALITY ASSURANCE

- .1 Acoustic Testing:
  - .1 Refer to Section 09 21 16 Gypsum Board Assemblies.

## **PART 2 - PRODUCTS**

### 2.1 MATERIALS

- .1 Standard hollow metal doors, frames and screens shall be as manufactured by Barron Steel Doors and Frames or approved alternate.
- .2 Acoustic doors, frames and screens shall be as manufactured by Fleming Steel Doors and Frames, or approved alternate.
  - .1 Provide whisper core acoustic doors and frames with applicable sound transmission control rating (STC) as indicated on the door and frame schedule.
  - .2 Acoustic door and frame construction to correspond to scheduled STC rating.
- .3 Hot dipped galvanized steel sheet: to ASTM A 653M, ZF75, minimum base steel thickness in accordance with CSDMA Table 1 - Thickness for Component Parts.
- .4 Reinforcement channel: to CSA G40.20/G40.21, Type 44W, coating designation to ASTM A 653M, ZF75.
- .5 Cast or rolled pure sheet lead: to ASTM B 29 ASTM B 749, weight: 19.5 kg/m<sup>2</sup>, thickness 1.6 mm.
- .6 Composites: balance of core materials used in conjunction with lead: in accordance with manufacturers' proprietary design.

### 2.2 DOOR CORE MATERIALS

- .1 Honeycomb Construction:
  - .1 Structural full, 1 1/4", cell size resin impregnated fibrous 'honeycomb'.
- .2 Stiffened: face sheets , insulated core.
  - .1 Insulation: polyurethane, rigid extruded, closed cell board and heat resistant. Density; 16 to 32 kg/m<sup>3</sup>, thermal values; RSI 1.0 (R 6.0) minimum, Type 1, in accordance with ASTM C578  
Fibreglass: to CAN/ULC-S702, semi-rigid, density 24 kg/m<sup>2</sup>.

### 2.3 ADHESIVES

- .1 Honeycomb cores and steel components: heat resistant, spray grade, resin reinforced neoprene/rubber (polychloroprene) based, low viscosity, contact cement.
- .2 Polystyrene and Polyurethane cores: heat resistant, epoxy resin based, low viscosity, contact cement.
- .3 Lock-seam doors: fire resistant, resin reinforced polychloroprene, high viscosity, sealant/adhesive.

## **2.4 PRIMER**

- .1 Touch-up prime CAN/CGSB-1.181.

## **2.5 PAINT**

- .1 Field paint steel doors and frames in accordance with Section 09 91 99 - Painting. Protect weatherstrips from paint. Provide final finish free of scratches or other blemishes.

## **2.6 ACCESSORIES**

- .1 Door silencers: single stud rubber/neoprene type.
- .2 Exterior and interior top and bottom caps: rigid polyvinylchloride extrusion conforming to CGSB 41-GP-19Ma.
- .3 Fabricate glazing stops as formed channel, minimum 16 mm height, accurately fitted, butted at corners and fastened to frame sections with counter-sunk oval head sheet metal screws.
- .4 Door bottom seal: Refer to Section 08 71 00 Door Hardware and door hardware schedule.
- .5 Metallic paste filler: to manufacturer's standard.
- .6 Fire labels: metal, riveted and clearly visible.
- .7 Sealant: Refer to Section 07 92 00 – Joint Sealing.
- .8 Glazing: Refer to Section 08 80 50 – Glazing.
  - .1 Make provisions for glazing as indicated and provide necessary glazing stops.
    - .1 Provide removable stainless steel glazing beads for use with glazing tapes and compounds and secured with countersunk stainless steel screws.
    - .2 Design exterior glazing stops to be tamperproof.

## **2.7 FRAMES FABRICATION GENERAL**

- .1 Fabricate frames in accordance with CSDMA specifications.
- .2 Fabricate frames to profiles and maximum face sizes as indicated.
- .3 Exterior frames: 16 ga. welded thermally broken type construction.
- .4 Interior frames:
  - .1 16 ga. welded type construction, unless otherwise indicated.
- .5 Blank, reinforce, drill and tap frames for mortised, templated hardware, and electronic hardware using templates provided by finish hardware supplier. Reinforce frames for surface mounted hardware.
- .6 Prepare frame for door silencers, three (3) for single door, two (2) at head for double door.
- .7 Weld in place all frame back boxes, provided by hardware schedule for electrical hardware. Boxes shall be centred on the electrical hardware preparation.

- .8 Provide ½" conduit to all electrical hardware locations in frame and screen mullions and mid-rails. Coordinate exact locations with hardware schedule.
- .9 Manufacturer's nameplates on frames and screens are not permitted.
- .10 Conceal fastenings except where exposed fastenings are indicated.
- .11 Provide factory-applied touch up primer at areas where zinc coating has been removed during fabrication.
- .12 Insulate entire interior of interior frame components with mineral wool acoustic insulation.
- .13 Wrap around frames to be used at gypsum wallboard interior partitions.
- .14 Insulate entire interior of exterior frame components with polyurethane foam insulation.

## **2.8 FRAME ANCHORAGE**

- .1 Provide appropriate anchorage to floor and wall construction.
- .2 Locate each wall anchor immediately above or below each hinge reinforcement on hinge jamb and directly opposite on strike jamb.
- .3 Provide a minimum of three anchors for doors. Provide two (2) anchors for rebate opening heights up to 1520 mm / 5'-0" and one (1) additional anchor for each additional 760 mm / 2'-6" of height or fraction thereof.
- .4 Locate anchors for frames in existing openings not more than 150 mm / 6" from top and bottom of each jamb and intermediate at 660 mm / 26" on centre maximum.

## **2.9 FRAMES: WELDED TYPE**

- .1 Welding in accordance with CSA W59.
- .2 Accurately mitre or mechanically joint frame product and securely weld on inside of profile.
- .3 Cope accurately and securely weld butt joints of mullions, transom bars, centre rails and sills.
- .4 Grind welded joints and corners to a flat plane, fill with metallic paste and sand to uniform smooth finish.
- .5 Securely attach floor anchors to inside of each jamb profile.
- .6 Weld in two (2) temporary jamb spreaders per frame to maintain proper alignment during shipment.

## **2.10 DOOR FABRICATION GENERAL**

- .1 Doors: swing type, flush, with provision for glass and/or louvre openings as indicated.
- .2 Exterior doors: insulated construction, size as indicated x 45 mm / 1 3/4" thick, unless otherwise indicated.

- .3 Exterior doors shall have extended P.V.C flush cap closing off head rail conforming to CGSB 41-GP-19Ma and will be insulated.
- .4 Interior doors: insulated steel construction, size as indicated x 45 mm / 1 3/4" thick, unless otherwise indicated.
- .5 Fabricate doors with longitudinal edges welded. Grind welded seam joints to a flat plane, fill with metallic paste filler and sand to a uniform smooth finish.
- .6 Doors: manufacturers' proprietary construction, tested and/or engineered as part of a fully operable assembly, including door, frame, gasketing and hardware in accordance with ASTM E 330.
- .7 Size doors to provide even margins between doors and jambs and doors and finished floor and thresholds as follows:
  - .1 Hinge side: 1.0 mm / 3/64".
  - .2 Latchside and head: 1/16".
  - .3 Underside of door to finished floor, top of carpet, noncombustible sill, and thresholds: 13 mm / 1/2".
- .8 Blank, reinforce, drill doors and tap for mortised, templated hardware and electronic hardware.
- .9 Factory prepare holes 12.7 mm / 1/2" diameter and larger except mounting and through-bolt holes, on site, at time of hardware installation.
- .10 Factory all doors to receive hardware, including preparation for specialized integral door power requirements, to be coordinated with the hardware supplier.
  - .1 Refer to Section 08 71 00 – Door hardware.
- .11 Provide 3/8" wire raceway and pull string from current transfer location to all electric hardware locations. Raceways must be clear of all other door cut outs. Electric mortise lock preps must be a minimum 124 mm deep to accommodate future wiring and connectors.
- .12 Reinforce doors where required, for surface mounted hardware. Provide inverted, recessed, spot welded channels to top and bottom of interior and exterior doors and finish with flush PVC top and bottom caps.
- .13 Provide factory-applied touch-up primer at areas where zinc coating has been removed during fabrication.
- .14 Provide fire labelled doors for those openings requiring fire protection ratings, as scheduled. Test such products in conformance with CAN4-S104, NFPA 252 and list by nationally recognized agency having factory inspection service and construct as detailed in Follow-Up Service Procedures/Factory Inspection Manuals issued by listing agency to individual manufacturers.
- .15 Manufacturer's nameplates on doors are not permitted.

## 2.11 HOLLOW STEEL CONSTRUCTION

- .1 Form face sheets for exterior doors from 16 ga. sheet steel.
- .2 Form face sheets for interior doors from 18 ga. sheet steel.

- .3 Reinforce doors with vertical stiffeners, securely welded to face sheets at 6" on centre maximum.
- .4 Fill voids between stiffeners of exterior doors with polyurethane core.
- .5 Fill voids between stiffeners of interior doors with acoustic insulation core to achieve required STC rating.
- .6 Provide temperature rise rated core where indicated.

## **2.12 THERMALLY BROKEN DOORS AND FRAMES**

- .1 Fabricate thermally broken doors by using insulated core and separating exterior parts from interior parts with continuous interlocking thermal break.
- .2 Thermal break: rigid polyvinylchloride extrusion conforming to CGSB 41-GP-19Ma.
- .3 Fabricate thermally broken frames separating exterior parts from interior parts with continuous interlocking thermal break.
- .4 Apply insulation to entire frame interior.

## **PART 3 - EXECUTION**

### **3.1 MANUFACTURER'S INSTRUCTIONS**

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.

### **3.2 INSTALLATION GENERAL**

- .1 Install labelled steel fire rated doors and frames to NFPA 80 except where specified otherwise.
- .2 Install doors and frames to CSDMA Installation Guide.

### **3.3 FRAME INSTALLATION**

- .1 Set frames plumb, square, level and at correct elevation.
- .2 Secure anchorages and connections to adjacent construction.
- .3 Brace frames rigidly in position while building-in. Install temporary horizontal wood spreader at third points of door opening to maintain frame width. Provide vertical support at centre of head for openings over 4'-0" wide. Remove temporary spreaders after frames are built-in.
- .4 Make allowances for deflection of structure to ensure structural loads are not transmitted to frames.
- .5 Caulk perimeter of frames between frame and adjacent material in accordance with Section 07 92 00 – Joint Sealants.
- .6 Maintain continuity of air barrier and vapour retarder. Provide continuous air / vapour barrier seal between thermal break of thermally broken frame and air / vapour barrier of exterior wall system with air / vapour barrier transition membrane. Refer to Section 07 28 00 Air / Vapour Barriers.

### **3.4 DOOR INSTALLATION**

- .1 Install doors and hardware in accordance with hardware templates and manufacturer's instructions and Section 08 71 00 – Door Hardware.
- .2 Adjust operable parts for correct function.
- .3 Install louvres.

### **3.5 FINISH REPAIRS**

- .1 Touch up with primer finishes damaged during installation.
- .2 Fill exposed frame anchors and surfaces with imperfections with metallic paste filler and sand to a uniform smooth finish.

### **3.6 GLAZING**

- .1 Install glazing for doors and frames in accordance with Section 08 80 50 – Glazing.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 REFERENCES**

- .1 American Architectural Manufacturers Association (AAMA)
  - .1 AAMA 609/610-09, Cleaning and Maintenance Guide for Architecturally Finished Aluminum.
- .2 ASTM International
  - .1 ASTM E 330/E330M-14, Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference.
- .3 Canadian General Standards Board (CGSB)
  - .1 CGSB 1.40-97, Anticorrosive Structural Steel Alkyd Primer.
  - .2 CAN/CGSB-12.1-M90, Tempered or Laminated Safety Glass.
  - .3 CAN/CGSB-12.20-M89, Structural Design of Glass for Buildings.
- .4 CSA International
  - .1 CSA G40.20-13/G40.21-13, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
  - .2 CAN/CSA G164-M92 (R2003), Hot Dip Galvanizing of Irregularly Shaped Articles.
  - .3 CSA A440-11, AAMA/WDMA/CSA 101/I.S.2/A440-11, North American Fenestration Standards/Specification for Windows, Doors and Skylights.
  - .4 CSA A440S1-09, Canadian Supplement to AAMA/WDMA/CSA 101/I.S.2/A440,NAFS # North American Fenestration Standard/Specification for windows, doors, and skylights, Includes Update No. 1 (2013).
- .5 Environmental Choice Program (ECP)
  - .1 CCD-045-95, Sealants and Caulking Compounds.

### **1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for doors and frames and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
  - .1 Indicate materials and profiles and provide full-size, scaled details of components for each type of door and frame. Indicate:
    - .1 Interior trim and exterior junctions with adjacent construction.
    - .2 Junctions between combination units.
    - .3 Elevations of units.
    - .4 Core thicknesses of components.
    - .5 Type and location of exposed finishes, method of anchorage, number of anchors, supports, reinforcement, and accessories.
    - .6 Location of caulking.
    - .7 Each type of door system including location.
    - .8 Arrangement of reinforcing for hardware and joints.
    - .9 Arrangement of hardware and required clearances.

- .4 Samples:
  - .1 Submit for review and acceptance of each unit.
  - .2 Samples may be returned for inclusion into work.
  - .3 Submit one 12" x 12" corner sample of each type door and frame.
  - .4 Submit sample showing glazing detail, reinforcement, finish and location of manufacturer's nameplates.
  - .5 Frame sample to show glazing stop, door stop, jointing detail, finish, and wall trim where indicated.
- .5 Manufacturers Reports:
  - .1 Manufacturer's Field Reports: submit manufacturer's written reports within three 3 days of review, verifying compliance of Work, as described in Part 3 - FIELD QUALITY CONTROL.

### 1.3 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 – Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for cleaning and maintenance of aluminum finishes for incorporation into manual.

### 1.4 QUALITY ASSURANCE

- .1 Test Reports: certified test reports showing compliance with specified performance characteristics and physical properties.
- .2 Certifications: product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.
- .3 Pre-installation Meetings: conduct pre-installation meeting to verify project requirements, manufacturer's installation instructions and manufacturer's warranty requirements.
- .4 Manufacturer's Field Services: as part of Manufacturer's Services described in PART 3 - FIELD QUALITY CONTROL, schedule site visits with manufacturer's representative, to review Work, at stages listed.
  - .1 After delivery and storage of products, and when preparatory Work and mock-up is complete, but before installation begins.
  - .2 Twice during progress of Work at 25% and 60% complete.
  - .3 Upon completion of Work, after cleaning is carried out.
- .5 Acoustic Testing:
  - .1 Refer to Section 09 21 16 Gypsum Board Assemblies.

### 1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 – Common Product Requirements and with manufacturer's written instructions.

- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
  - .1 Apply temporary protective coating to finished surfaces. Remove coating after erection. Use coatings that are easy to remove and residue free.
  - .2 Leave protective covering in place until final cleaning of building.
- .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 aluminum doors and frames from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.

## **1.6 GUARANTEES**

- .1 Door Manufacturer shall guarantee the frames and doors against defective material and workmanship which shall appear within a period of seven (7) years from the date of the architects' certificate of substantial completion.

## **PART 2 - PRODUCTS**

### **2.1 DESIGN CRITERIA**

- .1 Design frames and doors in exterior walls to:
  - .1 Accommodate expansion and contraction within service temperature range of -35 to 35 degrees C.
  - .2 Limit deflection of mullions to maximum 1/175th of clear span when tested to ASTM E 330 under wind load of 1.2 kPa submit certificate of tests performed.
  - .3 Movement within system.
  - .4 Movement between system and perimeter framing components or substrate.
  - .5 Fenestration performance grades:
    - .1 In accordance with the CSA A440SI Canadian Supplement, Clause (1)(b) appropriate for the conditions and geographic location in which the doors will be installed.
    - .2 Conform to performance grades selected under CSA A440SI Canadian Supplement, Sentence (2) when tested in accordance with the standard referenced in Clause (1)(a).
- .2 Include continuous air / vapour barrier and vapour retarder through door system. Primarily in line with inside pane of glass and heel bead of glazing compound.

### **2.2 MATERIALS**

- .1 Aluminum extrusions: to Aluminum Association alloy AA 6063-T5 or T6 anodizing quality.
- .2 Sheet aluminum: 1.5 mm/ 1/16" minimum thick to Aluminum Association alloy AA 1100 - H14 or AA 5005 - H32 or H34 anodizing quality.
- .3 Steel reinforcement: to CSA G40.20/G40.21, grade 300 W.
- .4 Fasteners: stainless steel, finished to match adjacent material.

- .5 Weatherstrip: replaceable, mohair and metal backed wool pile.
- .6 Door bumpers: black neoprene.
- .7 Door bottom seal: operable and automatic door seal of anodized extruded aluminum frame and vinyl weather seal, recessed in door bottom, closed ends, automatic retract mechanism when door is open.
- .8 Isolation coating: alkali resistant.
- .9 Glazing materials: Refer to Section 08 80 50 – Glazing.
- .10 Sealants: colour as later selected by Consultant in accordance with Section 07 92 00 - Joint Sealants.

## 2.3 ALUMINUM DOORS

- .1 Exterior Thermally Broken Aluminum Entrance Doors:
  - .1 Construct doors of porthole extrusions with minimum wall thickness of 0.125".
  - .2 Door depth: 2 1/4".
  - .3 Door stiles nominal 4 1/4" wide plus or minus 1/4".
  - .4 Top rail nominal 4 1/4" wide plus or minus 1/4".
  - .5 Bottom rail nominal 6 1/2" wide plus or minus 1/4".
  - .6 Mid rail nominal 3 1/2" wide plus or minus 1/4".
  - .7 Reinforce mechanically-joined corners of doors to produce sturdy door unit.
  - .8 Acceptable product: 'AA 425 wide stile', by Kawneer, or approved alternate.
- .2 Glazing stops: interlocking snap-in type for dry glazing. Exterior stops: tamperproof type.  
Hardware: Refer to Section 08 71 00 – Door Hardware.
- .3 Interior Aluminum Entrance Door:
  - .1 Construct doors of porthole extrusions with minimum wall thickness of 0.090" minimum.
  - .2 Door depth: 1 3/4".
  - .3 Door stiles nominal 89 mm / 3 1/2" wide plus or minus 1/4".
  - .4 Top rail nominal 89 mm / 3 1/2" wide plus or minus 1/4".
  - .5 Bottom rail nominal 165 mm / 6 1/2" wide plus or minus 1/4".
  - .6 Reinforce mechanically-joined corners of doors to produce sturdy door unit.
  - .7 Glazing stops: interlocking snap-in type for dry glazing. Exterior stops: tamperproof type.
  - .8 Hardware: Refer to Section 08 71 00 – Door Hardware.
  - .9 Acceptable product: '350 Medium Stile' by Kawneer, or approved alternate.

## 2.4 ALUMINUM FRAMES

- .1 Construct thermally broken and insulated frames of aluminum extrusions with minimum wall thickness of 13/64" at all hardware attachment points.
- .2 Frame members:
  - .1 Exterior: thermally broken, 50 mm x 115 mm / 2" x 4 1/2" nominal size, for flush glazing.
  - .2 Interior: 45 mm x 115 mm / 1 3/4" x 4 1/2" nominal size, for flush glazing.

- .3 Sidelite Base: width to match frame, height to match bottom rail of adjacent door.
- .4 Acceptable product:
  - .1 Interior and Exterior Frame: 'AA 6500', by Kawneer, or approved alternate.

## **2.5 ALUMINUM FINISHES**

- .1 All door and frame finish unless otherwise noted:
  - .1 Exterior Doors and Frames #17 clear, designation AA M12C22A31 anodized anodic finish, designation by Kawneer, or approved alternate.
  - .2 Interior Doors and Frames: #17 clear, designation AA M12C22A31 anodized anodic finish, designation AA M12C22A44 by Kawneer, or approved alternate.
- .2 Appearance and properties of anodized finishes designated by Aluminum Association as Architectural Class 1, Architectural Class 2, and Protective and Decorative.

## **2.6 STEEL FINISHES**

- .1 Finish steel clips and reinforcing steel with steel primer to CGSB 1.40.

## **2.7 FABRICATION**

- .1 Doors and framing to be by same manufacturer.
- .2 Fabricate doors and frames to profiles and maximum face sizes as indicated. 7/8" bite for insulating glazed units.
- .3 Provide structural steel reinforcement as required.
- .4 Fit joints tightly and secure mechanically.
- .5 Conceal fastenings.
- .6 Mortise, reinforce, drill and tap doors, frames and reinforcements to receive hardware using templates provided under Section 08 71 00 - Door Hardware.
- .7 Isolate aluminum from direct contact with dissimilar metals, concrete and masonry.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- .1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for aluminum doors and frames installation in accordance with manufacturer's written instructions.
  - .1 Visually inspect substrate. Examine work of other trades over which aluminum framing will be applied, for conformity to drawings. Report all discrepancies to Consultant prior to commencing with work for aluminum doors and framing systems.
  - .2 Deliver all Aluminum door frames and glazing material and related components in the manufacturers provided protective packaging. Do not deliver until ready for installation.

- .3 Inspect all components for damage upon delivery
- .4 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .5 Store all materials indoors, in dry locations. Ensure that materials do not come into direct contact with ground or damp substrates.
- .6 Inform Consultant of unacceptable conditions immediately upon discovery.
- .7 Proceed with installation only after unacceptable conditions have been remedied.

### **3.2 INSTALLATION**

- .1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.
- .2 Set frames plumb, square, level at correct elevation in alignment with adjacent work.
- .3 Anchor securely.
- .4 Install doors and hardware in accordance with hardware templates and manufacturer's instructions.
- .5 Adjust door components to ensure smooth operation.
- .6 Make allowances for deflection of structure to ensure that structural loads are not transmitted to frames.
- .7 Once door is hung and glazed contractor shall check and re-adjust, as required, all aspects including but not limited to; operating hardware installed under this section.
- .8 Strictly adhere to manufacturer's shop drawings specified widths and heights to ensure excellent fit and finish.
- .9 Once installation of door and hardware is complete, inspect door, frame and hardware to ensure proper function as intended.
- .10 Glaze aluminum doors and frames in accordance with Section 08 80 50 - Glazing.
- .11 Seal joints to provide weathertight seal at outside and air, vapour seal at inside.
- .12 Apply sealant in accordance with Section 07 92 00 - Joint Sealants. Conceal sealant within the aluminum work except where exposed use is permitted by Consultant.

### **3.3 FIELD QUALITY CONTROL**

- .1 Have manufacturer of products supplied under this Section review Work involved in handling, installation/application, protection and cleaning of its products, and submit written reports in acceptable format to verify compliance of Work with Contract.
- .2 Manufacturer's Field Services: 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 Manufacturer's Field Services:
  - .1 Obtain written reports from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.
  - .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, as directed in PART 1 - QUALITY ASSURANCE.

### **3.4 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 – Cleaning.
  - .1 Leave Work area clean at end of each day.
  - .2 Perform cleaning of aluminum components in accordance with AAMA 609.1 - Voluntary Guide Specification for Cleaning and Maintenance of Architectural Anodized Aluminum.
  - .3 Perform cleaning as soon as possible after installation to remove construction and accumulated environmental dirt.
  - .4 Clean aluminum with damp rag and approved non-abrasive cleaner.
  - .5 Remove traces of primer, caulking, epoxy and filler materials; clean doors and frames.
  - .6 Clean glass and glazing materials with approved non-abrasive cleaner.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 – Cleaning.

### **3.5 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by aluminum door and frame installation.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Verification:
  - .1 Obtain specific locations and sizes for required access doors and frames from trades, including mechanical and electrical, requiring access to concealed equipment and indicate on submittal schedule.
- .3 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for access door components and include product characteristics, performance criteria, physical size, finish, limitations, fire-resistive characteristics and details of anchorage devices.
- .4 Shop Drawings:
  - .1 Submit catalogue details for each type of door illustrating profiles, dimensions and methods of assembly.
  - .2 Door and panel units: Show types, elevations, thickness of metals, full size profiles of door members.
  - .3 Hardware: Show materials, finishes, locations of fasteners, types of fasteners, locations and types of operating hardware, and details of installation.
  - .4 General: Show connections of units and hardware to other Work. Include schedules showing location of each type and size of door and panel units.

### **1.2 CLOSEOUT SUBMITTALS**

- .1 Submit in accordance with Section 01 78 00 – Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for incorporation into manual.

### **1.3 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect access doors from nicks, scratches, and blemishes.

- .3 Apply temporary protective coating to finished surfaces. Remove coating after installation.
  - .1 Use coatings in accordance with manufacturer's written instructions that are easily removable.
  - .2 Leave protective coating in place until final cleaning of building.
- .4 Replace defective or damaged materials with new.

#### **1.4 QUALITY ASSURANCE**

- .1 Single Source Responsibility: Obtain access door and panel units, and frames for entire Project from 1 source and 1 single manufacturer.
- .2 Coordination: Provide inserts and anchoring devices that will be built into other Work for installation of access door assemblies. Coordinate delivery with other Work to avoid delay.

### **PART 2 - PRODUCTS**

#### **2.1 NON-RATED ACCESS DOORS FOR WALLS AND CEILINGS**

- .1 Source Limitations: Obtain each type of access door and frame for the entire project from a single source and from a single manufacturer.
- .2 Size: to suit access requirements.
  - .1 For body entry: 600 x 600 mm minimum.
  - .2 For hand entry: 300 x 300 mm minimum.
- .3 Construction: rounded safety corners, concealed hinges, screwdriver latch, anchor straps, able to open 180 degrees.
- .4 Gasketing: Fabricate access doors with neoprene gasket around perimeter of door frame.
- .5 Anchors: concealed, to suit application.
- .6 Finish: as follows:
  - .1 All areas unless otherwise indicated: Galvanized, bonderized steel with white powder coat primer.
  - .2 To all washrooms, kitchens, custodial wet areas and other wet areas as indicated: No. 304 stainless steel with No. 4 satin brushed polished finish.
- .7 Flush Access Doors with Exposed Flanges:
  - .1 Assembly Description: Fabricate door to fit flush to frame. Provide manufacturer's standard-width exposed flange, proportional to door size.
  - .2 Door: 1.6 mm / 16 gauge cold rolled steel with edge support for structural rigidity.
  - .3 Frame: Standard, 16 gauge cold rolled sheet steel with concealed fasteners.
  - .4 Hinge: Concealed continuous rod opening to 100 degrees.
  - .5 Latching : Factory installed 6 mm / 1/4" allen key, self-latching.

- .8 Flush Access Doors with Concealed Flanges / Frame:
  - .1 Assembly Description: Fabricate door to fit flush to frame. Provide frame with gypsum board beads for concealed flange installation.
  - .2 Door: 1.6 mm / 16 gauge cold rolled steel beveled on all 4 sides.
  - .3 Frame: 1.6 mm / 16 gauge cold rolled steel with 13 mm / 1/2" flange at perimeter.
  - .4 Hinge: Hinges: Flush continuous piano hinge.
  - .5 Latching: Factory installed 6 mm / 1/4" Allen key, self-latching.

## 2.2 FIRE-RATED ACCESS DOORS FOR WALLS AND CEILINGS

- .1 Fire-Rated Access Doors and Frames: Provide access door and frame assemblies tested for fire-test-response characteristics in accordance with NFPA 80 to the following test methods and that are listed and labeled by UL or Interek - Warnock Hersey and to the authorities having jurisdiction:
  - .1 NFPA 252 or UL 10B for fire-rated access door assemblies installed vertically.
  - .2 NFPA 288 for fire-rated access door assemblies installed horizontally.
- .2 Fire-Resistance Ratings: Wherever a fire-resistance classification is indicated, provide fire rated access door and panel assemblies with panel door, frame, hinge, and latch from manufacturer listed in Underwriter's Laboratories (UL), "Building Materials Directory" or Interek - Warnock Hersey for rating shown.
  - .1 Provide 90 minute UL label at 2-hour rated partitions.
  - .2 Provide 3 hour Warnock Hersey label at horizontal applications, up to 24 inches wide x 36 inches high.
  - .3 Provide 2 hour Warnock Hersey label at horizontal applications greater than 24 inches wide x 36 inches high.
- .3 Size: to suit access requirements.
  - .1 For body entry: 610 x 610 mm / 24" x 24" minimum.
  - .2 For hand entry: 305 x 305 mm / 12" x 12" minimum.
- .4 Construction: rounded safety corners, concealed hinges, screwdriver latch, anchor straps, able to open 180 degrees.
- .5 Anchors: concealed, to suit application.
- .6 Finish:
  - .1 All areas unless otherwise indicated: Galvanized, bonderized steel with white powder coat primer.
  - .2 To all washrooms, kitchens, custodial wet areas and other wet areas as indicated: No. 304 stainless steel with No. 4 satin brushed polished finish.
- .7 Maximum Size and Rating for:
  - .1 Horizontal Application: 610 mm wide x 914 mm high / 24" x 36".
  - .2 Maximum Size and Rating for Vertical Applications: 1219 mm x 1219 mm / 48" x 48".
- .8 Fire-Rated, Insulated Flush Access Doors with Exposed Flanges / Frame:
  - .1 Assembly Description: Fabricate door to fit flush to frame, with a core of mineral-fibre insulation enclosed in sheet metal. Provide self-latching door with automatic closer and interior latch release. Provide manufacturer's standard-width exposed flange, proportional to door size.

- .2 Door: 0.9 mm / 20 gauge galvanized (satin coated) steel door with 2 1/4 inch (57 mm) depth sandwich type assembly.
- .3 Frame Material: 1.6 mm / 16 gauge cold rolled steel of 64 mm / 2 1/2" depth with 25.4 mm / 1" flange at perimeter with concealed fasteners.
- .4 Hinges: Flush continuous piano hinge.
- .5 Latching / Locking Devices: Standard, self-latching tool-key operated slam latch and/or ring operated slam latch key operated cylinder cam latch with 2 keys per lock, keyed alike hex head cam latch, regular 6 mm / 1/4" Allen head.
- .6 Automatic Closure Devices: Spring operated automatic closure devices for each door, number of springs to suit door size.
- .7 Interior Latch Release all doors over 305 mm x 305 mm / 12" x 12": Mechanisms to allow panels to open from inside.
- .8 Insulation: 51 mm / 2" thick fire rated mineral wool.
- .9 Flush Access Doors with Concealed Flanges / Frame:
  - .1 Assembly Description: Fabricate door to fit flush to frame, with a core of mineral-fibre insulation enclosed in sheet metal with self-latching door, automatic closer and interior latch release. Provide frame with gypsum board plaster beads for concealed flange installation.
  - .2 Door: 0.9 mm / 20 gauge galvanized (satin coated) steel door with 2 1/4 inch (57 mm) depth sandwich type assembly.
  - .3 Frame: 1.6 mm / 16 gauge cold rolled steel of 64 mm / 2 1/2" depth with 25.4 mm / 1" flange at perimeter with concealed fasteners.
  - .4 Hinge: Hinges: Flush continuous piano hinge.
  - .5 Latching / Locking: Factory installed 6 mm / 1/4" Allen key, self-latching Key operated cylinder cam lock with 2 keys per lock, keyed alike Pinned Allen head security cam latches.
  - .6 Automatic Closure Devices: Spring operated automatic closure devices for each door, number of springs to suit door size.
  - .7 Interior Latch Release all doors over 305 mm x 305 mm / 12" x 12": Mechanisms to allow panels to open from inside.
  - .8 Insulation: 51 mm / 2" thick fire rated mineral wool.

## 2.3 EXCLUSIONS

- .1 Lay-in tile ceilings: use unobtrusive identification locators.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- .1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for access door installation in accordance with manufacturer's written instructions.
  - .1 Visually inspect substrate.
  - .2 Proceed with installation only after unacceptable conditions have been remedied.

### **3.2 INSTALLATION**

- .1 Installation: locate access doors within view of equipment and ensure equipment is accessible for operating, inspecting, adjusting, servicing without using special tools.
  - .1 Install masonry surfaces in accordance with Section 04 20 00 – Unit Masonry.
  - .2 Install gypsum board surfaces in accordance with Section 09 21 16 – Gypsum Board Assemblies.

### **3.3 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 – Cleaning.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 – Cleaning.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

### **3.4 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by access door installation.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 REFERENCES**

- .1 Aluminum Association (AA)
  - .1 AA DAF 45-03(R2009), Designation System for Aluminum Finishes.
- .2 American Architectural Manufacturers Association (AAMA)
  - .1 AAMA CW-10-04, Care and Handling of Architectural Aluminum From Shop to Site.
  - .2 AAMA CW-11-85, Design Wind Loads and Boundary Layer Wind Tunnel Testing.
  - .3 AAMA T1R-A1-04, Sound Control for Fenestration Products.
  - .4 AAMA 501-05, Methods of Test for Exterior Walls.
  - .5 AAMA 501.2, Quality Assurance and Diagnostic Water Leakage Field Check of Installed Storefronts, Curtain Walls and Sloped Glazing Systems
  - .6 AAMA 502, Voluntary Specification for Field Testing of Newly Installed Fenestration
  - .7 AAMA 503, Voluntary Specification for Field Testing of Newly Installed Storefronts, Curtain Walls and Sloped Glazing.
  - .8 AAMA 611-98, Voluntary Specifications for Anodized Finishes Architectural Aluminum.
  - .9 AAMA 612-02, Voluntary Specifications, Performance Requirements, and Test Procedures for Combined Coatings of Anode Oxide and Transparent Organic Coatings on Architectural Aluminum.
  - .10 AAMA 2603-02, Voluntary Specification Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels.
  - .11 AAMA 2604-05, Voluntary Specification Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels.
- .3 ASTM International
  - .1 ASTM A 36/A 36M-14, Specification for Carbon Structural Steel.
  - .2 ASTM A 123/A 123M-13, Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
  - .3 ASTM A 167-15, Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
  - .4 ASTM A653/A653M-15, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
  - .5 ASTM B 209-14, Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
  - .6 ASTM B 221-14, Specification for Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
  - .7 ASTM E 283-04(2012), Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.
  - .8 ASTM E 330/E330M-14, Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights, and Curtain Walls, by Uniform Static Air Pressure Difference.
  - .9 ASTM E 331-00(2009), Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls, by Uniform Static Air Pressure Difference.
  - .10 ASTM E 413-10, Classification for Rating Sound Insulation.
  - .11 ASTM E 1105-15, Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors, and Curtain Walls, by Uniform or Cyclic Static Air Pressure Difference.
- .4 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB 1.108-M89, Bituminous Solvent Type Paint.
  - .2 CAN/CGSB-12.20-M89, Structural Design of Glass for Buildings.

- .5 CSA International
  - .1 CSA G40.20/G40.21-13, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
  - .2 CSA S136-12, North American Specification for the Design of Cold Formed Steel Structural Members.
  - .3 CSA S157-05/S157.1-05(R2015), Strength Design in Aluminum/Commentary on CSA-S157-05, Strength Design in Aluminum.
  - .4 CSA W59.2-M1991(R2013), Welded Aluminum Construction.
  - .5 CSA A440-11, North American Fenestration Standards/Specification for Windows, Doors and Skylights.
  - .6 CSA A440S1-09, Canadian Supplement to AAMA/WDMA/CSA 101/I.S.2/A440,NAFS # North American Fenestration Standard/Specification for windows, doors, and skylights, Includes Update No. 1 (2013).
- .6 Society for Protective Coatings (SSPC)
  - .1 SSPC - Paint 20-02(R2014), Zinc Rich Coating, Type I - Inorganic and Type II - Organic.
  - .2 SSPC - Paint 25-11, BCS, Zinc Oxide, Alkyd, Linseed Oil and Primer for Use Over Hand Cleaned Steel Type 1 and Type 2.

## 1.2 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination: coordinate work of this Section with installation of air / vapour barrier placement, vapour retarder placement, flashing placement, and components or materials.
- .2 Pre-Installation Meetings:
  - .1 Convene pre-installation meeting 1 week prior to beginning work of this Section, with Contractor's Representative and Consultant in accordance with Section 01 31 19 - Project Meetings to:
    - .1 Verify project requirements.
    - .2 Review installation and substrate conditions.
    - .3 Coordination with other building subtrades.
    - .4 Review manufacturer's written installation instructions and warranty requirements.
    - .5 Arrange for site visit with Consultant prior to start of Work to examine existing site conditions adjacent to demolition Work

## 1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for curtain wall components, anchorage and fasteners, glass and infill, and internal drainage details and include product characteristics, performance criteria, physical size, finish and limitations and water flow diagrams.
- .3 Shop Drawings:
  - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
  - .2 Indicate system dimensions, framed opening requirements and tolerances, adjacent construction, anchor details anticipated deflection under load, affected related Work, weep drainage network, expansion and contraction joint location and details, and field welding required.

- .4 Samples:
  - .1 Submit for review and acceptance of each unit.
  - .2 Samples will be returned for inclusion into work if requested.
  - .3 Submit 2 samples 24" x 24" in size illustrating prefinished aluminum surface, finish, colour, texture, specified glass units, insulated infill panels, glazing materials illustrating edge and corner.
- .5 Test Reports:
  - .1 Submit substantiating engineering data, test results of previous tests by independent laboratory which purport to meet performance criteria, and supportive data.

#### **1.4 CLOSEOUT SUBMITTALS**

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for glazed aluminum curtain wall for incorporation into manual.

#### **1.5 QUALITY ASSURANCE**

- .1 Regulatory Requirements:
  - .1 Conform to applicable code for acoustic attenuation, sound transmission, requirements.
- .2 Mock-ups:
  - .1 Construct mock-ups in accordance with Section 01 45 00 - Quality Control.
  - .2 Supply 3 m x full height mock-up including intermediate mullion, corner mullion, vision glass light, and insulated infill panel.
    - .1 Assemble to illustrate component assembly including glazing materials, weep drainage system, attachments, anchors, and perimeter sealant.
  - .3 Locate mock-up where directed by Consultant. Allow 48 hours for inspection of mock-up by Consultant before proceeding with work. When accepted, mock-up will demonstrate minimum standard of quality and materials for work of this Section.
  - .4 Mock-up may remain as part of finished work to Consultant approval.
- .3 Manufacturer's Field Services: as part of Manufacturer's Services described in PART 3 - FIELD QUALITY CONTROL, schedule site visits with manufacturer's representative, to review Work, at stages listed.
  - .1 After delivery and storage of products, and when preparatory Work and mock-up is complete, but before installation begins.
  - .2 Twice during progress of Work at 25% and 60% complete.
  - .3 Upon completion of Work, after cleaning is carried out.

#### **1.6 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

- .3 Storage and Handling Requirements:
  - .1 Handle work of this Section in accordance with AAMA CW-10.
  - .2 Store materials off ground indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .3 Store and protect aluminum glazed curtain wall components from nicks, scratches, and blemishes.
  - .4 Protect prefinished aluminum surfaces with wrapping or strippable coating. Do not use adhesive papers or sprayed coatings which bond when exposed to sunlight or weather.
  - .5 Replace defective or damaged materials with new.

## **1.7 AMBIENT CONDITIONS**

- .1 Install sealants when ambient and surface temperature is above 5°C minimum.
- .2 Maintain this minimum temperature during and for forty-eight (48) hours minimum after installation of sealants.

## **1.8 MANUFACTURER'S FIELD SERVICES**

- .1 Arrange for initial job start-up site attendance, periodic site attendance of membrane manufacturer's technical representative during installation work, together with written report.
- .2 The Contractor must at all times enable and facilitate access to the work site by said representative.
- .3 Notify Consultant of date and time of inspection, a minimum of 48 hours prior to inspection. Provide one copy of manufacturer's report to the Consultant within 48 hours of inspection being carried out.

## **1.9 WARRANTY**

- .1 Contractor hereby warrants that glazed aluminum curtain wall will function as specified in accordance with CCDC 24, but for sixty (60) months.

## **PART 2 - PRODUCTS**

### **2.1 SYSTEMS**

- .1 Description:
  - .1 Vertical glazed aluminum curtain wall system includes thermally broken tubular aluminum sections with self-supporting framing supplementary support, shop fabricated, factory prefinished, vision glass, insulated metal panel spandrel infill, related flashings, anchorage and attachment devices.
  - .2 Assembled system to permit re-glazing of individual glass (and infill panel) units from exterior without requiring removal of structural mullion sections.
- .2 Performance Requirements:
  - .1 Design and size components to withstand dead and live loads caused by pressure and suction of wind, snow and hail for sloped glazing, acting normal to plane of system as calculated in accordance with OBC as measured to AAMA CW 11 and ASTM E 330.

- .2 Design and size components to withstand seismic loads and sway displacement as calculated in accordance with applicable codes.
- .3 Fenestration performance grades for curtain wall system:
  - .1 In accordance with the CSA A440SI Canadian Supplement, Clause (1)(b) appropriate for the conditions and geographic location in which the doors will be installed.
  - .2 Conform to performance grades selected under CSA A440SI Canadian Supplement, Sentence (2) when tested in accordance with the standard referenced in Clause (1)(a).
- .4 Deflection of Framing Members: At design wind pressure, as follows:
  - .1 Deflection Normal to Wall Plane: Limited to edge of glass in a direction perpendicular to glass plane not exceeding  $L/175$  of the glass edge length for each individual glazing lite, or an amount that restricts edge deflection of individual glazing lites to  $3/4"$ , whichever is less. Limit deflection of clear span of framing members to  $L/175$  for spans less than or equal  $16'-6"$  and  $L/240$  for spans greater than  $16'-6"$ .
  - .2 Deflection Parallel to Glazing Plane: Limited to  $L/360$  of clear span or  $1/8"$ , whichever is smaller.
  - .3 Operable Units: Provide a minimum  $1/16"$  clearance between framing members and operable units.
  - .4 Cantilever Deflection: Where framing members overhang an anchor point, limit deflection to two times the length of cantilevered member, divided by 175.
- .5 Ensure system allows for expansion and contraction within system components when temperature range is 95 degrees C over 12 hour period without causing detrimental effect to system components.
- .6 Drain water entering joints, condensation occurring in glazing channels, or migrating moisture occurring within system, to exterior by weep drainage network.
- .7 Maintain continuous air/vapour barrier and vapour retarder throughout assembly, primarily in line with inside pane of glass and heel bead of glazing compound.
  - .1 Position thermal insulation on exterior surface of air/vapour barrier and vapour retarder.
- .8 Ensure no vibration harmonics, wind whistles, noises caused by thermal movement transmitted to other building elements, loosening, weakening, or fracturing of attachments or components of system occur.
- .9 Reinforce curtain wall system to accommodate window washing guide rails.
  - .1 Supply sufficiently rigid anchors to resist loads caused by equipment platform, without damage to wall system.

## 2.2 MATERIALS

- .1 Aluminum Extrusions: Alloy and temper recommended by glazed aluminum curtain wall manufacturer for strength, corrosion resistance, and application of required finish and not less than  $5/64"$  wall thickness at any location for the main frame and complying with ASTM B 221: 6063-T6 alloy and temper.
- .2 Aluminum sheet alloy: to requirements of ASTM B209.
- .3 Fasteners: Aluminum, nonmagnetic stainless steel or other materials to be non-corrosive and compatible with aluminum window members, trim hardware, anchors, and other components.
- .4 Anchors, Clips, and Accessories: Aluminum, nonmagnetic stainless steel, or zinc-coated steel or iron complying with ASTM B 633 for SC 3 severe service conditions or other suitable zinc coating; provide sufficient strength to withstand design pressure indicated.
- .5 Pressure Plate: Aluminum fastened to the mullion with stainless steel screws.

- .6 Reinforcing Members: Aluminum, nonmagnetic stainless steel, or nickel/chrome-plated steel complying with ASTM B 456 for Type SC 3 severe service conditions, or zinc-coated steel or iron complying with ASTM B 633 for SC 3 severe service conditions or other suitable zinc coating; provide sufficient strength to withstand design pressure indicated.
- .7 Sealant: Refer to Section 07 92 00 – Sealants.
- .8 Thermal Barrier: Thermal barrier consists of 25 mm / 1" separation between the interior and exterior metal members in a typical condition, while maintaining a continuous watertight seal. Thermal barrier assembly tested in accordance with thermal cycling requirements of ASTM E2692 and show no sign of degradation following the test.
- .9 Tolerances: Reference to tolerances for wall thickness and other cross-sectional dimensions of glazed curtain wall members are nominal and in compliance with AA Aluminum Standards and Data.
- .10 Bituminous Paint: CAN/CGSB 1.108, Type 1 or 2, without thinner as recommended by manufacturer.
- .11 Glazing: Refer to Section 08 80 50 – Glazing.

## 2.3 COMPONENTS

- .1 Description: Thermally broken with interior tubular section insulated from exterior pressure plate; matching stops and pressure plate of sufficient size and strength to provide adequate bite on glass and infill panels; drainage holes, deflector plates and internal flashings to accommodate internal weep drainage system; internal mullion baffles to eliminate "stack effect" air movement within internal spaces.
- .2 Exterior Curtain Wall, Horizontal and Vertical members: overall size including cap, 2 1/2" x 7 1/2" nominal dimension.
  - .1 Acceptable product: 1600UT Wall System 1 by Kawneer, equivalent from Alumicor or approved alternate.
- .3 Fasteners: 300 Series stainless steel or 400 series stainless steel cadmium plated of sufficient size and quantity to perform work.
- .4 Weathering and Glazing Gaskets: extruded, black, closed cell or dense elastomer of durometer appropriate to function.
- .5 Thermally Broken Door Adaptors: provide thermal pressure plate door adaptors to accommodate insulated aluminum doors.
- .6 Gasket and Glazing Tape: EPDM gasket with integral glazing tape, 'Vision Strip' by Tremco, or approved alternate.
- .7 Cap Profile:
  - .1 Horizontal mullions: 2 1/2" x 3/4" deep nominal dimension unless otherwise indicated.
  - .2 Vertical mullion: 2 1/2" x 3/4" deep nominal dimension.
  - .3 Decorative cap and plate: Horizontal pressure plate and cap to extend across the full glass. Finish back of the pressure plate with anodized aluminum to match curtain wall framing.

- .8 Infill panels:
  - .1 Interior spandrel panel: 1.5 mm / 1/16" thick, aluminum panel laminated to 19 mm / 3/4" thick plywood, finish to match framing system.
  - .2 Internal back pan: galvanized metal, 22 gauge, x full depth, sealed air / vapour tight corners, and flanges designed to fit into glazing pocket to form an integral part of the curtain wall air / vapour barrier system.
  - .3 Insulation: Semi-rigid stone wool insulation board. Fill pan with mineral wool insulation. Allow for 7/8" space between back pan and inside mullion face in locations to receive anodized aluminum panel.
    - .1 Acceptable Product: CurtainRock 40 by Roxul Inc., or approved alternate.
  - .4 Exterior Spandrel Panel: Refer to Section 08 80 00 Glazing.
  - .5 Adjacent Wall Covers: 1/64" thick aluminum, full contact pressure bonded to wall surfaces, ensuring flat surface, finish to match curtain wall mullion sections.
  - .6 Flashings: 1/64" thick aluminum, to match curtain wall mullion sections where exposed, secured with concealed fastening method.
- .9 Sills: Refer to Section 07 62 00 Sheet Metal Flashing and Trim and 06 40 00 Architectural Woodwork.
- .10 Louvres: Refer to Section 08 90 00 - Louvers and Vents.
- .11 Condensation Gutters
  - .1 Aluminum condensation gutters, braked formed aluminum sheet, full length, of type and size and profile indicated, 3/64" thick anodized aluminum c/w watertight formed 1/2" high upstand, chairs and anchoring devices.
- .12 Air / Vapour Barrier: Refer to Section 07 28 00 - Air Barrier 07 27 00- Air / Vapour Barriers.
- .13 Vapour Retarder: specified in Section 07 26 00 - Vapour Retarders.
- .14 Air Barrier: specified in Section 07 27 00.01 - Air Barriers.

## 2.4 FABRICATION

- .1 Fabricate system components with minimum clearances and shim spacing around perimeter of assembly, yet enabling installation and dynamic movement of perimeter seal.
- .2 Accurately fit and secure joints and corners. Make joints flush, hairline, and weatherproof
- .3 Prepare components to receive anchor devices. Install anchors.
- .4 Arrange fasteners and attachments to ensure concealment from view.
- .5 Prepare system components to receive exterior doors and hardware specified in Section 08 11 16 - Aluminum Doors and Frames. Reinforce interior horizontal head rail to receive track brackets and attachments. Reinforce framing members for external imposed loads.
- .6 Visible manufacturer's identification labels not permitted.
- .7 Fabricate curtain wall system complete with glazing to withstand the lateral design loads as per OBC requirements.

- .8 Infill Panels:
  - .1 Fabricate infill panels with metal covered edge seals around perimeter of panel assembly, enabling installation and minor movement of perimeter seal.
  - .2 Reinforce interior surface of exterior panel sheet from deflection caused by wind and suction loads.
  - .3 Accurately fit and secure joints and corners. Make joints flush, hairline, and weatherproof.
  - .4 Place insulation within panel, adhered to exterior face of interior panel sheet over entire area of sheet with impale fasteners.
  - .5 Ventilate and pressure-equalize the air space outside the exterior surface of the insulation, to the exterior.
  - .6 Arrange fasteners and attachments to ensure concealment from view.
- .9 Finishes:
  - .1 Finish coatings: unless otherwise indicated finish all exposed surfaces of interior and exterior aluminum sections with anodic oxide treatment in accordance with Aluminum Association specification #14 clear, designation AA M12C22A41" by Kawneer, or approved alternate.
  - .2 Shop and touch-up primer for steel components: SSPC 25 Paint red oxide.
  - .3 Touch-up primer for galvanized steel surfaces: SSPC 20 Paint zinc rich.
  - .4 Concealed steel items: galvanized in accordance with CSA G164M to m2. Primed with iron oxide paint.
  - .5 Apply one coat of bituminous paint to concealed aluminum and steel surfaces in contact with cementitious or dissimilar materials.

## **2.5 SOURCE QUALITY CONTROL**

- .1 Perform work in accordance with AAMA GSM-1 AAMA CW-I-9. Maintain one 1 copy on site.
- .2 Manufacturer qualifications: company specializing in manufacturing the products specified in this section with minimum five (5) years documented experience.
- .3 Installer qualifications: company specializing in performing the work of this section with minimum five (5) years documented experience approved by manufacturer.
- .4 Design structural support framing components to CAN/CSA-S157 under direct supervision of a Professional Structural Engineer experienced in design of this Work and licensed at the place where the Project is located in the Province of Ontario, Canada.
- .5 Perform welding Work in accordance with CSA W59.2.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- .1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for aluminum curtain wall installation in accordance with manufacturer's written instructions.
  - .1 Visually inspect substrate.
  - .2 Verify dimensions, tolerances, and method of attachment with other work.
  - .3 Verify wall openings and adjoining air / vapour barrier and vapour retarder materials are ready to receive work of this Section.
  - .4 Inform Consultant of unacceptable conditions immediately upon discovery.
  - .5 Proceed with installation only after unacceptable conditions have been remedied.

### 3.2 INSTALLATION

- .1 Install curtain wall system in accordance with manufacturer's instructions.
- .2 Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.
- .3 Use alignment attachments and shims to permanently fasten system to building structure. Clean weld surfaces; apply protective primer to field welds and adjacent surfaces.
- .4 Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances and align with adjacent work.
- .5 Use thermal isolation where components penetrate or disrupt building insulation.
- .6 Install sill flashings.
- .7 Install eave edge flashings at sloped glazing system.
- .8 Coordinate attachment and seal of perimeter air / vapour barrier and vapour retarder materials.
- .9 Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier in accordance with curtain wall and insulation manufacturer's written instructions.
- .10 Install thermally broken pressure plate door adaptors to accommodate insulated aluminum doors.
- .11 Install louvres, associated flashings, blank-off plates and screening. Fit blank-off plates tight to ductwork. Install glass and infill panels in accordance with Section 08 80 50 – Glazing.
- .12 Place sealant on the up-slope side of the pressure plate cover caps; finish the surface with a slope to encourage drainage over the cap. Cover caps to conceal screws and ensure continuous sightline.
- .13 Install perimeter sealant to method required to achieve performance criteria and installation criteria in accordance with Section 07 92 00 – Joint Sealants.

### 3.3 SITE TOLERANCES

- .1 Maximum variation from plumb: 1/16" non-cumulative or 1/2":100', whichever is less.
- .2 Maximum misalignment of two adjoining members abutting in plane: 1/32".
- .3 Maximum sealant space between curtain wall and adjacent construction: 1/2".

### 3.4 FIELD QUALITY CONTROL

- .1 Inspection by independent testing agency will monitor quality of installation and glazing.
  - .1 Test system to: ASTM E 1105, AAMA 501, AAMA 501.2, AAMA 502 and AAMA 503..
  - .2 Evaluate installed system by thermo-photographic scan.
  - .3 Provide test report within one (1) week of testing.

- .2 Manufacturer's Field Services:
  - .1 Obtain written report from manufacturer of curtain wall and or glass verifying compliance of Work, in handling, installing, applying, protecting and cleaning of products, and submit written reports in acceptable format to verify compliance of Work with Contract within 3 days of review.
  - .2 Submit 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 Ensure manufacturer's representative of curtain wall and of glass is present before and during critical periods of installation construction of field joints and testing.
  - .4 Schedule site visits to review Work at stages listed:
    - .1 After delivery and storage of products, and when preparatory Work on which Work of this Section depends is complete, but before installation begins.
    - .2 Twice during progress of Work at 25% and 60% complete.
    - .3 Upon completion of Work, after cleaning is carried out.

### **3.5 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 – Cleaning.
  - .1 Leave Work area clean at end of each day.
  - .2 Remove protective material from prefinished aluminum surfaces.
  - .3 Wash down surfaces with a solution of mild detergent in warm water, applied with soft, clean wiping cloths. Take care to remove dirt from corners. Wipe surfaces clean.
  - .4 Remove excess sealant by moderate use of mineral spirits or other solvent acceptable to sealant manufacturer.
  - .5 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 – Cleaning.

### **3.6 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by glazed aluminum curtain wall installation.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 REFERENCES**

- .1 Aluminum Association (AA)
  - .1 AA DAF 45-03(R2009), Designation System for Aluminum Finishes.
- .2 American Architectural Manufacturers Association (AAMA)
  - .1 AAMA CW-10-04, Care and Handling of Architectural Aluminum From Shop to Site.
  - .2 AAMA CW-11-85, Design Wind Loads and Boundary Layer Wind Tunnel Testing.
  - .3 AAMA T1R-A1-04, Sound Control for Fenestration Products.
  - .4 AAMA 501-05, Methods of Test for Exterior Walls.
  - .5 AAMA 611-98, Voluntary Specifications for Anodized Finishes Architectural Aluminum.
  - .6 AAMA 612-02, Voluntary Specifications, Performance Requirements, and Test Procedures for Combined Coatings of Anode Oxide and Transparent Organic Coatings on Architectural Aluminum.
  - .7 AAMA 2603-02, Voluntary Specification Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels.
  - .8 AAMA 2604-05, Voluntary Specification Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels.
- .3 ASTM International
  - .1 ASTM A 123/A 123M-13, Standard Specification for Zinc (Hot-Dip galvanized) Coatings on Iron and Steel Products.
  - .2 ASTM E 1748-95(2009), Standard Test Method for Evaluating the Engagement Between Windows and Insect Screens as an Integral System.
- .4 CSA Group
  - .1 AAMA/WDMA/CSA 101/I.S.2/A440-11, NAFS - North American Fenestration Standard for Windows, Doors, and Skylights.
  - .2 CSA A440S1-09, Canadian Supplement to AAMA/WDMA/CSA 101/I.S.2/A440, NAFS - North American Fenestration Standard for Windows, Doors, and Skylights.
  - .3 CAN/CSA-A440.4-07(R2012), Window, Door, and Skylight Installation.
  - .4 CAN/CSA-A440.2/A440.3-14, Fenestration energy performance/User guide to CSA A440.2, Fenestration energy performance.
  - .5 CAN/CSA-Z91-02(R2013), Health and Safety Code for Suspended Equipment Operations.
  - .6 CAN/CSA-Z809-08(R2013), Sustainable Forest Management.
- .5 Forest Stewardship Council (FSC)
  - .1 FSC-STD-01-001-2004, FSC Principle and Criteria for Forest Stewardship.
- .6 Green Seal Environmental Standards (GS)
- .7 Master Painters Institute (MPI)
  - .1 Architectural Painting Specification Manual - current edition.
    - .1 MPI #79, Primer, Alkyd, Anti-Corrosive for Metal.
- .8 Screen Manufacturers Association (SMA)
  - .1 SMA 1201R-2002 Specification for Insect Screens for Windows, Sliding Doors and Swinging Doors.

## **1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for windows and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
  - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
  - .2 Indicate materials and details in full size scale for head, jamb and sill, profiles of components, interior and exterior trim junction between combination units elevations of unit, anchorage details, location of isolation coating, description of related components and exposed finishes fasteners, and caulking. Indicate location of manufacturer's nameplates.
- .4 Samples:
  - .1 Submit for review and acceptance of each unit.
  - .2 Samples may be returned for inclusion into work if requested.
  - .3 Submit one representative model complete full size window sample of each type window.
  - .4 Include frame, sash, sill, glazing and weatherproofing method, insect screens, surface finish and hardware. Show location of manufacturer's nameplates.
  - .5 Include 6" long samples of head, jamb, sill, and mullions to indicate profile.
- .5 Test Reports:
  - .1 Submit substantiating engineering data, and test results performed by independent testing agency, which purport to meeting performance criteria and supportive data.

## **1.3 CLOSEOUT SUBMITTALS**

- .1 Submit in accordance with Section 01 78 00 – Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for windows for incorporation into manual.

## **1.4 QUALITY ASSURANCE**

- .1 Certifications: product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.
- .2 Acoustic Testing:
  - .1 Refer to Section 09 21 16 Gypsum Board Assemblies.

## **1.5 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 – Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

- .3 Storage and Handling Requirements:
  - .1 Store materials off ground, indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect windows from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.

## **PART 2 - PRODUCTS**

### **2.1 DESIGN CRITERIA**

- .1 Fenestration performance grades for windows:
  - .1 In accordance with the CSA A440SI Canadian Supplement, Clause (1)(b) appropriate for the conditions and geographic location in which the doors will be installed.
  - .2 Conform to performance grades selected under CSA A440SI Canadian Supplement, Sentence (2) when tested in accordance with the standard referenced in Clause (1)(a).

### **2.2 MATERIALS**

- .1 Materials: to CSA-A440/A440.1 supplemented as follows:
- .2 All windows by same manufacturer.
- .3 Sash: aluminum thermally broken.
- .4 Main frame: aluminum thermally broken.
- .5 Aluminum Support Angles: Design and fabricate aluminum support angles at sill jambs and head in accordance with OBC and manufacturers requirements.
- .6 Glass: in accordance with Section 08 80 50 - Glazing.
- .7 Flashings: Refer to Section 07 62 00 Sheet Metal Flashing and Trim.
- .8 Sills: Refer to Section 07 62 00 Sheet Metal Flashing and Trim.
- .9 Exterior aluminum facings: brake formed, 1/16" thick, clear anodized aluminum panel laminated to 3/4" thick plywood.
- .10 Isolation coating: alkali resistant bituminous paint.
- .11 Sealants: Refer to Section 07 92 00 Joint Sealants.

### **2.3 WINDOW TYPE AND CLASSIFICATION**

- .1 Types:
  - .1 Fixed Window Unit: fixed window unit designed and fabricated to 'rainscreen principals', 6" wide, c/w thermal break.
    - .1 Acceptable product: 'Kawneer AA 6600' fixed framing, or approved equivalent by Alumicor.

## 2.4 FABRICATION

- .1 Fabricate in accordance with CSA-A440/A440.1 supplemented as follows:
- .2 Fabricate units square and true with maximum tolerance of plus or minus 1/16" for units with a diagonal measurement of 6'0" or less and plus or minus 1/8" for units with a diagonal measurement over 6'-0".
- .3 Face dimensions detailed are maximum permissible sizes.
- .4 Brace frames to maintain squareness and rigidity during shipment and installation.
- .5 Finish steel clips and reinforcement with shop coat primer to MPI #79 CAN/CGSB-1.40 380 g/m<sup>2</sup> zinc coating to ASTM A 123/A 123M.

## 2.5 ALUMINUM FINISHES

- .1 Finish exposed surfaces of aluminum components in accordance with Aluminum Association Designation System for Aluminum Finishes.
  - .1 Finish coatings: finish all exposed surfaces of interior and exterior aluminum sections with anodic oxide treatment in accordance with Aluminum Association specification AA-M12c22A31, "No. 17 Clear" by Kawneer, approved equivalent by Alumicor. or approved alternate.

## 2.6 ISOLATION COATING

- .1 Primers, Paints, and Coatings: in accordance with manufacturer's recommendations for surface conditions.
- .2 Isolate aluminum from following components, by means of isolation coating:
  - .1 Dissimilar metals except stainless steel, zinc, or white bronze of small area.
  - .2 Concrete, mortar and masonry.
  - .3 Wood.

## 2.7 GLAZING

- .1 Glaze windows: Refer to Section 08 80 50 – Glazing.

## 2.8 AIR BARRIER /VAPOUR BARRIER SEAL

- .1 Provide positive air / vapour / watertight seal between window frames and exterior wall system using air / vapour barrier transition strip as per Section 07 28 00 Air / Vapour Barriers 07 26 00 – Vapour Retarders / 07 27 00 – Air Barriers.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- .1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for product installation in accordance with manufacturer's written instructions.
  - .1 Visually inspect substrate to verify dimensions, tolerances, and method of attachment with other work.
  - .2 Inform Consultant of unacceptable conditions immediately upon discovery.
  - .3 Proceed with installation only after unacceptable conditions have been remedied.

### **3.2 AIR/VAPOUR BARRIER CONNECTIONS**

- .1 Prior to installing windows, prepare window system to provide a continuous air / vapour seal from the window system to the wall air / vapour barrier system.
- .2 Apply a continuous strip of 305 mm / 12" wide 'Self-Adhered Sheet Membrane' as described in Section 07 28 00.01 – Air / Vapour Barriers around on all sides of window opening. Apply sheet membrane lapped in a 'shingle like manner' to shed water. Ensure a positive continuous seal is provided to wall framing.
- .3 Provide a 2nd overlapping lapping layer of 'Self-Adhered Sheet Membrane' at each corner as required to seal all air leaks at corner conditions.

### **3.3 INSTALLATION**

- .1 Window installation:
  - .1 Install in accordance with CSA-A440/A440.1.
  - .2 Arrange components to prevent abrupt variation in colour.
  - .3 Do not exceed 3 mm / 1/8" in 3.0 m / 10' variation from plumb and level.
- .2 Aluminum Support Angles:
  - .1 Design and fabricate aluminum angles in accordance with OBC and manufacturers requirements. Provide slotted clip angle connection where deflection is anticipated.
- .3 Sill installation: Refer to Section 07 62 00 – Sheet Metal Flashing and Trim.
- .4 Aluminum Closure Panel and Column Cover Installation:
  - .1 Install aluminum closure panel and column covers, level in length, straight in alignment with plumb upstands and faces. Use one (1) piece lengths where practicable.
  - .2 Where joints in closure panels and column covers are necessary, provide hairline joints with concealed watertight anchors.
  - .3 Secure closure panels and column covers in place with anchoring devices located spaced 24" o/c maximum between.
- .5 Caulking:
  - .1 Seal joints between windows and window sills with sealant. Bed sill expansion joint cover plates and drip deflectors in bedding compound. Caulk between sill upstand and window-frame. Caulk butt joints in continuous sills.
  - .2 Apply sealant in accordance with Section 07 92 00 – Joint Sealants. Conceal sealant within window units except where exposed use is permitted by Consultant.

.6 Field Quality Control

- .1 Testing, inspection and reporting in accordance with 3.4 Field Quality Control in Section 08 44 13 – Glazed Aluminum Curtainwall.

**3.4 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 – Cleaning.  
.1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 –Cleaning.

**3.5 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by window installation.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 REFERENCES**

- .1 American National Standards Institute (ANSI) / Builders Hardware Manufacturers Association (BHMA)
  - .1 ANSI/BHMA A156.9-2010, Cabinet Hardware.
  - .2 ANSI/BHMA A156.11-2014, Cabinet Locks.
  - .3 ANSI/BHMA A156.16-2013, Auxiliary Hardware.
  - .4 ANSI/BHMA A156.18-2012, Materials and Finishes.
  - .5 ANSI/BHMA A156.20-2012, Strap and Tee Hinges and Hasps.

### **1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for cabinet hardware and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Samples:
  - .1 Submit samples in accordance with Section 01 33 00 – Submittal Procedures.
  - .2 Identify each sample by label indicating applicable specification paragraph number, brand name and number, finish and hardware package number.
  - .3 After approval samples may be returned if requested for incorporation in the Work.
- .4 Hardware List:
  - .1 Submit contract hardware list.
  - .2 Indicate specified hardware, including make, model, material, function, finish and other pertinent information.
- .5 Test Reports: certified test reports showing compliance with specified performance characteristics and physical properties.
- .6 Manufacturer's Instructions: submit manufacturer's installation instructions.

### **1.3 CLOSEOUT SUBMITTALS**

- .1 Submit in accordance with Section 01 78 00 – Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for cabinet hardware for incorporation into manual.

### **1.4 QUALITY ASSURANCE**

- .1 Certificates: product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

## 1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 – Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Package items of hardware including fastenings, separately or in like groups of hardware, label each package as to item definition and location.
- .4 Storage and Handling Requirements:
  - .1 Store cabinet hardware in locked, clean, dry area, off ground, indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect cabinet hardware from nicks, scratches, and blemishes.
  - .3 Protect prefinished surfaces with wrapping strippable coating.
  - .4 Replace defective or damaged materials with new.

## PART 2 - PRODUCTS

### 2.1 HARDWARE ITEMS

- .1 Cabinet hardware listed within provides a 'standard of acceptance' for the specified item. Equivalent products by Richelieu, Häfele, Hettich, or approved alternate are acceptable for use on this project.
  - .1 Use one manufacturer's product for all similar items.

### 2.2 CABINET AND MISCELLANEOUS HARDWARE

- .1 Cabinet hardware: to CAN/CGSB-69.25, as listed below:
  - .1 Hinges: soft close hinge:
    - .1 Type 1 - 110° swing:
      - .1 Application: where door opens adjacent to a wall
      - .2 Acceptable product: '71T Series' hinge with 'Blumotion 973A, by Richelieu, model type to suit cabinet.
    - .2 Type 2 - 170° swing:
      - .1 Application: where door has no adjacent wall
      - .2 Acceptable product: '71T Series' hinge with 'Blumotion 973A, by Richelieu, model type to suit cabinet.
    - .3 Type 3 - 180° swing piano hinge:
      - .1 Application: viewing room 127A
      - .2 Side: to suit application
      - .3 Acceptable product: 2" wide x 0.037" pre-drilled stainless steel by Richelieu or approved alternate.
  - .2 Drawer and Door Pulls:
    - .1 Straight Handle: metal, stainless steel, 192mm long, vertical installation on doors and horizontal on drawers.
      - .1 Acceptable product: 'Contemporary Stainless Steel Handle Pull – 1310, by Richelieu.
  - .3 Drawer Slides:
    - .1 'Type 1': For all drawers unless otherwise noted, easy close, medium duty, 100 lb. capacity, zinc finish, length to suit drawer for full extension.
      - .1 Acceptable product: 'Accuride 3832EC2G Full Extension Slide', by Richelieu.

- .2 Door and Drawer Bumpers:
  - .1 Acceptable product: 'No. MP30311', by Richelieu, clear nylon, 1/8" height x 3/8" diameter, peel and stick bumpers.
- .3 Cabinet and Drawer Unit, Locks: to CAN/CGSB-69.27, as listed below:
  - .1 Door or drawer locks – Type 1 (typical):
    - .1 Acceptable product:
      - .1 Universal Cam Lock Body: Adjustable from 7/8" to 1 3/8". '235.09.000', by Häfele Canada Inc.
      - .2 Material: steel.
      - .3 Cylinder Rosette: '210.04.062', by Häfele Canada Inc. Material: nickel-polished finish.
      - .4 Lock Core: '210.04.606', by Häfele Canada Inc., Snap-in lock core, material zinc die cast, Lock face, nickel polished finish.
    - .2 Door locks – Type 2 (closed storage):
      - .1 Acceptable product:
        - .1 '322CR Locking Hasp', complete with like keyed cylinder and locking cores, by Richelieu or approved alternate.
        - .2 Material: steel.
      - .3 Cylinders: key into keying system. Master key each department complete with grand master key, as later selected by Consultant.
- .4 Shelf labels:
  - .1 25mm H x 64mm D x 125mm W clip-on plastic shelf label holders.
  - .2 Acceptable product:
    - .1 '48-610A' by Carr McLean or approved equal.
- .5 Shelf Supports:
  - .1 Acceptable product:
    - .1 Metal Pilaster: 'No. 2552G', by Richelieu, 5/8" wide x total length. zinc finish.
    - .2 Pilaster Shelf Clip: 'No. CP2392G', by Richelieu, heavy-duty, zinc finish.
- .6 Sliding Glass Reception Window: Aluminum extrusion kit for glass sliding door: satin anodized aluminum, finish satin aluminum.
  - .1 Acceptable product: 'D1042A Jamb less Daisy Pass-Thru Window', by C.R. Laurence Company. Provide custom double loaded, double width overhead track, size as indicated.
- .7 Glass Handrail Mount:
  - .1 Acceptable product: 'HR2JGBS Series' by C.R. Laurence Aluminum.
  - .2 Refer also to Section 08 80 50 – Glazing.
- .8 Glass Clamps
  - .1 Acceptable product: 'GE90SBN Geneva Series' by C.R. Laurence Aluminum.
  - .2 Refer also to Section 08 80 50 – Glazing.
- .9 Cable Entry Plug (Grommets):
  - .1 Refer to Divisions 26, 27 and 28.
- .10 Garbage Grommet: Stainless steel trash grommet
  - .1 Size: 150 dia x 50mm deep
  - .2 Acceptable Product: '61432171' by Richelieu, polished finish.

## **2.3 FASTENINGS**

- .1 Supply screws, bolts, expansion shields and other fastening devices required for satisfactory installation and operation of hardware.
- .2 Exposed fastening devices to match finish of hardware.
- .3 Use fasteners compatible with material through which they pass.

## **2.4 KEYING**

- .1 Cabinet locks to be keyed as directed by Owner. Submit keying schedule for approval.
- .2 Supply keys in duplicate for every lock in this Contract.
- .3 Supply three (3) master keys for each master key or grand master key group.
- .4 Stamp keying code numbers on keys and cylinders.

## **PART 3 – EXECUTION**

### **3.1 INSTALLATION**

- .1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.
- .2 Install hardware to standard hardware location dimensions in accordance with manufacturer's recommendations and to project design requirements.
- .3 Make all shelves in cabinets adjustable, unless otherwise indicated.
- .4 Install locks on all cabinet doors and drawers where indicated.
- .5 Install drawer slides to all drawers, number as required to suit application.
- .6 Install drawer & drawer bumpers to all doors and drawers.

### **3.2 ADJUSTING**

- .1 Adjust cabinet hardware for optimum, smooth operating condition.
- .2 Lubricate hardware and other moving parts.
- .3 Adjust cabinet door hardware to ensure tight fit at contact points with frames.

### **3.3 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 – Cleaning.
  - .1 Leave Work area clean at end of each day.
  - .2 Clean hardware with damp rag and approved non-abrasive cleaner, and polish hardware in accordance with manufacturer's instructions.
  - .3 Remove protective material from hardware items where present.
  - .4 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 – Cleaning.

### **3.4 DEMONSTRATION**

- .1 Keying System Setup and Cabinet:
  - .1 Set up key control system with file, duplicate key tags, alphabetical index.
- .2 Maintenance Staff Briefing:
  - .1 Brief maintenance staff regarding:
    - .1 Proper care, cleaning, and general maintenance of projects complete hardware.
    - .2 Description, use, handling, and storage of keys.
- .3 Demonstrate operation, operating components, adjustment features, and lubrication requirements.

### **3.5 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by cabinet and miscellaneous hardware installation.

### **3.6 SCHEDULE**

- .1 All cabinet drawers, unless otherwise noted:
  - .1 1 set full extension drawer slides: 'Type 1'.
  - .2 Lock, all cabinets.
  - .3 1 pull per drawer.
  - .4 Drawer bumpers.
- .2 Cabinet swing doors:
  - .1 1 pull per door
  - .2 Lock, all cabinets.
  - .3 1 set of hinges, number as recommended by manufacturer to suit condition.
  - .4 Door bumpers.
- .3 Shelf supports:
  - .1 4 recessed metal standards per unit.
  - .2 4 pilaster shelf clips per shelf.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 REFERENCES**

- .1 American National Standards Institute (ANSI) / Builders Hardware Manufacturers Association (BHMA)
  - .1 ANSI/BHMA A156.1-2013, American National Standard for Butts and Hinges.
  - .2 ANSI/BHMA A156.2-2011, Bored and Preassembled Locks and Latches.
  - .3 ANSI/BHMA A156.3-2014, Exit Devices.
  - .4 ANSI/BHMA A156.4-2013, Door Controls - Closers.
  - .5 ANSI/BHMA A156.5-2014, Auxiliary Locks and Associated Products.
  - .6 ANSI/BHMA A156.6-2010, Architectural Door Trim.
  - .7 ANSI/BHMA A156.8-2010, Door Controls - Overhead Stops and Holders.
  - .8 ANSI/BHMA A156.10-2011, Power Operated Pedestrian Doors.
  - .9 ANSI/BHMA A156.12-2013, Interconnected Locks and Latches.
  - .10 ANSI/BHMA A156.13-2013, Mortise Locks and Latches Series 1000.
  - .11 ANSI/BHMA A156.14-2013, Sliding and Folding Door Hardware.
  - .12 ANSI/BHMA A156.15-2011, Release Devices - Closer Holder, Electromagnetic and Electromechanical.
  - .13 ANSI/BHMA A156.16-2013, Auxiliary Hardware.
  - .14 ANSI/BHMA A156.17-2014, Self-closing Hinges and Pivots.
  - .15 ANSI/BHMA A156.18-2012, Materials and Finishes.
  - .16 ANSI/BHMA A156.19-2013, Power Assist and Low Energy Power - Operated Doors.
  - .17 ANSI/BHMA A156.20-2012, Strap and Tee Hinges and Hasps.
  - .18 ANSI/BHMA A156.26 – Continuous Hinges
  - .19 ANSI/BHMA A250.4 – Steel Doors and Frames Physical Endurance
- .2 Underwriters Laboratories' (UL):
  - .1 UL10C – Positive Pressure Fire Tests of Door Assemblies
- .3 Canadian Steel Door and Frame Manufacturers' Association (CSDMA)
  - .1 CSDMA Recommended Dimensional Standards for Commercial Steel Doors and Frames - 2009.

### **1.2 GENERAL**

1. The work in this section includes furnishing and installation of all items of finish hardware as hereinafter specified or obviously necessary for all swinging, sliding, folding and other doors. Except items, which are specifically excluded from this section of the specification or of unique hardware, specified in the same sections as the doors and frames on which they are installed.
2. The following list of bidders have been pre-qualified to bid on this work:

Pinders Security Products  
25 Nihan Drive  
St. Catharines Ontario  
905-934-6333  
Attn: Greg Pinder

Knell's Door & Hardware  
2090 Shirley Drive  
Kitchener, Ontario  
519-578-1000  
Attn: Mark Bauman

jpw systems inc.  
30 Doan Drive  
Komoka, Ontario  
519-474-9797  
Attn: Andy Pope

### 1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for door hardware and include product characteristics, performance criteria, physical size, finish and limitations. Submit catalog cuts and/or product data sheets for all scheduled finish hardware.
- .3 Samples:
  - .1 Submit for review and acceptance of each unit.
  - .2 Samples may be returned for inclusion into work.
  - .3 Identify each sample by label indicating applicable specification paragraph number, brand name and number, finish and hardware package number.
  - .4 After approval samples will be returned for incorporation in Work.
- .4 Hardware List:
  - .1 Submit contract hardware list.
  - .2 Prior to hardware schedule submittal, the successful bidder shall review all drawings and related documents to ensure compatibility and completeness. Schedules to be in vertical format, listing each door opening, and organized into "hardware sets" indicating complete designations of every item required for each door opening to function as intended. Hardware schedule shall be submitted within two (2) weeks from date the purchase order is received by the finish hardware supplier. Furnish four (4) copies of revised schedules after approval for field and file use. Note any special mounting instructions or requirements with the hardware schedule. Schedules to include the following information:
    - .1 Location of each hardware set cross-referenced to indications on drawings, both on floor plans and in door and frame schedule.
    - .2 Handing and degree of swing of each door.
    - .3 Door and frame sizes and materials.
    - .4 Keying information.
    - .5 Type, style, function, size, and finish of each hardware item.
    - .6 Provide complete methods of operation for all openings containing electronic components. Operational descriptions to detail how each electrical component functions within the opening incorporating all conditions of ingress and egress.
    - .7 Provide elevation drawings of electronic hardware and systems identifying locations of the system components with respect to their placement in the door opening
    - .8 Name and manufacturer of each hardware item.
    - .9 Fastenings and other pertinent information.
    - .10 Explanation of all abbreviations, symbols and codes contained in schedule
    - .11 Mounting locations for hardware when varies from standard.
- .5 Submit separate detailed keying schedule without keysets assigned to the University of Guelph's Lock Shop for coordination of keying layout and the number of keys required. Locks and cylinders are not to be ordered until the finalized keying schedule has been approved and the schedule returned to the Hardware Supplier.

.6 Templates:

- .1 Furnish a complete list and suitable templates, together with finish hardware schedule to contractor, for distribution to necessary trades supplying materials to be prepped for finish hardware.
- .7 It is the responsibility of the hardware supplier to update and keep current the hardware schedule. All approved hardware changes shall be noted in the hardware schedule and kept current throughout the duration of the project. Update pages as necessary to the contractor for furtherance to the Consultant
- .8 . Provide the end user with the original tendered hardware schedule and a copy of the updated hardware schedule incorporating all changes upon completion of the project. Where changes occur to electrical products and functions the hardware supplier shall be responsible to produce new elevations and methods of operation both for submittal with changes and update the hardware schedule.
- .9 Test Reports: certified test reports showing compliance with specified performance characteristics and physical properties.
- .10 Manufacturer's Instructions: submit manufacturer's installation instructions.

#### **1.4 ELECTRONIC HARDWARE SYSTEMS**

- .1 Wiring Diagrams: Prepared and submitted within 2 weeks of receipt of purchase order by or under the supervision of supplier and coordinated with all drawings and related documents to ensure accurate function and coordination.
  - .1 Elevations: Provide diagrams for each unique opening with electronic hardware components identifying individual item locations, conduits, back boxes, junction boxes and miscellaneous system requirements and devices.
  - .2 Risers: Provide diagrams detailing locations and infrastructure between door openings, power supplies, access control panels and system components.
  - .3 Point to Points: Provide diagrams detailing wiring terminations at all electrified devices as applicable to function of all openings. (inclusion depending on installation)
  - .4 Responsibility matrix: Provide documentation for approval detailing basic responsibilities inclusive of all related sections involved in the preparation for, installation and commissioning of electrified systems.
- .2 Proof of Certification: Provide copy of manufacturer(s) official certification or accreditation document indicating proof of status as a qualified and authorized provider and/or installer of specified integrated locking products.

#### **1.5 CLOSEOUT SUBMITTALS**

- .1 Submit in accordance with Section 01 78 00 – Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for door hardware for incorporation into manual.

## **1.6 MAINTENANCE MATERIALS SUBMITTALS**

- .1 Extra Stock Materials:
  - .1 Supply maintenance materials in accordance with Section 01 78 00 – Closeout Submittals.
  - .2 Tools:
    - .1 Supply 2 sets of wrenches for door closers, locksets, and fire exit hardware.
- .2 Upon completion of construction and building turnover, furnish two (2) complete maintenance manuals to the owner. Manuals to include the following items:
  - .1 Approved hardware schedule, catalog cuts and keying schedule.
  - .2 Hardware installation and adjustment instructions.
  - .3 Hardware installation and adjustment instructions in searchable format on CD.
  - .4 Copy of product templates.
  - .5 Manufacturer's maintenance information, including any required lubrication schedules.
  - .6 Parts lists and diagrams for high frequency of use products.
  - .7 Manufacturer's written warranty information.
  - .8 Wiring diagrams, elevation drawings and operational descriptions for all electronic openings.

## **1.7 QUALITY ASSURANCE**

- .1 Substitutions
  - .1 All requests for approved alternates must be submitted in writing 10 working days prior to closing date. Any products suggested for substitution must be submitted with the following information:
  - .2 Manufacturer's name and address.
  - .3 Written confirmation that the alternate product shall not exceed the space requirements allocated in the drawings.
  - .4 Detailed catalogue cuts illustrating function and documentation of ANSI testing.
  - .5 Cost savings from accepting the alternate product.
  - .6 Letter acknowledging that this Section is responsible for any additional installation costs resulting from the acceptance of a substituted product.
  - .7 Alternate acceptance shall be subject to the approval at the discretion of the Consultant, the hardware consultant and the University Electronic Access Team and Lock Shop
- .2 Supplier Qualifications
  - .1 A recognized architectural door hardware supplier who has maintained an office and has been furnishing hardware in the project's vicinity for a period of at least two (2) years. Hardware Supplier shall be available for site visits when requested by the University.
  - .2 Hardware supplier shall have office and warehouse facilities to accommodate this project.
  - .3 Hardware supplier must be an authorized factory distributor of all products specified herein.
  - .4 Hardware supplier shall have in his employment at least one (1) Architectural Hardware Consultant (AHC) accredited in the Continuing Education Program (CEP) administered by The Door and Hardware Institute, Chantilly, VA.
  - .5 It shall be clearly understood that within the terms of this Subcontract, the Hardware Supplier is bound not just as a supplier but also is responsible for the supply of hardware services relative to the project co-ordination, supervision and inspection.

- .6 Hardware Subcontractor shall meet with the Owner, Consultant, Electrical Subcontractor, Security Consultant, and Access Control Subcontractor to review, coordinate and implement all details relating to the proper operation of all electronic hardware including locations of power supplies, back boxes, junction boxes and conduit details prior to start of construction.
- .7 Hardware supplier shall provide all-inclusive consultation and solutions to the Consultant and related trades and shall be fully responsible for coordinating, managing, and assisting in the design of full system integration of security access control (i.e. proximity card reader, CCTV, and other electrified security hardware components not specified in the hardware schedule) and electronic hardware.
- .3 Regulatory Requirements:
  - .1 Hardware for doors in fire separations and exit doors certified by a Canadian Certification Organization accredited by Standards Council of Canada.
  - .2 Provide door hardware for fire-rated openings that comply with NFPA 80 and requirements of authorities having jurisdiction. Provide only items of door hardware that are listed by Underwriter's Laboratories (UL) or Warnock Hersey (WH) for use on types and sizes of doors indicated
- .4 Certificates: product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.
- .5 Acoustic Testing:
  - .1 Refer to Section 09 21 16 Gypsum Board Assemblies.

## **1.8 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 – Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Properly package and mark items according to the approved hardware schedule, complete with necessary screws and accessories, instructions and installation templates for spotting mortising tools. Contractor shall check deliveries against accepted list and provide receipt for them, after which he is responsible for storage and care. Any shortage or damaged good shall be made without cost to the owner.
- .4 Packaging of door hardware is the responsibility of the supplier. As hardware supplier receives material from various manufacturers, sort and repackage in containers clearly marked with appropriate hardware set and door numbers to match the approved hardware schedule. Two or more identical sets may be packed in same container.
- .5 Storage and Handling Requirements:
  - .1 Store materials locked in clean and dry area off ground, indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 The Contractor shall set up a clean, dry & secure hardware storage room with adequate shelving to layout each item of hardware by door number and hardware schedule item number. It is the responsibility of the hardware supplier/installer to coordinate the room size with the Contractor to ensure proper layout of products. Hardware is to be shipped to site floor specific, if required.
  - .3 Store and protect door hardware from nicks, scratches, and blemishes.
  - .4 Protect prefinished surfaces with wrapping strippable coating.
  - .5 Replace defective or damaged materials with new.

## **1.9 WARRANTY**

- .1 All items, are to carry a warranty to meet the conditions listed in Division 1. Products listed below shall carry an extended warranty to meet the time span detailed. Products warranty shall commence of the date of substantial completion. Warranty is to cover complete replacement, including adjacent Work.
  - .1 Mortise locksets – Ten (10) years
  - .2 Electrified Locksets – Two (2) years
  - .3 Exit Devices - Five (5) years
  - .4 Electrical Exit Devices - Five (5) years
  - .5 Door closers - Ten (10) years
  - .6 Door closers with electrical hold open – Two (2) years
  - .7 Electric Strikes – Five (5) years
  - .8 Securitron electrified hardware - Unlimited Lifetime

## **PART 2 - PRODUCTS**

### **2.1 HARDWARE ITEMS**

- .1 Use one manufacturer's products only for similar items.

### **2.2 DOOR HARDWARE**

- .1 Unless otherwise indicated, refer to Hardware Schedule as prepared by Pat Ryan, Assa Abloy, attached following this section for finishing hardware.
- .2 Manufacturers as listed below have been determined as the acceptable standard. Obtain each type of finish hardware (hinges, latch and locksets, exit devices, door closers, etc.) from a single manufacturer.

### **2.3 MISCELLANEOUS HARDWARE**

- .1 Key Control Cabinet: refer to hardware schedule.

### **2.4 FASTENINGS**

- .1 Use only fasteners provided by manufacturer. Failure to comply may void warranties and applicable licensed labels.
- .2 Supply screws, bolts, expansion shields and other fastening devices required for satisfactory installation and operation of hardware. All required screws shall be supplied as necessary for securing finish hardware in the appropriate manner. Thru-bolts shall be supplied for exit devices and door closers where required by code and the appropriate blocking or reinforcing is not present in the door to preclude their use.
- .3 Exposed fastening devices to match finish of hardware.

- .4 Where pull is scheduled on one side of door and push plate on other side, supply fastening devices, and install so pull can be secured through door from reverse side. Install push plate to cover fasteners.
- .5 Use fasteners compatible with material through which they pass.

## 2.5 HANGING DEVICES

### .1 HINGES

- .1 Hinges shall conform to ANSI A156.1 and have the number of knuckles as specified, oil-impregnated bearings as specified with NRP (non-removable pin) feature, at all exterior and interior locked reverse bevel doors. Unless otherwise scheduled, supply 2 hinges for doors up to 60" (1520mm) in height and supply one (1) additional hinge for every 30" (760mm) of door height or part thereof. Hinges shall be sized per the manufacturer's recommendations. Hinges shall be a minimum of 4 1/2" high and 4" wide; heavy weight hinges (.180+) shall be supplied at all doors where specified.

Provide hinge size to comply with the following:

<u>Door Width</u>	<u>Hinge Height</u>	<u>Hinge Width</u>
Up to 36"	4-1/2"	4"
Over 36"	5"	4-1/2"
Up to 48"	5"	5"
Over 48"	6"	6"

- .2 Specified Manufacturer: McKinney TA/T4A Series

### .2 CONTINUOUS GEARED HINGES

- .1 All hinges to be non-handed and completely reversible. Hinge line to be available in concealed flush mount with or without inset, full surface and half surface types as specified in the hardware sets. All hinges to be made of extruded 6060 T6 aluminum alloy with polyacetal thrust bearings, anodized after cutouts are made for bearings. All concealed hinges to be fire-rated for 20, 45 and 90 minutes when incorporated into proper door and frame labeled installations, without necessitating the use of fusible-link pins. All concealed hinges to be available in standard, heavy, and extra heavy duty weights; all full surface and half surface hinges in standard and heavy duty weights as specified in the hardware sets. All hinges to be factory cut for door size.
- .2 Where specified electric continuous geared hinges shall be provided with a removable access panel to allow connection/testing without requiring the removal of the door. Provide with Molex standardized plug connectors to accommodate up to twelve (12) wires. Plug connectors shall plug directly into Molex through-door wiring harnesses for connection to electric locking devices and power supplies. Provide sufficient number of concealed wires to accommodate electric function of specified hardware. Provide a mortar guard for each electric hinge specified.
  - .1 Specified Manufacturers: McKinney - MCK12HD (MCK12HDK for Kawneer doors)

## 2.6 FLUSH BOLTS AND ACCESSORIES

- .1 All automatic flush bolts to be furnished as specified.
- .2 Manual flush bolts are to be supplied with a dust proof strike and threaded rod to suit door height.
  - .1 Specified Manufacturer: Rockwood

## 2.7 CYLINDERS AND KEYING FOR NEW CONSTRUCTION

### .1 CYLINDERS

- .1 Furnished cylinders must provide the capability of a high security, patented, pick- and attack-resistant design with angled key cuts, rotating tumblers, a keyway side biting, and a slider mechanism. Cylinders shall provide the option of certified listing to Underwriters Laboratories Listed Standard--UL437--for key locks. Cylinders shall provide the option of certification under American National Standards Institute (ANSI)/Builder's Hardware Manufacturer's Association (BHMA) certification A156.30 2007 (High Security Cylinders) "Levels M1AAAM," and ANSI/BHMA A156.5 2010 "Grade 1."
- .2 All cylinders with the high security option shall incorporate three locking elements, consisting of a slider mechanism, a sidebar mechanism with tumbler rotation, and pin tumbler elevation. The critical parts of the locking mechanism such as pins, shear line, sidebar, and slider mechanism shall be afforded extra protection from drilling and other forceful attack by the strategic placement of hardened steel inserts in a minimum of 7 possible locations within the cylinder. The lock tumblers shall combine a dual-axis action, with one axis utilized for pin tumbler rotation and the other axis utilized for positioning key cuts. Randomly selected tumbler pins shall incorporate a hardened steel insert for additional drill resistance.
- .3 The locking system is to be furnished in a restricted key section for which key blanks are not made available from the manufacturer's factory or any other source by uncontrolled distribution methods. The key and cylinder must have utility patent protection so as to hinder unlawful or unauthorized key duplication. Such patent protection shall be afforded in the United States of America, Canada, Mexico, and a plurality of other countries. The keys and key blanks must be capable of being furnished to allow an upgrade to a dual mechanical and electronic credential by the single exchange of a field removable key bow. The key blank thickness should be no less than .125" (one hundred twenty-five thousandths). The manufacturer shall have the capability of establishing a key system with a minimum of six angled cuts in six possible pin positions with the capability of two distinct positions of cut per pin chamber, if required by the parameters of the system.

The manufacturer shall have the capability of producing a patent-protected keying system in either of two distinct and different keying specifications and pinning specifications. The system shall be capable of incorporating a key which is capable of more than one biting per position to expand master keying and key changes. The key shall also incorporate the capacity to include twelve possible side bittings along the key blade located on two different planes or surfaces of the key. The system shall also have the capability to provide a single master key with over 1,000,000 (1 million) usable, non-interchangeable change keys in a single profile

- .4 The cylinders shall be immediately rekeyable to new combinations or a new system at any time desired and shall be serviceable on location in the field. Installation of cylinders shall require no modification to U.S. manufactured commercial-grade locksets. All master keys and bitting lists for this project shall be sent using appropriate shipping carriers from the factory directly to the owner. Prior to shipment of keys, the owner shall verify, in writing, preference for shipping carrier and destination.
- .5 Specified Manufacturer: MEDECO M3 – No alternate.

### .2 KEYING

- .1 Keying: All locks and permanent cylinders to be master-keyed or grandmaster-keyed as directed by the owner (or sub-assembled if requested by owner). The factory shall key all locks and cylinders and maintain keying records.
- .2 Prepare detailed keying schedule in conjunction with University of Guelph Representative and Consultant.
- .3 Factory key cylinders to Owner requirements.

- .4 The contractor shall be responsible to remove construction cylinders and install all permanent cylinders
- .5 All locksets to be supplied with keyed alike cylinders to act as construction cylinders until end of construction.
- .6 Pack all permanent cylinders and keys separately from locksets. Identify door number and keyset symbol on each envelope and ship directly to owner.
- .7 Construction keys are to be issued by the Owner. Do not ship construction keys with locksets.
- .8 Ship the control keys directly to the owner unless directed otherwise.
- .9 Furnish the following:
  - .1 Two (2) change keys per lock. Determine final quantities during keying meeting.
  - .2 Allow for 100 key blanks. Determine quantity per key set during keying meeting.
  - .3 All cylinders and keys are to be provided with visual, keyset symbol, key control.
  - .4 Fifteen (15) construction keys.
  - .5 Master keys and all high-security or patented keyway blanks shall be sealed in tamper-proof packaged boxes when shipped from the factory. The boxes shall be shrink wrapped and imprinted to ensure the integrity of the packaging. Deliver all keys and key blanks directly to owner's representative as directed.
  - .6 The construction keys are to be shipped separate from the locksets, directly to the University of Guelph.

## 2.8 LOCKING DEVICES

### .1 MORTISE LOCKSETS

- .1 All locksets shall be ANSI 156.13 Series 1000, Grade 1 Certified. All functions shall be manufactured in a single sized case formed from 12 gauge steel minimum. The lockset shall have a field-adjustable, beveled armored front, with a .125" minimum thickness and shall be reversible without opening the lock body. The lockset shall be 2 3/4" backset with a one-piece 3/4" anti-friction stainless steel latch bolt. The deadbolt shall be a full 1" throw made of stainless steel and have 2 hardened steel roller inserts. All strikes shall be non-handed with a curved lip. To insure proper alignment, all trim, shall be thru-bolted and fully interchangeable between rose and escutcheon designs and shall be the product of one manufacturer. Locks shall have all functions available in one size case, manufactured from heavy gauge steel, minimum thickness 3/32"(2mm). The handing of all locks shall be reversible without the disassembly of the lock case. Cases are to be closed on all sides to protect internal parts. Locks are to have adjustable, beveled and armored fronts, standard 2-3/4" (70mm) backset, a full 3/4" (19mm) throw two-piece mechanical anti-friction latch bolt, and a one-piece stainless steel 1" (25mm) throw deadbolt, and shall be available for a minimum door thickness of 1-3/8" (35mm). Internal parts shall be heavy gauge steel, zinc dichromate plated for corrosion resistance.
- .2 All locksets with latch bolts, regardless of trim, shall be listed by Underwriters Laboratories for A label and lesser class doors, 4' x 10' single or 8' x 10' pair.
- .3 Lock trim (knob, lever, sectional or escutcheon) shall be through bolted through the lock case to ensure correct alignment and proper operation.
- .4 Certification:
  - .1 UBC - 7 - 2 and UL10C – Positive Pressure
  - .2 ANSI/BHMA A156.13 Series 1000, Grade 1
  - .3 ANSI/BHMA A117.1, Accessibility Code
- .5 Specified Manufacturer: Corbin Russwin ML2000 NSA Series – No alternate.

**.2 ELECTRIFIED LOCKSETS**

- .1 Mechanical features of locksets shall conform to standards as specified above. Locksets shall be fail-secure unless otherwise specified. Where specified electrified locksets shall be provided with a switch to monitor inside or outside lever handle and a switch to monitor the latch bolt/deadbolt position. Locksets shall be operationally insensitive from 12 VDC to 24 VDC. Locksets shall include Molex connectors for simplified installation.
  - .1 Specified Manufacturers: Corbin Russwin ML20906 NSA Series – No alternate.

**.3 LOCKSET STRIKES**

- .1 Strikes shall be available with curved lip as required. Provide strikes with lip-length required to accommodate jamb and/or trim detail and projection.

**2.9 ELECTRIC STRIKES**

**.1 STANDARD STRIKES**

- .1 All standard electric strikes shall meet BHMA standard 501, grade 1 and be UL Listed for Burglary Resistance, category 1034. Strikes shall be all stainless steel construction for corrosion resistance, strength and durability. Strikes shall have been tested to withstand a static strength of a minimum 2500 lbs, a dynamic strength of 350 lbs before releasing and perform with a minimum of one million cycles of operation. Strikes shall be 24VDC fail-safe unless otherwise specified.
  - .1 Specified Manufacturers: RCI (dormakaba) F Series - F2364

**2.10 EXIT DEVICES**

**.1 CONVENTIONAL DEVICES – PUSH RAIL**

- .1 All exit devices shall be ANSI A156.3, Grade 1 Certified and shall be listed by Underwriters Laboratories and bear the UL label for life safety in full compliance with NFPA 80 and NFPA 101. Mounting rails shall be formed from a solid single piece of stainless steel, brass or bronze no less than 0.072" thick. Push rails shall be constructed of 0.062" thick material. Painted or anodized aluminum shall not be considered heavy duty and is not acceptable. Lever trim shall be available in finishes and designs to match that of the specified locksets.
  - .1 Specified Manufacturer: Sargent 80 Series

**.2 ELECTRIFIED DEVICES**

- .1 Electrified exit devices shall conform to all traditional exit device standards as specified above. All power requirements for exit devices used must utilize a telescopic jamb mounted power transfer for ease of maintenance and testing. Exit devices shall include a factory wired Molex connector.
- .2 Provide exterior doors with request to exit switch and latch retraction as specified.
- .3 Exit devices with electrified trim shall be fail-secure unless otherwise specified.
- .4 At controlled openings, exit devices shall be provided with a switch to monitor push rail to provide request-to-exit signaling.
  - .1 Specified Manufacturers: Sargent 80 Series

**.3 MULLIONS**

- .1 Mullions are to be fabricated from steel or aluminum and be removable only through the use of a cylinder keyed into the building's master key system.
  - .1 Specified Manufacturer: Sargent 12-L980 – no alternate  
L980A – no alternate

## 2.11 DOOR CLOSERS

### .1 SURFACE MOUNTED CLOSERS – HEAVY DUTY

- .1 All exterior door closers shall be ANSI 156.4, Grade 1 Certified. All closers shall have cast aluminum bodies at interior doors and cast iron bodies at exterior doors. All closers shall be furnished forged steel arms, and separate valves for adjusting back check, closing and latching cycles and adjustable spring to provide up to 50% increase in spring power. Closers shall be furnished with parallel arms mounting on all doors opening into corridors or other public spaces and shall be mounted to permit 180 degrees door swing wherever wall conditions permit. Closers shall not be installed on exterior or corridor side of doors; where possible install closers on door for optimum aesthetics.

- .1 Specified Manufacturer: LCN 4041XP – exterior doors only – no alternate  
Norton 7500 series – interior doors – no alternate  
8500 series – interior doors – no alternate

### .2 POWERED DOOR OPERATORS – HEAVY DUTY

- .1 Door operators shall be in accordance with ANSI 156.19 and work in conjunction with the fire rated hardware. Operators shall be powered by 24V, 1/8 hp motor. Non handed operator with adjustable spring to compensate for different manual push forces required on varying door widths. Microprocessor controlled unit shall control the operation and switching of the swing power operator. Operator to include power open, power close, power assist, electronic dampening, stack pressure consumption and lock retry circuit features. Provide 4.5" square actuators with concealed fasteners with International Symbol Accessibility and "PUSH TO OPEN".

- .1 Specified Manufacturer: Besam SW200i

## 2.12 DOOR TRIM AND PROTECTIVE PLATES

- .1 Door Pulls/Push/Kick/Armor Plates: to be 0.050 inches thick and 1.5 inches less full width of door, or as specified. Furnish all push/kick and armor plates with 'B4E' beveled edges with self-adhesive tape fastening for new doors and stainless steel mechanical fasteners for existing doors. Follow specific mounting instructions where push plate, door pull and deadlock applications occur. Fasteners for push plates, pull plates, door pulls and miscellaneous door trim shall be as shown in the hardware schedule. Where full height door pulls are specified supply units less 150mm from the top of door and 300mm from bottom of door. Submit shop drawing of pulls for review.

- .1 Specified Manufacturer: Rockwood

## 2.13 DOOR STOPS AND HOLDERS

### .1 WALL MOUNTED DOOR STOPS

- .1 Where a door is indicated on the plans to strike flush against a wall, wall bumpers shall be provided. Provide convex or concave design as indicated.

- .1 Specified Manufacturers: Rockwood

### .2 OVERHEAD STOPS/HOLDERS

- .1 Where specified, overhead stops/holders as shown in the hardware sets are to be provided. Track, slide, arm and jamb bracket shall be constructed of extruded bronze and shock absorber spring shall be of heavy tempered steel. Overhead stops shall be of non-handed design.

- .1 Specified Manufacturer: Rixson 1, 2, 6 and 10 Series.

## **2.14 GASKETING AND THRESHOLDS**

- .1 On exterior doors and smoke, light, or sound seals on interior doors where indicated or scheduled. Provide seals as required to meet UL10C. Provide only those units where silicon seal strip is easily replaceable and readily available from stocks maintained by manufacturer. Provide head seal as solid aluminum extrusion suitable for stop applied hardware ie P/A closers or surface overhead door stops.
- .2 Door Sweeps: House nylon brush seal in extruded aluminum case. Surface applied and adjusted to suit gap at bottom of door, complete with snap cover.
- .3 Auto Door Bottoms: Surface or semi mortise automatic door bottoms housed in aluminum case and equipped with nylon brush or silicone inserts. Each unit sized to suit the door width and meets the requirements of ANSI/BHMA 156.22-2003 for latching force and air infiltration.
- .4 Astragal Seal: Overlapping stainless steel astragal. Surface applied, meeting stile astragal consisting of one piece attached to active leaf, pull side face of door.
- .5 Provide threshold units not less than 5" wide at hollow metal frames and not less than 4" at aluminum frames, formed to accommodate change in floor elevation where indicated, fabricated to accommodate door hardware and to fit door frames. Provide 3" wide thresholds with a flat contact surface at locations with automatic door bottoms.
  - .1 Specified Manufacturers: Pemko

## **2.15 SILENCERS**

- .1 Furnish rubber door silencers all hollow metal frames; two (2) per pair and three (3) per single door frame.

## **2.16 ELECTRONIC PRODUCTS AND ACCESSORIES**

- .1 POWER SUPPLIES
  - .1 Power supplies shall furnish regulated 24VDC and shall be UL class 2 listed. LED's shall monitor zone status (voltage/no voltage) and slide switches shall be provided to connect or disconnect the load from power; 1, 4 or 8 separate output circuit breakers shall be provided to divide the load. Power supplies shall have the internal capability of charging optional 24VDC sealed lead acid batteries in addition to operating the DC load. Power supplies shall be supplied complete requiring only 120VAC to the fused input and shall be supplied in an enclosure. Power supplies shall be provided with emergency release terminals that allow the release of all devices upon activation of the fire alarm system. Power supplies to be provided for local installation at required electrified openings.
    - .1 Specified Manufacturer: Securitron BPS
- .2 ELYNX CABLES
  - .1 All power transfer hinges, electrified locksets, electric exit device trim and electric exit devices are to be equipped with Molex plug connectors. Door and Frame Elynx cables have been specified at a provisional length at each of these locations. It is the responsibility of the finishing hardware supplier to supply these cables, prior to door/frame manufacture, in appropriate lengths required by the various manufacturers. The hardware supplier is responsible to contact the door manufacturers to determine the cabling route and supply the correct length. Where the door manufacturer requires flying ends on Elynx cables the hardware installer will be responsible to map and pin Molex connectors.
    - .1 Specified Manufacturer: McKinney

**.3 CURRENT TRANSFER DEVICES**

- .1 Provide current transfers concealed in both door and frame. Provide current transfers with molex connectors and suitable gauge wire with a minimum of ten (10) conductors to properly connect schedule electrified hardware.
  - .1 Specified Manufacturer: Securitron CEPT-10-EL

**2.17 FINISHES**

- .1 The designations used in schedules and elsewhere to indicate hardware finishes are those listed in ANSI/BHMA A156.18 or traditional U.S. finishes shown by certain manufacturers for their products.
- .2 Provide quality of finish, including thickness of plating or coating (if any), composition, hardness, and other qualities complying with manufacturer's standards, but in no case less than specified by referenced standards for the applicable units of hardware.

**PART 3 - EXECUTION**

**3.1 EXAMINATION**

- .1 Contractor shall ensure that the building is secured and free from weather elements prior to installing interior door hardware. Examine hardware before installation to ensure it is free of defects.
- .2 It is the responsibility of the Hardware Supplier's AHC to provide a written inspection report to the Contractor, Consultant and Hardware Consultant after door hardware installation has been completed. The report is to certify that the finishing hardware has been supplied as specified and has been installed and is functioning according to the manufacturer's instructions. Subsequently the deficiencies will be corrected by the Contractor and reported in writing to the Consultant and Hardware Consultant.
- .3 After the deficiencies have been corrected, the Hardware Consultant will provide the final inspection. Any deficiencies found during this final inspection will be reported, in writing, to the Consultant.
- .4 Existing Openings: Hardware supplier is responsible for surveying all existing doors and frames to verify existing site conditions, preparations and opening details to ensure compatibility with specified hardware prior to submittal of schedules and shop drawings. Provide a letter confirming that the survey was completed accompanied with a list by door number of evident discrepancies or conflicts. Discrepancies and conflicts to be resolved in writing prior to order of hardware.

**3.2 INSTALLATION**

- .1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.
- .2 Supply metal door and frame manufacturers with complete instructions and templates for preparation of their work to receive hardware.
- .3 Supply manufacturers' instructions for proper installation of each hardware component.

- .4 Install hardware to standard hardware location dimensions in accordance with CSDFMA Canadian Metric Guide for Steel Doors and Frames (Modular Construction).
- .5 Where door stop contacts door pulls, mount stop to strike bottom of pull.
- .6 Install key control cabinet where directed by Consultant.
- .7 Use only manufacturer's supplied fasteners.
  - .1 Use of "quick" type fasteners, unless specifically supplied by manufacturer, is unacceptable.
- .8 Remove construction cores when directed by Consultant.
  - .1 Install permanent cores and ensure locks operate correctly.
- .9 Install each item of mechanical and electromechanical hardware and access control equipment to comply with the manufacturer's written instructions and according to specifications. All items to be installed with fasteners identified by manufacturer's installation instructions unless otherwise noted.
- .10 All high voltage and low voltage wire, junction boxes and conduit shall be installed by Division 26.
- .11 All Access Control System components not listing in the Hardware Schedule shall be installed by Division 28.
- .12 Mounting Heights: Install door hardware at heights indicated in the following applicable publications unless; specifically indicated or required by local governing regulations, requirements to match existing conditions, special templates, necessary coordination with door elevations, and or to ensure consistency with pairs of doors.
  - .1 DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames"
  - .2 DHI's "Recommended Locations for Architectural Hardware for Wood Flush Doors"
  - .3 ANSI A117.1 "Accessibility Guidelines for Buildings and Facilities"
  - .4 NWWDA
- .13 Power door operator products and accessories are required to be installed by an AAADM certified technician as approved by the manufacturer. The 110 VAC connection shall be made by Division 26. All low voltage connections to all operator peripherals shall be made by this section. Adjust for proper opening and closing operation per operational requirements. Ensure proper operation is maintained after final balancing of HVAC system.
- .14 Wall stops: Locate wall stops to contact door pulls/levers at mounting post connecting to door. Ensure existence of necessary wall reinforcing where specified for installation on drywall, plaster or clad wall conditions prior to installation.
- .15 Vertical rods: Adjust rod lengths to ensure positive latching of devices. Install bottom strikes as required by finished flooring conditions and in coordination with flooring subcontractor.
- .16 Closers: Size closers as per manufacturer's installation instructions. Adjust all closers after final balancing of HVAC system to ensure; proper latching of doors, proper closing/latch speed, adequate back check and opening force in accordance with referenced accessibility requirements.
- .17 Protection plates – Install on clean surface, and in temperature range of 5-25 degrees Celsius where tape applied. Pre-drill pilot holes doors when using mechanical fasteners.
- .18 Thresholds: Set thresholds in full bed of sealant complying with requirements specified in Division 7, Section 07 92 00, and Joint Sealants.

- .19 Architectural Seals – Install prior to other soffit mounted door hardware as indicated in hardware schedule. Ensure continuous seal of gasketing to door without impeding latching.
- .20 Door Bottoms – Ensure continuous seal to threshold or finished floor.
- .21 Electronic hardware systems: Install all electronic hardware as per electrical elevations and point-to-point drawings furnished under Submittals.
- .22 Retrofitting: Install door hardware to comply with manufacturers published templates and written instructions. Coordinate; cutting and fitting of doors and frames, installation of door hardware items, and removal of protective coverings with related sections.

### **3.3 FIELD QUALITY CONTROL**

- .1 The Contractor shall be solely responsible for and have control over construction means, methods, techniques, sequences, and procedures for coordinating all portions of the work under the Contract, unless the contract Documents give other specific instructions concerning these matters.
- .2 The hardware supplier shall attend site meetings to make certain of proper execution of the guidelines set in this document. The Contractor will do periodic inspection of door frames, prior to door and hardware installation to ensure frames have been installed plumb and true.
- .3 The installer will verify all frames to be plumb and true, prior to hardware installation.

### **3.4 ADJUSTING**

- .1 Adjust door hardware, operators, closures and controls for optimum, smooth operating condition, safety and for weather tight closure.
- .2 Lubricate hardware, operating equipment and other moving parts.
- .3 Adjust door hardware to ensure tight fit at contact points with frames.
- .4 Prior to acceptance or occupancy, adjust and check each operating item of hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate freely and smoothly or as intended for the application made.
- .5 Where door hardware is installed more than one month prior to acceptance or occupancy of a space or area, return to the installation during the week prior to acceptance or occupancy and make final check and adjustment of all hardware items in such space or area. Clean operating items as necessary to restore to proper function and finish of hardware and doors. Adjust door control devices to compensate for final operation of heating and ventilating equipment.
- .6 Instruct owner's personnel in the proper adjustment and maintenance of door hardware and hardware finishes and usage of any electronic devices.
- .7 This Section shall Commission and train the Owners in the use of all the Kaba-Ilco stand-alone locks supplied where specified.

### **3.5 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 – Cleaning.
  - .1 Leave Work area clean at end of each day.
  - .2 Clean hardware with damp rag and approved non-abrasive cleaner, and polish hardware in accordance with manufacturer's instructions.
  - .3 Remove protective material from hardware items where present.
  - .4 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 – Cleaning.

### **3.6 DEMONSTRATION**

- .1 Keying System Setup and Cabinet:
  - .1 Set up key control system with file key tags and numerical index,
  - .2 Place file keys and duplicate keys in key cabinet on their respective hooks.
- .2 Lock key cabinet and turn over key to University of Guelph representative Maintenance Staff Briefing:
  - .1 Brief maintenance staff regarding:
    - .1 Proper care, cleaning, and general maintenance of projects complete hardware.
    - .2 Description, use, handling, and storage of keys.
    - .3 Use, application and storage of wrenches for door closers locksets and fire exit hardware.
- .3 Demonstrate operation, operating components, adjustment features, and lubrication requirements.

### **3.7 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by door hardware installation.

### **3.8 HARDWARE SCHEDULE**

- .1 The following schedule is furnished for whatever assistance it may afford the Contractor; do not consider it as entirely inclusive. Prior to tender closing, it is the responsibility of the hardware supplier, to bring to the attention of the Contractor any errors or omissions. Cross-reference hardware schedule with architectural drawings and door schedule. Should any particular door or item be omitted in any scheduled hardware heading, provide door or item with hardware same as required for similar purposes. Hardware supplier is responsible for handing and sizing all products as listed in the hardware heading. Quantities listed are for each pair of doors, or for each single door.
- .2 Refer to the following Hardware Schedule, prepared by Pat Ryan of Assa Abloy, attached as Appendix A.

END OF SECTION

**APPENDIX "A"**

**FINISH HARDWARE SCHEDULE**

## APPENDIX A – FINISH HARDWARE SCHEDULE

### Set: 1.0

Pair D103, corridor C103 from corridor C102, 1930 x 2135 x 45, Hollow Metal x , LHR/LHR,  
Pair D104, corridor C102 from corridor C104, 1930 x 2135 x 45, Hollow Metal x , LHR/LHR,  
Pair D106, corridor C104 from corridor C106, 1930 x 2135 x 45, Hollow Metal x , LHR/LHR,  
Pair D108, corridor C108 from corridor C106, 1930 x 2135 x 45, Hollow Metal x , LHR/LHR,

6	Hinges	T4A3786 Size to Suit (NRP at Outswing Doors)	652	MK
1	Magnetic Lock	M62		SU
1	Exit Device	8893 J	US32D	SA
1	Rim Exit Device	55 56 8810	US32D	SA
2	Concealed Overhead Stop	6-X36	630	RF
2	Auto Door Operator	SW200i-IS-99-CL	628	BM
2	Wall Switch	CM-45/4	630	OT
2	Kick Plate	K1050 8" x WIDTH 4BE CSK	US32D	RO
2	Door Position Switch	1076-D		OT
2	ElectroLynx Harness (In Frame)	QC-C1500P		MK
2	ElectroLynx Harness (In Door)	QC-CX00 LENGTH		MK
1	Electric Power Transfer	CEPT-10		SU
1	Card Reader	HID multiCLASS SE RP40		HID
1	Wiring Diagrams	POINT TO POINT		00
2	Mortar Box	TA-6410 (to suit door contact location)		OT
2	Mortar Box	TA-6410 (to suit mag lock locations)		OT
2	Mortar Box	TA-6413 (to suit auto operator location)		OT
1	Bracket	ASB-62CL	628	SU
1	Signage	TA-EXS-1		OT

Notes: 120vac to door operator by division 26 00 00

Conduit, back boxes, and pull strings to door operator header and wall switches by division 26 00 00

Mortar boxes welded in place by HM frame supplier

### Mode of Operation

One leaf normally closed and locked by mag lock. Presentation of valid card to card reader will release power to mag lock and enable wall switch to activate door operator. Entry by pushing door open or by pushing door operator wall switch. Free egress at all times by pushing exit device rail which will release mag lock and enable operator button.

Upon activation of fire alarm mag locks are to lose power allowing free egress. Mag locks to be locally released by fire alarm pull stations located on either side of opening. Mag locks to be overridden and reset by key switch located at main fire alarm annunciator panel.

Door# D103 - East leaf of double egress pair to receive 55-56-8810 and CEPT-10

Door# D104, D106, D108 - North leaf of double egress pair to receive 55-56-8810 and CEPT-10

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**Set: 2.0**

Single D116, corridor C102 to custodian C116, 915 x 2135 x 45, Hollow Metal x , RH,  
Single D116g, washroom WR116 to chase, ~497 x 2135 x 45, Hollow Metal x , RH,

3	Hinge	TA2714 Size to Suit (NRP at Outswinging Doors)	US26D	MK
1	Storeroom Lock	ML2057 NSA CMK	630	RU
1	Cylinder	100200AT P GMK GGMK Z09	19	MC
1	Conc Overhead Stop	2-X36	619	RF
1	Kick Plate	K1050 8" x WIDTH 4BE CSK	US32D	RO
1	Gasketing	S773BL		PE
1	Sweep	18061CNB TKSP8 WIDTH		PE

Notes: Template overhead stop to maximum degree of opening allowable by site conditions

**Set: 3.0**

Single D116a, corridor C102 to washroom 116a, 915 x 2135 x 45, Hollow Metal x , LH,  
Single D116f, corridor c102 to washroom 116f, 915 x 2135 x 45, Hollow Metal x , RH,

3	Hinge	TA2714 Size to Suit (NRP at Outswinging Doors)	US26D	MK
1	Privacy Set	ML2020 NSA M19S	630	RU
1	Kick Plate	K1050 8" x WIDTH 4BE CSK	US32D	RO
1	Wall Stop	405	US26D	RO

**Set: 4.0**

Single D116b, corridor C102 to washroom 116b, 610 x 2135 x 45, Hollow Metal x , LH,  
Single D116c, corridor C102 to washroom 116c, 610 x 2135 x 45, Hollow Metal x , LH,  
Single D116d, corridor C102 to washroom 116d, 610 x 2135 x 45, Hollow Metal x , RH,  
Single D116e, corridor C102 to washroom 116e, 610 x 2135 x 45, Hollow Metal x , RH,

3	Hinge	TA2714 Size to Suit (NRP at Outswinging Doors)	US26D	MK
1	Privacy Set	ML2020 NSA M19S	630	RU
1	Surf Overhead Stop	10-X36	652	RF
1	Kick Plate	K1050 8" x WIDTH 4BE CSK	US32D	RO

Notes: Template overhead stop to maximum degree of opening allowable by site conditions

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**Set: 5.0**

Single D117, corridor C103 from vestibule 117, 915 x 2135 x 45, Hollow Metal x , RHR,

3	Hinge	TA2714 Size to Suit (NRP at Outswinging Doors)	US26D	MK
1	Storeroom Lock	ML2057 NSA CMK	630	RU
1	Cylinder	100200AT P GMK GGMK Z09	19	MC
1	Surf Overhead Stop	10-X36	652	RF
1	Surface Closer	CPS7500	689	NO
1	Kick Plate	K1050 8" x WIDTH 4BE CSK	US32D	RO
1	Mortar Box	TA-6410 (to suit future door contact location)		OT
1	Mortar Box	TA-6410 (to suite future current transfer location)		OT
1	Filler Plate Set	CEPT-10 (filler frame and door)	600	OT

Notes: Door supplier to provide raceway thru door to future electric lock location  
Mortar boxes welded in place by HM frame supplier

**Set: 6.0**

Single D117a, vestibule 117 from server 117a, 915 x 2135 x 45, Hollow Metal x , LHR,

3	Hinge	TA2714 Size to Suit (NRP at Outswinging Doors)	US26D	MK
1	Electrified Mortise Lock	RX-ML20906-SEC NSA M92 CMK	630	RU
1	Cylinder	100200AT P GMK GGMK Z09	19	MC
1	Surface Closer	CPS7500	689	NO
1	Door Position Switch	1076-D		OT
1	ElectroLynx Harness (In Frame)	QC-C1500P		MK
1	ElectroLynx Harness (In Door)	QC-CX00 LENGTH		MK
1	Electric Power Transfer	CEPT-10		SU
1	Card Reader	HID multiCLASS SE RP40		HID
1	Mortar Box	TA-6410 (to suit current transfer location)		OT
1	Mortar Box	TA-6410 (to suit door contact location)		OT

Notes: Door supplier to provide raceway thru door to electric lock location  
Mortar boxes welded in place by HM frame supplier

**Mode of Operation**

Door normally closed and locked. Presentation of valid card to card reader will unlock door and  
allow entry by turning lever and pulling / pushing door open.

Free egress at all times from inside by turning lever and pulling / pushing door open.

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**Set: 7.0**

Single D117b, vestibule 117 to CCS 117b, 915 x 2135 x 45, Hollow Metal x , RH,

3	Hinge	TA2714 Size to Suit (NRP at Outswinging Doors)	US26D	MK
1	Storeroom Lock	ML2057 NSA CMK	630	RU
1	Cylinder	100200AT P GMK GGMK Z09	19	MC
1	Surface Closer	7500 (pull side mount)	689	NO
1	Wall Stop	405	US26D	RO

**Set: 8.0**

Single D123, corridor C103 to reception 123, 965 x 2135 x 45, Hollow Metal x , RH,

3	Hinge (heavy weight)	T4A3786 Size to Suit (NRP at Outswinging Doors)	US26D	MK
1	Electrified Mortise Lock	RX-ML20906-SEC NSA M92 CMK	630	RU
1	Cylinder	100200AT P GMK GGMK Z09	19	MC
1	Concealed Overhead Stop	1-X36	689	RF
1	Surface Closer	7500 (pull side mount)	689	NO
1	Kick Plate	K1050 8" x WIDTH 4BE CSK	US32D	RO
1	Threshold	151A x door width	627	PE
1	Gasketing	supplied by acoustic door and frame supplier		PE
1	Door Bottom	supplied by acoustic door and frame supplier		PE
1	ElectroLynx Harness (In Frame)	QC-C1500P		MK
1	ElectroLynx Harness (In Door)	QC-CX00 LENGTH		MK
1	Electric Power Transfer	CEPT-10		SU
1	Card Reader	HID multiCLASS SE RP40		HID
1	Wiring Diagrams	POINT TO POINT		00
1	Mortar Box	TA-6410 (to suit current transfer location)		OT
1	Mortar Box	TA-6410 (to suit door contact location)		OT

Notes: Door supplier to provide raceway thru door to electric lock location  
Mortar boxes welded in place by HM frame supplier  
Template overhead stop to maximum degree allowable by site conditions

**Mode of Operation**

Door normally closed and locked. Presentation of valid card to card reader will unlock door and  
allow entry by turning lever and pulling / pushing door open.  
Free egress at all times from inside by turning lever and pulling / pushing door open.

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**Set: 8.1**

Single D123a, corridor C103 to corridor C123, 965 x 2135 x 45, Hollow Metal x , RH,

3	Hinge (heavy weight)	T4A3786 Size to Suit (NRP at Outswinging Doors)	US26D	MK
1	Storeroom Lock	RX 21 8206 LNL	US32D	SA
1	Cylinder	100200AT P GMK GGMK Z20	19	MC
1	Concealed Overhead Stop	1-X36	689	RF
1	Surface Closer	7500 (pull side mount)	689	NO
1	Kick Plate	K1050 8" x WIDTH 4BE CSK	US32D	RO
1	Threshold	151A x door width	627	PE
1	Gasketing	supplied by acoustic door and frame supplier		PE
1	Door Bottom	supplied by acoustic door and frame supplier		PE
1	ElectroLynx Harness (In Frame)	QC-C1500P		MK
1	ElectroLynx Harness (In Door)	QC-CX00 LENGTH		MK
1	Electric Power Transfer	CEPT-10		SU
1	Wiring Diagrams	POINT TO POINT		00
1	Mortar Box	TA-6410 (to suit current transfer location)		OT
1	Mortar Box	TA-6410 (to suit door contact location)		OT

Notes: Door supplier to provide raceway thru door to future electric lock location  
Mortar boxes welded in place by HM frame supplier  
Template overhead stop to maximum degree allowable by site conditions

Mode of Operation

Door normally closed and locked. Free egress at all times by turning lever and pulling / pushing door open. Integral request to exit switch to shunt door contact when interior lever depressed.

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**Set: 9.0**

Single D123b, reception 123 to office 123b, 965 x 2135 x 45, Hollow Metal x , LH,  
Single D123c, reception 123 to office 123c, 965 x 2135 x 45, Hollow Metal x , LH,  
Single D123d, corridor C123 to office 123d, 965 x 2135 x 45, Hollow Metal x , LH,

3	Hinge	TA2714 Size to Suit (NRP at Outswinging Doors)	US26D	MK
1	Office Lock	ML2051 NSA CMK	630	RU
1	Cylinder	100200AT P GMK GGMK Z09	19	MC
1	Floor Stop	441H	US26D	RO
1	Gasketing	supplied by acoustic door and frame supplier		PE
1	Door Bottom	supplied by acoustic door and frame supplier		PE

**Set: 10.0**

Single D123e, corridor C123 to meeting 123e, 965 x 2135 x 45, Hollow Metal x , RH,

3	Hinge	TA2714 Size to Suit (NRP at Outswinging Doors)	US26D	MK
1	Passage Latch	ML2010 NSA	630	RU
1	Floor Stop	441H	US26D	RO
1	Gasketing	supplied by acoustic door and frame supplier		PE
1	Door Bottom	supplied by acoustic door and frame supplier		PE

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**Set: 11.0**

Single D124, corridor C104 to closed file storage 124, 965 x 2135 x 45, Hollow Metal x , RH,

3	Hinge	TA2714 Size to Suit (NRP at Outswinging Doors)	US26D	MK
1	Electrified Mortise Lock	RX-ML20906-SEC NSA M92 CMK	630	RU
1	Cylinder	100200AT P GMK GGMK Z09	19	MC
1	Surface Closer	7500 (pull side mount)	689	NO
1	Kick Plate	K1050 8" x WIDTH 4BE CSK	US32D	RO
1	Floor Stop	441H	US26D	RO
1	Door Position Switch	1076-D		OT
1	ElectroLynx Harness (In Frame)	QC-C1500P		MK
1	ElectroLynx Harness (In Door)	QC-CX00 LENGTH		MK
1	Electric Power Transfer	CEPT-10		SU
1	Card Reader	HID multiCLASS SE RP40		HID
1	Wiring Diagrams	POINT TO POINT		00
1	Mortar Box	TA-6410 (to suit current transfer location)		OT
1	Mortar Box	TA-6410 (to suit door contact location)		OT

Notes: Door supplier to provide raceway thru door to electric lock location  
Mortar boxes welded in place by HM frame supplier

**Mode of Operation**

Door normally closed and locked. Presentation of valid card to card reader will unlock door and allow entry by turning lever and pulling / pushing door open.  
Free egress at all times from inside by turning lever and pulling / pushing door open.

**Set: 12.0**

Single D125, corridor C150e to family therapy room 125, 965 x 2135 x 45, Hollow Metal x , LH,  
Single D126a, corridor C104 to couple / individual room 126a, 965 x 2135 x 45, Hollow Metal x , LH,  
Single D126b, corridor C104 to couple /individual room 126b, 965 x 2135 x 45, Hollow Metal x , RH,  
Single D126c, corridor C104 to couple / individual room 126c, 965 x 2135 x 45, Hollow Metal x , LH,  
Single D126d, corridor c104 to couple / individual room 126d, 965 x 2135 x 45, Hollow Metal x , RH,

3	Hinge	TA2714 Size to Suit (NRP at Outswinging Doors)	US26D	MK
1	Electrified Mortise Lock	RX-ML20906-SEC NSA M92 CMK	630	RU
1	Cylinder	100200AT P GMK GGMK Z09	19	MC
1	Surface Closer	7500 (pull side mount)	689	NO
1	Kick Plate	K1050 8" x WIDTH 4BE CSK	US32D	RO
1	Floor Stop	441H	US26D	RO
1	Threshold	151A x door width	627	PE
1	Gasketing	supplied by acoustic door and frame supplier		PE
1	Door Bottom	supplied by acoustic door and frame supplier		PE
1	ElectroLynx Harness (In Frame)	QC-C1500P		MK
1	ElectroLynx Harness (In Door)	QC-CX00 LENGTH		MK
1	Electric Power Transfer	CEPT-10		SU
1	Card Reader	HID multiCLASS SE RP40		HID
1	Wiring Diagrams	POINT TO POINT		00
1	Mortar Box	TA-6410 (to suit current transfer location)		OT
1	Mortar Box	TA-6410 (to suit door contact location)		OT

Notes: Door supplier to provide raceway thru door to electric lock location  
Mortar boxes welded in place by HM frame supplier  
Template overhead stop to maximum degree allowable by site conditions

**Mode of Operation**

Door normally closed and locked. Presentation of valid card to card reader will unlock door and  
allow entry by turning lever and pulling / pushing door open.  
Free egress at all times from inside by turning lever and pulling / pushing door open.

UNIVERSITY OF GUELPH BUILDING #046 RENOVATION  
GUELPH, ON

**Set: 13.0**

Single D125a, corridor C150e to viewing room D125a, 965 x 2135 x 45, Hollow Metal x , RH,  
Single D127a, corridor C150e to viewing / child care 127a, 965 x 2135 x 45, Hollow Metal x , LH,

3	Hinge	TA2714 Size to Suit (NRP at Outswinging Doors)	US26D	MK
1	Electrified Mortise Lock	RX-ML20906-SEC NSA M92 CMK	630	RU
1	Cylinder	100200AT P GMK GGMK Z09	19	MC
1	Surface Closer	7500 (pull side mount)	689	NO
1	Kick Plate	K1050 8" x WIDTH 4BE CSK	US32D	RO
1	Floor Stop	441H	US26D	RO
1	Threshold	151A x door width	627	PE
1	Gasketing	supplied by acoustic door and frame supplier		PE
1	Door Bottom	supplied by acoustic door and frame supplier		PE
1	ElectroLynx Harness (In Frame)	QC-C1500P		MK
1	ElectroLynx Harness (In Door)	QC-CX00 LENGTH		MK
1	Electric Power Transfer	CEPT-10		SU
1	Card Reader	HID multiCLASS SE RP40		HID
1	Wiring Diagrams	POINT TO POINT		00
1	Mortar Box	TA-6410 (to suit current transfer location)		OT
1	Mortar Box	TA-6410 (to suit door contact location)		OT

Notes: Door supplier to provide raceway thru door to electric lock location  
Mortar boxes welded in place by HM frame supplier  
Template overhead stop to maximum degree allowable by site conditions

Mode of Operation

Door normally closed and locked. Presentation of valid card to card reader will unlock door and  
allow entry by turning lever and pulling / pushing door open.

Free egress at all times from inside by turning lever and pulling / pushing door open.

**Set: 14.0**

Single D127, corridor C150e to family therapy room 127, 965 x 2135 x 45, Hollow Metal x , RH,

3	Hinge	TA2714 Size to Suit (NRP at Outswinging Doors)	US26D	MK
1	Electrified Mortise Lock	RX-ML20906-SEC NSA M92 CMK	630	RU
1	Cylinder	100200AT P GMK GGMK Z09	19	MC
1	Surface Closer	7500 (pull side mount)	689	NO
1	Kick Plate	K1050 8" x WIDTH 4BE CSK	US32D	RO
1	Floor Stop	441H	US26D	RO
1	Threshold	151A x door width	627	PE
1	Gasketing	supplied by acoustic door and frame supplier		PE
1	Door Bottom	supplied by acoustic door and frame supplier		PE
1	ElectroLynx Harness (In Frame)	QC-C1500P		MK
1	ElectroLynx Harness (In Door)	QC-CX00 LENGTH		MK
1	Electric Power Transfer	CEPT-10		SU
1	Card Reader	HID multiCLASS SE RP40		HID
1	Wiring Diagrams	POINT TO POINT		00
1	Mortar Box	TA-6410 (to suit current transfer location)		OT
1	Mortar Box	TA-6410 (to suit door contact location)		OT

Notes: Door supplier to provide raceway thru door to electric lock location  
Mortar boxes welded in place by HM frame supplier  
Template overhead stop to maximum degree allowable by site conditions

**Mode of Operation**

Door normally closed and locked. Presentation of valid card to card reader will unlock door and allow entry by turning lever and pulling / pushing door open.  
Free egress at all times from inside by turning lever and pulling / pushing door open.

UNIVERSITY OF GUELPH BUILDING #046 RENOVATION  
GUELPH, ON

**Set: 15.0**

Single D127b, viewing / child care 127a to family therapy room 127, 762 x 2135 x 45, Hollow Metal  
x , LH,

3	Hinge	TA2714 Size to Suit (NRP at Outswinging Doors)	US26D	MK
1	Classroom Lock	ML2055 NSA CMK	630	RU
1	Cylinder	100200AT P GMK GGMK Z09	19	MC
1	Floor Stop	441H	US26D	RO
1	Threshold	151A x door width	627	PE
1	Gasketing	supplied by acoustic door and frame supplier		PE
1	Door Bottom	supplied by acoustic door and frame supplier		PE

UNIVERSITY OF GUELPH BUILDING #046 RENOVATION  
GUELPH, ON

**Set: 16.0**

Single D128, corridor C104 to multi-purpose room 128, 965 x 2135 x 45, Hollow Metal x , RH,  
Single D129, corridor C104 to large group room 129, 965 x 2135 x 45, Hollow Metal x , LH,  
Single D129a, corridor C104 to large group room 129, 965 x 2135 x 45, Hollow Metal x , RH,  
Single D130, corridor C104 to sessional office 130, 965 x 2135 x 45, Hollow Metal x , LH,

3	Hinge	TA2714 Size to Suit (NRP at Outswinging Doors)	US26D	MK
1	Electrified Mortise Lock	RX-ML20906-SEC NSA M92 CMK	630	RU
1	Cylinder	100200AT P GMK GGMK Z09	19	MC
1	Surface Closer	7500 (pull side mount)	689	NO
1	Kick Plate	K1050 8" x WIDTH 4BE CSK	US32D	RO
1	Floor Stop	441H	US26D	RO
1	Threshold	151A x door width	627	PE
1	Gasketing	supplied by acoustic door and frame supplier		PE
1	Door Bottom	supplied by acoustic door and frame supplier		PE
1	ElectroLynx Harness (In Frame)	QC-C1500P		MK
1	ElectroLynx Harness (In Door)	QC-CX00 LENGTH		MK
1	Electric Power Transfer	CEPT-10		SU
1	Card Reader	HID multiCLASS SE RP40		HID
1	Wiring Diagrams	POINT TO POINT		00
1	Mortar Box	TA-6410 (to suit current transfer location)		OT
1	Mortar Box	TA-6410 (to suit door contact location)		OT

Notes: Door supplier to provide raceway thru door to electric lock location  
Mortar boxes welded in place by HM frame supplier  
Template overhead stop to maximum degree allowable by site conditions

**Mode of Operation**

Door normally closed and locked. Presentation of valid card to card reader will unlock door and  
allow entry by turning lever and pulling / pushing door open.  
Free egress at all times from inside by turning lever and pulling / pushing door open.

UNIVERSITY OF GUELPH BUILDING #046 RENOVATION  
GUELPH, ON

**Set: 17.0**

Single D131, corridor C137 to storage 131, 965 x 2135 x 45, Hollow Metal x , RH,

3	Hinge	TA2714 Size to Suit (NRP at Outswinging Doors)	US26D	MK
1	Storeroom Lock	ML2057 NSA CMK	630	RU
1	Cylinder	100200AT P GMK GGMK Z09	19	MC
1	Wall Stop	405	US26D	RO

**Set: 18.0**

Single D132, corridor C106 to research space 132, 965 x 2135 x 45, Hollow Metal x , RH,  
Single D133, corridor C107 to office / supervision 133, 965 x 2135 x 45, Hollow Metal x , LH,  
Single D135, corridor C107 to office / supervision 135, 965 x 2135 x 45, Hollow Metal x , RH,  
Single D137, corridor C107 to office / supervision 137, 965 x 2135 x 45, Hollow Metal x , LH,  
Single D139, corridor C107 to office / supervision 139, 965 x 2135 x 45, Hollow Metal x , RH,

3	Hinge	TA2714 Size to Suit (NRP at Outswinging Doors)	US26D	MK
1	Electrified Mortise Lock	RX-ML20906-SEC NSA M92 CMK	630	RU
1	Cylinder	100200AT P GMK GGMK Z09	19	MC
1	Surface Closer	7500 (pull side mount)	689	NO
1	Kick Plate	K1050 8" x WIDTH 4BE CSK	US32D	RO
1	Floor Stop	441H	US26D	RO
1	Threshold	151A x door width	627	PE
1	Gasketing	supplied by acoustic door and frame supplier		PE
1	Door Bottom	supplied by acoustic door and frame supplier		PE
1	ElectroLynx Harness (In Frame)	QC-C1500P		MK
1	ElectroLynx Harness (In Door)	QC-CX00 LENGTH		MK
1	Electric Power Transfer	CEPT-10		SU
1	Card Reader	HID multiCLASS SE RP40		HID
1	Wiring Diagrams	POINT TO POINT		00
1	Mortar Box	TA-6410 (to suit current transfer location)		OT
1	Mortar Box	TA-6410 (to suit door contact location)		OT

Notes: Door supplier to provide raceway thru door to electric lock location  
Mortar boxes welded in place by HM frame supplier  
Template overhead stop to maximum degree allowable by site conditions

**Mode of Operation**

Door normally closed and locked. Presentation of valid card to card reader will unlock door and  
allow entry by turning lever and pulling / pushing door open.  
Free egress at all times from inside by turning lever and pulling / pushing door open.

UNIVERSITY OF GUELPH BUILDING #046 RENOVATION  
GUELPH, ON

**Set: 19.0**

Single D134, corridor C106 to kitchenette 134, 965 x 2135 x 45, Hollow Metal x , RH,

3	Hinge	TA2714 Size to Suit (NRP at Outswinging Doors)	US26D	MK
1	Electrified Mortise Lock	RX-ML20906-SEC NSA M92 CMK	630	RU
1	Cylinder	100200AT P GMK GGMK Z09	19	MC
1	Surface Closer	7500 (pull side mount)	689	NO
1	Kick Plate	K1050 8" x WIDTH 4BE CSK	US32D	RO
1	Floor Stop	441H	US26D	RO
1	ElectroLynx Harness (In Frame)	QC-C1500P		MK
1	ElectroLynx Harness (In Door)	QC-CX00 LENGTH		MK
1	Electric Power Transfer	CEPT-10		SU
1	Card Reader	HID multiCLASS SE RP40		HID
1	Wiring Diagrams	POINT TO POINT		00
1	Mortar Box	TA-6410 (to suit current transfer location)		OT
1	Mortar Box	TA-6410 (to suit door contact location)		OT

Notes: Door supplier to provide raceway thru door to electric lock location  
Mortar boxes welded in place by HM frame supplier  
Template overhead stop to maximum degree allowable by site conditions

Mode of Operation

Door normally closed and locked. Presentation of valid card to card reader will unlock door and allow entry by turning lever and pulling / pushing door open.  
Free egress at all times from inside by turning lever and pulling / pushing door open.

UNIVERSITY OF GUELPH BUILDING #046 RENOVATION  
GUELPH, ON

**Set: 20.0**

Single D136, corridor C106 from student work area 136, 965 x 2135 x 45, Hollow Metal x , LHR,

3	Hinge	TA2714 Size to Suit (NRP at Outswinging Doors)	US26D	MK
1	Electrified Mortise Lock	RX-ML20906-SEC NSA M92 CMK	630	RU
1	Cylinder	100200AT P GMK GGMK Z09	19	MC
1	Surface Closer	7500 (pull side mount)	689	NO
1	Kick Plate	K1050 8" x WIDTH 4BE CSK	US32D	RO
1	Floor Stop	441H	US26D	RO
1	Threshold	151A x door width	627	PE
1	Gasketing	supplied by acoustic door and frame supplier		PE
1	Door Bottom	supplied by acoustic door and frame supplier		PE
1	ElectroLynx Harness (In Frame)	QC-C1500P		MK
1	ElectroLynx Harness (In Door)	QC-CX00 LENGTH		MK
1	Electric Power Transfer	CEPT-10		SU
1	Card Reader	HID multiCLASS SE RP40		HID
1	Wiring Diagrams	POINT TO POINT		00
1	Mortar Box	TA-6410 (to suit current transfer location)		OT
1	Mortar Box	TA-6410 (to suit door contact location)		OT

Notes: Door supplier to provide raceway thru door to electric lock location  
Mortar boxes welded in place by HM frame supplier  
Template overhead stop to maximum degree allowable by site conditions

**Mode of Operation**

Door normally closed and locked. Presentation of valid card to card reader will unlock door and allow entry by turning lever and pulling / pushing door open.  
Free egress at all times from inside by turning lever and pulling / pushing door open.

UNIVERSITY OF GUELPH BUILDING #046 RENOVATION  
GUELPH, ON

**Set: 21.0**

Single D136b, student work area 136 to telephone 136b, 965 x 2135 x 45, Hollow Metal x , RH,  
Single D136c, student work area 136 to breakout room 136c, 965 x 2135 x 45, Hollow Metal x , LH,

3	Hinge	TA2714 Size to Suit (NRP at Outswinging Doors)	US26D	MK
1	Passage Latch	ML2010 NSA	630	RU
1	Floor Stop	441H	US26D	RO
1	Threshold	151A x door width	627	PE
1	Gasketing	supplied by acoustic door and frame supplier		PE
1	Door Bottom	supplied by acoustic door and frame supplier		PE

**Set: 22.0**

Single D138, corridor C106 from sprinkler room 138, 762 x 2135 x 45, Hollow Metal x , RHR,

3	Hinge	TA2714 Size to Suit (NRP at Outswinging Doors)	US26D	MK
1	Storeroom Lock	ML2057 NSA CMK	630	RU
1	Cylinder	100200AT P GMK GGMK Z09	19	MC
1	Surface Closer	CPS7500	689	NO

UNIVERSITY OF GUELPH BUILDING #046 RENOVATION  
GUELPH, ON

**Set: 23.0**

Single D138a, corridor C108 to universal washroom WR138, 965 x 2135 x 45, Hollow Metal x , RH,

3	Hinges	T4A3786 Size to Suit (NRP at Outswing Doors)	652	MK
1	Storeroom Lock	21 8206 LNL x less strike	US32	SA
1	Cylinder	100200AT GMK GGMK (key switch)	19	MC
1	Cylinder	100200AT P GMK GGMK Z20	19	MC
1	Electric Strike	F2364 (fail safe)	630	RCI
1	Push Plate	70C x 152mm x 762mm x CFC x TAPE x B4E (RH)	630	RO
1	Concealed Overhead Stop	6-X36	630	RF
1	Auto Door Operator	SW200i-IS-99-CL	628	BM
1	Kick Plate	K1050 8" x WIDTH 4BE CSK	US32D	RO
1	Universal Washroom Call System	CX-WC13AXFM		OT
1	Key Switch	MKA	628	OT
1	Universal Emergency Call System Kit	CX-WEC10K2	630	OT
1	Relay	RB-4-24		SU
1	Door Position Switch	1076-D		OT
1	ElectroLynx Harness (In Frame)	QC-C1500P		MK
1	ElectroLynx Harness (In Door)	QC-CX00 LENGTH		MK
1	Emergency Instructional Signage	CM-SE21		00
1	Power Supply	BPS-24-1		SU
1	Mortar Box	TA-6410 (to suit door contact location)		OT
1	Mortar Box	TA-6410 (to suit door operator location)		OT
1	Mortar Box	TA-6410 (to suit electric strike location)		OT

Notes: Mortar boxes welded in place by HM frame supplier  
Template overhead stop to maximum degree of opening allowable by site conditions

**Mode of Operation**

Door normally closed and latched. Outside occupancy indicator GREEN. Door can be opened manually by pushing door open or by pushing operator wall switch. Once inside room and with door closed, pressing Push-To-Lock button locks door and disables corridor side wall switch, and changes LED on occupancy indicator to RED from GREEN.

Egress by pushing / pulling door open or by pushing inside wall switch.

Key switch inside secures bathroom if service work required.  
Pressing inside wall mounted mushroom button activates washroom and corridor mounted lights and horn. Free egress at all times.

UNIVERSITY OF GUELPH BUILDING #046 RENOVATION  
GUELPH, ON

**Set: 24.0**

Single D141, corridor C107 to mail 141, 965 x 2135 x 45, Hollow Metal x , LH,

3	Hinge	TA2714 Size to Suit (NRP at Outswinging Doors)	US26D	MK
1	Electrified Mortise Lock	RX-ML20906-SEC NSA M92 CMK	630	RU
1	Cylinder	100200AT P GMK GGMK Z09	19	MC
1	Surface Closer	7500H	689	NO
1	Door Position Switch	1076-D		OT
1	ElectroLynx Harness (In Frame)	QC-C1500P		MK
1	ElectroLynx Harness (In Door)	QC-CX00 LENGTH		MK
1	Card Reader	HID multiCLASS SE RP40		HID
1	Wiring Diagrams	POINT TO POINT		00
1	Mortar Box	TA-6410 (to suit current transfer location)		OT
1	Mortar Box	TA-6410 (to suit door contact location)		OT

Notes: Door supplier to provide raceway thru door to electric lock location  
Mortar boxes welded in place by HM frame supplier

Mode of Operation

Door normally closed and locked. Presentation of valid card to card reader will unlock door and allow entry by turning lever and pulling / pushing door open.

Free egress at all times from inside by turning lever and pulling / pushing door open.

UNIVERSITY OF GUELPH BUILDING #046 RENOVATION  
GUELPH, ON

**Set: 25.0**

Single D143, corridor C108 to waiting 143, 965 x 2135 x 45, Hollow Metal x , RH,

3	Hinge (heavy weight)	T4A3786 Size to Suit (NRP at Outswinging Doors)	US26D	MK
1	Electrified Mortise Lock	RX-ML20906-SEC NSA M92 CMK	630	RU
1	Cylinder	100200AT P GMK GGMK Z09	19	MC
1	Electric Strike	1006CLB	630	HS
2	Wall Switch	CM-35N/4	630	OT
1	Auto Door Operator	SW200i-IS-99-CL	628	BM
1	Kick Plate	K1050 8" x WIDTH 4BE CSK	US32D	RO
1	Threshold	151A x door width	627	PE
1	Gasketing	supplied by acoustic door and frame supplier		PE
1	Door Bottom	supplied by acoustic door and frame supplier		PE
1	Door Position Switch	1076-D		OT
1	ElectroLynx Harness (In Frame)	QC-C1500P		MK
1	ElectroLynx Harness (In Door)	QC-CX00 LENGTH		MK
1	Electric Power Transfer	CEPT-10		SU
1	Card Reader	HID multiCLASS SE RP40		HID
1	Wiring Diagrams	POINT TO POINT		00
1	Mortar Box	TA-6410 (to suit current transfer location)		OT
1	Mortar Box	TA-6410 (to suit door contact location)		OT
1	Mortar Box	TA-6410 (to suit door operator location)		OT
1	Mortar Box	TA-6410 (to suit electric strike location)		OT

Notes: Door supplier to provide raceway thru door to electric lock location

Mortar boxes welded in place by HM frame supplier

120vac to door operator by division 26 00 00

Wall switch back boxes and pull strings to operator header by division 26 00 00.

**Mode of Operation**

Door normally closed and locked. Presentation of valid card to card reader will unlock door and enable outside operator wall switch. Ingress by turning lever and push / pull door open, or by, pressing outside push button

which will release the electric strike and door will open automatically.

Free egress at all times from inside by turning inside lever and pulling / pushing door open, or by, pushing inside wall switch which will release the electric strike and door will open automatically.

UNIVERSITY OF GUELPH BUILDING #046 RENOVATION  
GUELPH, ON

**Set: 26.0**

Single D145, waiting 143 to reception 145, 965 x 2135 x 45, Hollow Metal x , LH,  
Single D147, reception 145 to admin office D147, 965 x 2135 x 45, Hollow Metal x , RH,  
Single D149, reception 145 to office / supervision 149, 965 x 2135 x 45, Hollow Metal x , RH,

3	Hinge	TA2714 Size to Suit (NRP at Outswinging Doors)	US26D	MK
1	Electrified Mortise Lock	RX-ML20906-SEC NSA M92 CMK	630	RU
1	Cylinder	100200AT P GMK GGMK Z09	19	MC
1	Surf Overhead Stop	10-X36 (door D145 only)	652	RF
1	Surface Closer	7500 (pull side mount)	689	NO
1	Floor Stop	441H	US26D	RO
1	Threshold	151A x door width	627	PE
1	Gasketing	supplied by acoustic door and frame supplier		PE
1	Door Bottom	supplied by acoustic door and frame supplier		PE
1	ElectroLynx Harness (In Frame)	QC-C1500P		MK
1	ElectroLynx Harness (In Door)	QC-CX00 LENGTH		MK
1	Electric Power Transfer	CEPT-10		SU
1	Card Reader	HID multiCLASS SE RP40		HID
1	Wiring Diagrams	POINT TO POINT		00
1	Mortar Box	TA-6410 (to suit current transfer location)		OT
1	Mortar Box	TA-6410 (to suit door contact location)		OT

Notes: Door supplier to provide raceway thru door to electric lock location  
Mortar boxes welded in place by HM frame supplier  
Template overhead stop to maximum degree allowable by site conditions

**Mode of Operation**

Door normally closed and locked. Presentation of valid card to card reader will unlock door and  
allow entry by turning lever and pulling / pushing door open.  
Free egress at all times from inside by turning lever and pulling / pushing door open.

UNIVERSITY OF GUELPH BUILDING #046 RENOVATION  
GUELPH, ON

**Set: 27.0**

Pair DST101, exterior from entrance vestibule ST101a, 1930 x 2135 x 57, Aluminum x , RHRA/LHR,

2	Continuous Hinge	MCK-12HD EPT 83"	CL	MK
1	Removable Mullion	L980A x 980C1 Less Cyl	US28	SA
1	Exit Device (Elect)	21 31 55 56 AD8504 x 649	US32D	SA
1	Exit Device (Elect)	21 31 55 56 AD8510 x 649	US32D	SA
1	Cylinder	100200AT P GMK GGMK Z20	19	MC
1	Cylinder	100403VT P GMK GGMK	19	MC
2	Door Pull	RM3312MP 12XHD x Dr Height (- 450mm) x Thickness	US32D	RO
2	Concealed Overhead Stop	6-X36	630	RF
1	Closer	4021 LONG x ST-3212 x mws (concealed in operator header)	689	LC
2	Actuator Inside Non-Lit	CM-45/4		00
1	Auto Door Operator	SW200i-OS-51-CL x full width header x 120vac	628	BM
1	Threshold	255x5AFG		PE
2	Sweep	18061CNB TKSP8 WIDTH		PE
1	Relay	RB-4-24		SU
1	Door Position Switch	1076-D		OT
2	ElectroLynx Harness (In Frame)	QC-C1500P		MK
2	ElectroLynx Harness (In Door)	QC-CX00 LENGTH		MK
1	Interface Module	CX-12		OT
2	Electric Power Transfer	CEPT-10		SU
1	Card Reader	HID multiCLASS SE RP40		HID
2	Actuator Back Box	CM-43CBL	BLK	00
1	Video Intercom	Video Intercom supplied and installed by division 26 00 00		OT

Notes: Balance of perimeter weather strip by the aluminum frame supplier  
Template overhead stops to maximum degree of opening allowable by site conditions

120vac to door operator by division 26 00 00  
Wall switch back boxes and pull strings to operator header by division 26 00 00.

**Mode of Operation**

Doors normally closed and locked. Entry by presenting valid card to card reader which will electrically retract exit device latches on both leaves and allow door to be pulled open. Valid card will also enable exterior wall switch which when pressed will activate door operator allowing one leaf to open automatically. Secondary entry by remote release located in intercom monitoring station, location of station to be confirmed.

Free egress at all times by pushing doors open or by pushing inside wall switch which will retract exit device latch and automatically open door.

UNIVERSITY OF GUELPH BUILDING #046 RENOVATION  
GUELPH, ON

**Set: 28.0**

Pair DST102, existing stairwell ST102 from corridor C103, 1930 x 2135 x 45, Hollow Metal x ,  
RHRA/LHR, 45 min

6	Hinge (heavy weight)	T4A3786 Size to Suit (NRP at Outswinging Doors)	US26D	MK
1	Removable Mullion	12-L980	PC	SA
1	Rim Exit Device	12 55 56 8810	US32D	SA
1	Rim Exit Device	12 55 56 8804 Less Pull	US32D	SA
1	Cylinder	100200AT P GMK GGMK Z20	19	MC
1	Cylinder	100403VT P GMK GGMK	19	MC
2	Door Pull	BF158 Mtg-Type 12XHD	US32D	RO
2	Surface Closer	PR7500	689	NO
2	Kick Plate	K1050 8" x WIDTH 4BE CSK	US32D	RO
2	Wall Stop	405	US26D	RO
1	Gasketing	S773BL		PE
2	Sweep	18061CNB TKSP8 WIDTH		PE
1	Relay	RB-4-24		SU
2	Door Position Switch	1076-D		OT
2	ElectroLynx Harness (In Frame)	QC-C1500P		MK
2	ElectroLynx Harness (In Door)	QC-CX00 LENGTH		MK
2	Electric Power Transfer	CEPT-10		SU
1	Card Reader	HID multiCLASS SE RP40		HID
1	Wiring Diagrams	POINT TO POINT		00
2	Mortar Box	TA-6410 (to suit current transfer location)		OT
1	Mortar Box	TA-6410 (to suit door contact location)		OT

Notes: Template overhead stops to maximum degree of opening allowable by site conditions

**Mode of Operation**

Doors normally closed and locked. Entry by presenting valid card to card reader which will electrically retract exit device latches on both leaves and allow doors to be pulled open. Free egress at all times by pushing doors open. Upon activation of the fire alarm power will be disconnected to the electric exit devices.

UNIVERSITY OF GUELPH BUILDING #046 RENOVATION  
GUELPH, ON

**Set: 29.0**

Pair DST101a, entrance vestibule ST101A from corridor C108, 1930 x 2135 x 45, Hollow Metal x , RHRA/LHR, 45 min

Pair D101, entrance vestibule from corridor C101, 1930 x 2135 x 45, Hollow Metal x , RHRA/LHR, 45 min

6	Hinge (heavy weight)	T4A3786 Size to Suit (NRP at Outswinging Doors)	US26D	MK
1	Removable Mullion	12-L980	PC	SA
1	Rim Exit Device	12 55 56 8810	US32D	SA
1	Rim Exit Device	12 55 56 8804 Less Pull	US32D	SA
1	Cylinder	100200AT P GMK GGMK Z20	19	MC
1	Cylinder	100403VT P GMK GGMK	19	MC
2	Door Pull	BF158 Mtg-Type 12XHD	US32D	RO
2	Closer	4021 LONG x ST-3212 x mws (concealed in operator header)	689	LC
1	Actuator Inside Non-Lit	CM-45/4		00
1	Auto Door Operator	SW200i-OS-51-CL x full width header x 120vac	628	BM
1	Wall Stop	405	US26D	RO
1	Floor Stop	441H	US26D	RO
1	Gasketing	supplied by acoustic door and frame supplier		PE
2	Sweep	18061CNB TKSP8 WIDTH		PE
1	Relay	RB-4-24		SU
1	Door Position Switch	1076-D		OT
1	ElectroLynx Harness (In Frame)	QC-C1500P		MK
1	ElectroLynx Harness (In Door)	QC-CX00 LENGTH		MK
1	Interface Module	CX-12		OT
1	Electric Power Transfer	CEPT-10		SU
1	Card Reader	HID multiCLASS SE RP40		HID
1	Actuator Back Box	CM-43CBL	BLK	00
1	Wiring Diagrams	POINT TO POINT		00
2	Mortar Box	TA-6410 (to suit current transfer location)		OT
1	Mortar Box	TA-6410 (to suit door contact location)		OT
1	Mortar Box	TA-6413 (to suit auto operator location)		OT

Notes: Mortar boxes welded in place by HM frame supplier.

120vac to door operator by division 26 00 00

Wall switch back boxes and pull strings to operator header by division 26 00 00.

**Mode of Operation**

Doors normally closed and locked. Entry by presenting valid card to card reader which will electrically retract exit device latches on both leaves and allow door to be pulled open. Valid card will also enable exterior wall

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switch which when pressed will activate door operator allowing one leaf to open automatically.  
Free egress at all times by pushing doors open or by pushing inside wall switch which will retract exit device latch and automatically open door.

**Set: 30.0**

Pair DST103, exterior from existing stairwell ST103, 1930 x 2135 x 57, Aluminum x , RHRA/LHR,

2	Continuous Hinge	MCK-12HD EPT 83"	CL	MK
1	Removable Mullion	L980A x 980C1 Less Cyl	US28	SA
1	Exit Device (Elect)	21 31 55 56 AD8504 x 649	US32D	SA
1	Exit Device (Elect)	21 31 55 56 AD8510 x 649	US32D	SA
1	Cylinder	100200AT P GMK GGMK Z20	19	MC
1	Cylinder	100403VT P GMK GGMK	19	MC
2	Door Pull	RM3312MP 12XHD x Dr Height (- 450mm) x Thickness	US32D	RO
2	Closer	4041XP SCUSH	689	LC
2	Adapter Plate	4040XP-18PA	689	LC
1	Threshold	255x5AFG		PE
2	Sweep	18061CNB TKSP8 WIDTH		PE
1	Relay	RB-4-24		SU
2	Door Position Switch	1076-D		OT
2	ElectroLynx Harness (In Frame)	QC-C1500P		MK
2	ElectroLynx Harness (In Door)	QC-CX00 LENGTH		MK
2	Electric Power Transfer	CEPT-10		SU
1	Card Reader	HID multiCLASS SE RP40		HID

Notes: Balance of perimeter weather strip by the aluminum frame supplier

**Mode of Operation**

Doors normally closed and locked. Entry by presenting valid card to card reader which will electrically retract exit device latches on both leaves and allow doors to be pulled open.

Free egress at all times by pushing doors open.

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**Set: 31.0**

Single DST103a, existing stairwell ST103 from corridor C103, 1015 x 2135 x 45, Hollow Metal x ,  
LHR, 45 min

3	Hinge (heavy weight)	T4A3386 Size to Suit (NRP at Outswinging Doors)	US32D	MK
1	Electrified Rim Exit	12 21 55 8876-24v ETL	US32D	SA
1	Cylinder	100403VT P GMK GGMK	19	MC
1	Surface Closer	7500 (pull side mount)	689	NO
1	Kick Plate	K1050 8" x WIDTH 4BE CSK	US32D	RO
1	Wall Stop	405	US26D	RO
1	Gasketing	S773BL		PE
1	Sweep	18061CNB TKSP8 WIDTH		PE
1	Door Position Switch	1076-D		OT
1	ElectroLynx Harness (In Frame)	QC-C1500P		MK
1	ElectroLynx Harness (In Door)	QC-CX00 LENGTH		MK
1	Electric Power Transfer	CEPT-10		SU
1	Card Reader	HID multiCLASS SE RP40		HID
1	Wiring Diagrams	POINT TO POINT		00
1	Mortar Box	TA-6410 (to suit current transfer location)		OT
1	Mortar Box	TA-6410 (to suit door contact location)		OT

Notes: Mortar boxes welded in place by HM frame supplier

Mode of Operation

Door normally closed and locked. Presentation of valid card will unlock exit device trim lever. Entry  
by turning lever and pulling door open.  
Free egress at all times.

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**Set: 32.0**

Single D001, stairwell STB001 from corridor CB001, 965 x 2135 x 45, Hollow Metal x Hollow Metal,  
RHR, 45 min

3	Hinge	TA2714 Size to Suit (NRP at Outswinging Doors)	US26D	MK
1	Storeroom Lock	ML2057 NSA CMK	630	RU
1	Cylinder	100200AT P GMK GGMK Z09	19	MC
1	Surface Closer	PR7500	689	NO
1	Wall Stop	405	US26D	RO
1	Gasketing	S773BL		PE
1	Sweep	18061CNB TKSP8 WIDTH		PE

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**Set: 33.0**

Pair D100, exterior from existing vestibule C100, 1930 x 2135 x 57, Aluminum x , RHRA/LHR,  
Pair D103a, exterior from existing vestibule C101A, 1930 x 2135 x 45, Aluminum x , RHRA/LHR,

2	Continuous Hinge	MCK-12HD EPT 83"	CL	MK
1	Removable Mullion	L980A x 980C1 Less Cyl	US28	SA
1	Exit Device (Elect)	21 31 55 56 AD8504 x 649	US32D	SA
1	Exit Device (Elect)	21 31 55 56 AD8510 x 649	US32D	SA
1	Cylinder	100200AT P GMK GGMK Z20	19	MC
1	Cylinder	100403VT P GMK GGMK	19	MC
2	Door Pull	RM3312MP 12XHD x Dr Height (- 450mm) x Thickness	US32D	RO
2	Concealed Overhead Stop	6-X36	630	RF
2	Closer	4021 LONG x ST-3212 x mws (concealed in operator header)	689	LC
1	Actuator Inside Non-Lit	CM-45/4		00
1	Auto Door Operator	SW200i-OS-51-CL x full width header x 120vac	628	BM
1	Threshold	252x3AFG WIDTH		PE
2	Sweep	18061CNB TKSP8 WIDTH		PE
1	Relay	RB-4-24		SU
2	Door Position Switch	1076-D		OT
2	ElectroLynx Harness (In Frame)	QC-C1500P		MK
2	ElectroLynx Harness (In Door)	QC-CX00 LENGTH		MK
1	Interface Module	CX-12		OT
2	Electric Power Transfer	CEPT-10		SU
1	Card Reader	HID multiCLASS SE RP40		HID
2	Actuator Back Box	CM-43CBL	BLK	00

Notes: Balance of perimeter weather strip by the aluminum frame supplier  
Template overhead stops to maximum degree of opening allowable by site conditions

120vac to door operator by division 26 00 00  
Wall switch back boxes and pull strings to operator header by division 26 00 00.

**Mode of Operation**

Doors normally closed and locked. Entry by presenting valid card to card reader which will electrically retract exit device latches on both leaves and allow door to be pulled open. Valid card will also enable exterior wall switch which when pressed will activate door operator allowing one leaf to open automatically.

Free egress at all times by pushing doors open or by pushing inside wall switch which will retract exit device latch and automatically open door.

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**Set: 34.0**

Single D104WR, existing corridor C101 to universal washroom 104, 965 x 2135 x 45, Hollow Metal  
x , RH,

3	Hinges	T4A3786 Size to Suit (NRP at Outswing Doors)	652	MK
1	Storeroom Lock	21 8206 LNL x less strike	US32	SA
1	Cylinder	100200AT GMK GGMK (key switch)	19	MC
1	Cylinder	100200AT P GMK GGMK Z20	19	MC
1	Electric Strike	F2364 (fail safe)	630	RCI
1	Push Plate	70C x 152mm x 762mm x CFC x TAPE x B4E (RH)	630	RO
1	Concealed Overhead Stop	6-X36	630	RF
1	Auto Door Operator	SW200i-IS-99-CL	628	BM
1	Kick Plate	K1050 8" x WIDTH 4BE CSK	US32D	RO
1	Universal Washroom Call System	CX-WC13AXFM		OT
1	Key Switch	MKA	628	OT
1	Universal Emergency Call System Kit	CX-WEC10K2	630	OT
1	Relay	RB-4-24		SU
1	Door Position Switch	1076-D		OT
1	ElectroLynx Harness (In Frame)	QC-C1500P		MK
1	ElectroLynx Harness (In Door)	QC-CX00 LENGTH		MK
1	Emergency Instructional Signage	CM-SE21		00
1	Power Supply	BPS-24-1		SU
1	Mortar Box	TA-6410 (to suit door contact location)		OT
1	Mortar Box	TA-6410 (to suit door operator location)		OT
1	Mortar Box	TA-6410 (to suit electric strike location)		OT

Notes: Mortar boxes welded in place by HM frame supplier  
Template overhead stop to maximum degree of opening allowable by site conditions

**Mode of Operation**

Door normally closed and latched. Outside occupancy indicator GREEN. Door can be opened manually by pushing door open or by pushing operator wall switch. Once inside room and with door closed, pressing Push-To-Lock button locks door and disables corridor side wall switch, and changes LED on occupancy indicator to RED from GREEN.

Egress by pushing / pulling door open or by pushing inside wall switch.

Key switch inside secures bathroom if service work required.  
Pressing inside wall mounted mushroom button activates washroom and corridor mounted lights and horn. Free egress at all times.

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**Set: 35.0**

Single D104a, existing corridor C101 to washroom 104a, 965 x 2135 x 45, Hollow Metal x , LH,

3	Hinge	TA2714 Size to Suit (NRP at Outswinging Doors)	US26D	MK
1	Privacy Set	ML2020 NSA M19S	630	RU
1	Concealed Overhead Stop	6-X36	630	RF
1	Kick Plate	K1050 8" x WIDTH 4BE CSK	US32D	RO

Notes: Template overhead stop to maximum degree allowable by site conditions

**Set: 36.0**

Pair D110a, existing classroom 110 from closet 110a, 1930 x 2135 x 45, Hollow Metal x ,  
RHRA/LHR,

6	Hinge	TA2714 Size to Suit (NRP at Outswinging Doors)	US26D	MK
1	Flush Bolt	555	US26D	RO
1	Dust Proof Strike	570	US26D	RO
1	Storeroom Lock	ML2057 NSA CMK	630	RU
1	Cylinder	100200AT P GMK GGMK Z09	19	MC
2	Conc Overhead Stop	2-X36	619	RF

Notes: template overhead stops to maximum degree of opening allowable by site conditions

**Set: 37.0**

Single D201, corridor C201 to custodian 201, 915 x 2135 x 45, Hollow Metal x , RH,  
Single D201g, washroom WR201 to chase, ~555 x 2135 x 45, Hollow Metal x , RH,

3	Hinge	TA2714 Size to Suit (NRP at Outswinging Doors)	US26D	MK
1	Storeroom Lock	ML2057 NSA CMK	630	RU
1	Cylinder	100200AT P GMK GGMK Z09	19	MC
1	Conc Overhead Stop	2-X36	619	RF
1	Surface Closer	7500 (pull side mount)	689	NO
1	Kick Plate	K1050 8" x WIDTH 4BE CSK	US32D	RO
1	Gasketing	S773BL		PE
1	Sweep	18061CNB TKSP8 WIDTH		PE

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**Set: 38.0**

Single D201a, corridor C201 to washroom 201a, 915 x 2135 x 45, Hollow Metal x , LH,  
Single D201f, corridor C201 to washroom 201f, 915 x 2135 x 45, Hollow Metal x , RH,

3	Hinge	TA2714 Size to Suit (NRP at Outswinging Doors)	US26D	MK
1	Privacy Set	ML2020 NSA M19S	630	RU
1	Kick Plate	K1050 8" x WIDTH 4BE CSK	US32D	RO
1	Wall Stop	405	US26D	RO

**Set: 39.0**

Single D201b, corridor C201 to washroom 201b, 610 x 2135 x 45, Hollow Metal x , LH,  
Single D201c, corridor C201 to washroom 201c, 610 x 2135 x 45, Hollow Metal x , LH,  
Single D201d, corridor C201 to washroom 201d, 610 x 2135 x 45, Hollow Metal x , RH,  
Single D201e, corridor C201 to washroom 201e, 610 x 2135 x 45, Hollow Metal x , RH,

3	Hinge	TA2714 Size to Suit (NRP at Outswinging Doors)	US26D	MK
1	Privacy Set	ML2020 NSA M19S	630	RU
1	Conc Overhead Stop	2-X36	619	RF
1	Kick Plate	K1050 8" x WIDTH 4BE CSK	US32D	RO

Notes: Template overhead stop to maximum degree allowable by site conditions

**Set: 40.0**

Single D202, corridor C206 to assessment room 202, 965 x 2135 x 45, Hollow Metal x , RH,  
Single D203, corridor C206 to couple / individual room 203 , 965 x 2135 x 45, Hollow Metal x , LH,  
Single D204, corridor C206 to assessment room 204, 965 x 2135 x 45, Hollow Metal x , LH,  
Single D205, corridor C206 to couple / individual room 205, 965 x 2135 x 45, Hollow Metal x , RH,  
Single D207, corridor C206 to couple / individual room 207, 965 x 2135 x 45, Hollow Metal x , LH,  
Single D208, corridor C206 to assessment room 208, 965 x 2135 x 45, Hollow Metal x , LH,  
Single D209, corridor C206 to play room 209, 965 x 2135 x 45, Hollow Metal x , RH,  
Single D210, corridor C207 to playroom 210, 965 x 2135 x 45, Hollow Metal x , RH,  
Single D211, corridor C207 to family therapy room 211, 965 x 2135 x 45, Hollow Metal x , LH,  
Single D213, corridor C208 to family therapy room 213, 965 x 2135 x 45, Hollow Metal x , RH,  
Single D214, corridor C208 to viewing room 214, 965 x 2135 x 45, Hollow Metal x , LH,

3	Hinge	TA2714 Size to Suit (NRP at Outswinging Doors)	US26D	MK
1	Classroom Lock	ML2055 NSA CMK	630	RU
1	Cylinder	100200AT P GMK GGMK Z09	19	MC
1	Floor Stop	441H	US26D	RO
1	Threshold	151A x door width	627	PE
1	Gasketing	supplied by acoustic door and frame supplier		PE
1	Door Bottom	supplied by acoustic door and frame supplier		PE

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**Set: 41.0**

Single D206, corridor C206 to viewing room 206, 965 x 2135 x 45, Hollow Metal x , LH,  
Single D210a, corridor C207 to viewing room 210a, 965 x 2135 x 45, Hollow Metal x , LH,

3	Hinge	TA2714 Size to Suit (NRP at Outswinging Doors)	US26D	MK
1	Classroom Lock	ML2055 NSA CMK	630	RU
1	Cylinder	100200AT P GMK GGMK Z09	19	MC
1	Floor Stop	441H	US26D	RO
1	Threshold	151A x door width	627	PE
1	Gasketing	supplied by acoustic door and frame supplier		PE
1	Door Bottom	supplied by acoustic door and frame supplier		PE

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**Set: 42.0**

Pair D202a, corridor C202 from corridor C201, 1930 x 2135 x 45, Hollow Metal x , LHR/LHR,  
Pair D206a, corridor C206 from corridor C201, 1930 x 2135 x 45, Hollow Metal x , LHR/LHR,

6	Hinges	T4A3786 Size to Suit (NRP at Outswing Doors)	652	MK
1	Magnetic Lock	M62		SU
1	Exit Device	8893 J	US32D	SA
2	Rim Exit Device	55 56 8810	US32D	SA
2	Concealed Overhead Stop	6-X36	630	RF
2	Auto Door Operator	SW200i-IS-99-CL	628	BM
2	Wall Switch	CM-45/4	630	OT
2	Kick Plate	K1050 8" x WIDTH 4BE CSK	US32D	RO
2	Door Position Switch	1076-D		OT
2	ElectroLynx Harness (In Frame)	QC-C1500P		MK
2	ElectroLynx Harness (In Door)	QC-CX00 LENGTH		MK
1	Electric Power Transfer	CEPT-10		SU
1	Card Reader	HID multiCLASS SE RP40		HID
1	Wiring Diagrams	POINT TO POINT		00
1	Mortar Box	TA-6410 (to suit door contact location)		OT
1	Mortar Box	TA-6410 (to suit mag lock locations)		OT
2	Mortar Box	TA-6413 (to suit auto operator location)		OT
1	Bracket	ASB-62CL	628	SU

Notes: 120vac to door operator by division 26 00 00

Conduit, back boxes, and pull strings to door operator header and wall switches by division 26 00 00

Mortar boxes welded in place by HM frame supplier

**Mode of Operation**

One leaf normally closed and locked by mag lock. Presentation of valid card to card reader will release power to mag lock and enable wall switch to activate door operator. Entry by pushing door open or by pushing door operator wall switch. Free egress at all times by pushing exit device rail which will release mag lock and enable operator button.

Upon activation of fire alarm mag locks are to lose power allowing free egress. Mag locks to be locally released by fire alarm pull stations located on either side of opening. Mag locks to be overridden and reset by key switch located at main fire alarm annunciator panel.

Door# D206 - East leaf of double egress pair to receive 55-56-8810 and CEPT-10

Door# D104, D106, D108 - North leaf of double egress pair to receive 55-56-8810 and CEPT-10

**Set: 43.0**

Single D212, corridor C207 to test library 212, 965 x 2135 x 45, Hollow Metal x , RH,

3	Hinge	TA2714 Size to Suit (NRP at Outswinging Doors)	US26D	MK
1	Electrified Mortise Lock	RX-ML20906-SEC NSA M92 CMK	630	RU
1	Cylinder	100200AT P GMK GGMK Z09	19	MC
1	Surface Closer	7500 (pull side mount)	689	NO
1	Wall Stop	405	US26D	RO
1	ElectroLynx Harness (In Frame)	QC-C1500P		MK
1	ElectroLynx Harness (In Door)	QC-CX00 LENGTH		MK
1	Electric Power Transfer	CEPT-10		SU
1	Card Reader	HID multiCLASS SE RP40		HID
1	Wiring Diagrams	POINT TO POINT		00
1	Mortar Box	TA-6410 (to suit current transfer location)		OT
1	Mortar Box	TA-6410 (to suit door contact location)		OT

Notes: Door supplier to provide raceway thru door to electric lock location  
Mortar boxes welded in place by HM frame supplier  
Template overhead stop to maximum degree allowable by site conditions

**Mode of Operation**

Door normally closed and locked. Presentation of valid card to card reader will unlock door and allow entry by turning lever and pulling / pushing door open.  
Free egress at all times from inside by turning lever and pulling / pushing door open.

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**Set: 44.0**

Single D215, corridor C208 from family therapy room 215, 965 x 2135 x 45, Hollow Metal x , LHR,  
Single D216, corridor C201 to wellness room 216, 965 x 2135 x 45, Hollow Metal x , RH,  
Single D217b, corridor C201 to lounge 217, 965 x 2135 x 45, Hollow Metal x , LH,

3	Hinge	TA2714 Size to Suit (NRP at Outswinging Doors)	US26D	MK
1	Electrified Mortise Lock	RX-ML20906-SEC NSA M92 CMK	630	RU
1	Cylinder	100200AT P GMK GGMK Z09	19	MC
1	Surface Closer	7500 (pull side mount)	689	NO
1	Floor Stop	441H	US26D	RO
1	Threshold	151A x door width	627	PE
1	Gasketing	supplied by acoustic door and frame supplier		PE
1	Door Bottom	supplied by acoustic door and frame supplier		PE
1	ElectroLynx Harness (In Frame)	QC-C1500P		MK
1	ElectroLynx Harness (In Door)	QC-CX00 LENGTH		MK
1	Electric Power Transfer	CEPT-10		SU
1	Card Reader	HID multiCLASS SE RP40		HID
1	Wiring Diagrams	POINT TO POINT		00
1	Mortar Box	TA-6410 (to suit current transfer location)		OT
1	Mortar Box	TA-6410 (to suit door contact location)		OT

Notes: Door supplier to provide raceway thru door to electric lock location  
Mortar boxes welded in place by HM frame supplier

**Mode of Operation**

Door normally closed and locked. Presentation of valid card to card reader will unlock door and  
allow entry by turning lever and pulling / pushing door open.

Free egress at all times from inside by turning lever and pulling / pushing door open.

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**Set: 44.1**

Single D217, corridor C201 to lounge 217, 965 x 2135 x 45, Hollow Metal x , RH,

3	Hinge	TA2714 Size to Suit (NRP at Outswinging Doors)	US26D	MK
1	Electrified Mortise Lock	RX-ML20906-SEC NSA M92 CMK	630	RU
1	Cylinder	100200AT P GMK GGMK Z09	19	MC
1	Concealed Overhead Stop	6-X36	630	RF
1	Surface Closer	7500 (pull side mount)	689	NO
1	Threshold	151A x door width	627	PE
1	Gasketing	supplied by acoustic door and frame supplier		PE
1	Door Bottom	supplied by acoustic door and frame supplier		PE
1	ElectroLynx Harness (In Frame)	QC-C1500P		MK
1	ElectroLynx Harness (In Door)	QC-CX00 LENGTH		MK
1	Electric Power Transfer	CEPT-10		SU
1	Card Reader	HID multiCLASS SE RP40		HID
1	Wiring Diagrams	POINT TO POINT		00
1	Mortar Box	TA-6410 (to suit current transfer location)		OT
1	Mortar Box	TA-6410 (to suit door contact location)		OT

Notes: Door supplier to provide raceway thru door to electric lock location  
Mortar boxes welded in place by HM frame supplier  
Template overhead stop to maximum degree allowable by site conditions

Mode of Operation

Door normally closed and locked. Presentation of valid card to card reader will unlock door and  
allow entry by turning lever and pulling / pushing door open.  
Free egress at all times from inside by turning lever and pulling / pushing door open.

**Set: 45.0**

Single D217a, lounge 217 to coats 217a, 610 x 2135 x 45, Hollow Metal x , LH,

3	Hinge	TA2714 Size to Suit (NRP at Outswinging Doors)	US26D	MK
1	Storeroom Lock	ML2057 NSA CMK	630	RU
1	Cylinder	100200AT P GMK GGMK Z09	19	MC
1	Floor Stop	441H	US26D	RO

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**Set: 46.0**

Single D218, corridor C201 from storage 218, 965 x 2135 x 45, Hollow Metal x , LHR,

3	Hinge	TA2714 Size to Suit (NRP at Outswinging Doors)	US26D	MK
1	Storeroom Lock	ML2057 NSA CMK	630	RU
1	Cylinder	100200AT P GMK GGMK Z09	19	MC
1	Surface Closer	CPS7500	689	NO

**Set: 47.0**

Single D219, corridor C203 from storage 219, 965 x 2135 x 45, Hollow Metal x , RHR,

3	Hinge	TA2714 Size to Suit (NRP at Outswinging Doors)	US26D	MK
1	Storeroom Lock	ML2057 NSA CMK	630	RU
1	Cylinder	100200AT P GMK GGMK Z09	19	MC
1	Surface Closer	CPS7500	689	NO

**Set: 47.1**

Single D231, corridor C203 from elevator machine room 231, 965 x 2135 x 45, Hollow Metal x ,  
LHR, 45 min

3	Hinge	TA2714 Size to Suit (NRP at Outswinging Doors)	US26D	MK
1	Storeroom Lock	ML2057 NSA CMK	630	RU
1	Cylinder	100200AT P GMK GGMK Z09	19	MC
1	Surface Closer	CPS7500	689	NO
1	Gasketing	S773BL		PE
1	Sweep	18061CNB TKSP8 WIDTH		PE

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**Set: 48.0**

Single D220, corridor C201 to prayer room 220, 965 x 2135 x 45, Hollow Metal x , RH,  
Single D221, corridor C203 to office / supervision 221, 965 x 2135 x 45, Hollow Metal x , LH,  
Single D222, corridor C201 to confidential student work room 222, 965 x 2135 x 45, Hollow Metal x ,  
RH,  
Single D223, corridor C203 to office / supervision 223, 965 x 2135 x 45, Hollow Metal x , LH,  
Single D225, corridor C203 to office / supervision 225, 965 x 2135 x 45, Hollow Metal x , RH,  
Single D227, corridor C203 to office / supervision 227, 965 x 2135 x 45, Hollow Metal x , LH,  
Single D229, corridor C203 to office / supervision 229, 965 x 2135 x 45, Hollow Metal x , RH,

3	Hinge	TA2714 Size to Suit (NRP at Outswinging Doors)	US26D	MK
1	Electrified Mortise Lock	RX-ML20906-SEC NSA M92 CMK	630	RU
1	Cylinder	100200AT P GMK GGMK Z09	19	MC
1	Surface Closer	7500 (pull side mount)	689	NO
1	Kick Plate	K1050 8" x WIDTH 4BE CSK	US32D	RO
1	Floor Stop	441H	US26D	RO
1	Threshold	151A x door width	627	PE
1	Gasketing	supplied by acoustic door and frame supplier		PE
1	Door Bottom	supplied by acoustic door and frame supplier		PE
1	ElectroLynx Harness (In Frame)	QC-C1500P		MK
1	ElectroLynx Harness (In Door)	QC-CX00 LENGTH		MK
1	Electric Power Transfer	CEPT-10		SU
1	Card Reader	HID multiCLASS SE RP40		HID
1	Wiring Diagrams	POINT TO POINT		00
1	Mortar Box	TA-6410 (to suit current transfer location)		OT
1	Mortar Box	TA-6410 (to suit door contact location)		OT

Notes: Door supplier to provide raceway thru door to electric lock location  
Mortar boxes welded in place by HM frame supplier

**Mode of Operation**

Door normally closed and locked. Presentation of valid card to card reader will unlock door and  
allow entry by turning lever and pulling / pushing door open.  
Free egress at all times from inside by turning lever and pulling / pushing door open.

UNIVERSITY OF GUELPH BUILDING #046 RENOVATION  
GUELPH, ON

**Set: 49.0**

Single D224, corridor C204 to research / therapy assessment room 224, 965 x 2135 x 45, Hollow Metal x , LH,

Single D228, corridor C204 to research therapy assessment room 228, 965 x 2135 x 45, Hollow Metal x , RH,

3	Hinge	TA2714 Size to Suit (NRP at Outswinging Doors)	US26D	MK
1	Classroom Lock	ML2055 NSA CMK	630	RU
1	Cylinder	100200AT P GMK GGMK Z09	19	MC
1	Floor Stop	441H	US26D	RO
1	Threshold	151A x door width	627	PE
1	Gasketing	supplied by acoustic door and frame supplier		PE
1	Door Bottom	supplied by acoustic door and frame supplier		PE

**Set: 50.0**

Single D224a, corridor C204 to viewing room 224a, 965 x 2135 x 45, Hollow Metal x , LH,

Single D228a, corridor C204 to viewing room 228a, 965 x 2135 x 45, Hollow Metal x , LH,

3	Hinge	TA2714 Size to Suit (NRP at Outswinging Doors)	US26D	MK
1	Classroom Lock	ML2055 NSA CMK	630	RU
1	Cylinder	100200AT P GMK GGMK Z09	19	MC
1	Floor Stop	441H	US26D	RO
1	Threshold	151A x door width	627	PE
1	Gasketing	supplied by acoustic door and frame supplier		PE
1	Door Bottom	supplied by acoustic door and frame supplier		PE

UNIVERSITY OF GUELPH BUILDING #046 RENOVATION  
GUELPH, ON

**Set: 51.0**

Single D226, corridor C204 to office 226, 965 x 2135 x 45, Hollow Metal x , LH,  
Single D232, corridor C204 to office 232, 965 x 2135 x 45, Hollow Metal x , RH,  
Single D237, reception / copy 235 to admin office 237, 965 x 2135 x 45, Hollow Metal x , LH,

3	Hinge	TA2714 Size to Suit (NRP at Outswinging Doors)	US26D	MK
1	Office Lock	ML2051 NSA CMK	630	RU
1	Cylinder	100200AT P GMK GGMK Z09	19	MC
1	Threshold	151A x door width	627	PE
1	Gasketing	supplied by acoustic door and frame supplier		PE
1	Door Bottom	supplied by acoustic door and frame supplier		PE

**Set: 52.0**

Single D230, corridor C204 to research data / analysis room 230, 965 x 2135 x 45, Hollow Metal x , LH,

Single D233, corridor C202 to large group room 233 , 965 x 2135 x 45, Hollow Metal x , LH,

Single D235, corridor C202 to reception / copy 235, 965 x 2135 x 45, Hollow Metal x , LH,

Single D239, reception copy 239 to seminar 239, 965 x 2135 x 45, Hollow Metal x , RH,

3	Hinge	TA2714 Size to Suit (NRP at Outswinging Doors)	US26D	MK
1	Electrified Mortise Lock	RX-ML20906-SEC NSA M92 CMK	630	RU
1	Cylinder	100200AT P GMK GGMK Z09	19	MC
1	Surface Closer	7500 (pull side mount)	689	NO
1	Floor Stop	441H	US26D	RO
1	Threshold	151A x door width	627	PE
1	Gasketing	supplied by acoustic door and frame supplier		PE
1	Door Bottom	supplied by acoustic door and frame supplier		PE
1	ElectroLynx Harness (In Frame)	QC-C1500P		MK
1	ElectroLynx Harness (In Door)	QC-CX00 LENGTH		MK
1	Electric Power Transfer	CEPT-10		SU
1	Card Reader	HID multiCLASS SE RP40		HID
1	Wiring Diagrams	POINT TO POINT		00
1	Mortar Box	TA-6410 (to suit current transfer location)		OT
1	Mortar Box	TA-6410 (to suit door contact location)		OT

Notes: Door supplier to provide raceway thru door to electric lock location  
Mortar boxes welded in place by HM frame supplier

**Mode of Operation**

Door normally closed and locked. Presentation of valid card to card reader will unlock door and allow entry by turning lever and pulling / pushing door open.

Free egress at all times from inside by turning lever and pulling / pushing door open.

UNIVERSITY OF GUELPH BUILDING #046 RENOVATION  
GUELPH, ON

**Set: 52.1**

Single D235a, reception / copy 235 to active storage 235a, 965 x 2135 x 45, Hollow Metal x , LH,

3	Hinge	TA2714 Size to Suit (NRP at Outswinging Doors)	US26D	MK
1	Electrified Mortise Lock	RX-ML20906-SEC NSA M92 CMK	630	RU
1	Cylinder	100200AT P GMK GGMK Z09	19	MC
1	Surface Closer	7500 (pull side mount)	689	NO
1	Floor Stop	441H	US26D	RO
1	ElectroLynx Harness (In Frame)	QC-C1500P		MK
1	ElectroLynx Harness (In Door)	QC-CX00 LENGTH		MK
1	Electric Power Transfer	CEPT-10		SU
1	Card Reader	HID multiCLASS SE RP40		HID
1	Wiring Diagrams	POINT TO POINT		00
1	Mortar Box	TA-6410 (to suit current transfer location)		OT
1	Mortar Box	TA-6410 (to suit door contact location)		OT

Notes: Door supplier to provide raceway thru door to electric lock location  
Mortar boxes welded in place by HM frame supplier

Mode of Operation

Door normally closed and locked. Presentation of valid card to card reader will unlock door and allow entry by turning lever and pulling / pushing door open.

Free egress at all times from inside by turning lever and pulling / pushing door open.

**Set: 53.0**

Pair D234, corridor C204 from IT 234, 1930 x 2135 x 45, Hollow Metal x , RHRA/LHR,

6	Hinge	TA2714 Size to Suit (NRP at Outswinging Doors)	US26D	MK
1	Flush Bolt	555	US26D	RO
1	Dust Proof Strike	570	US26D	RO
1	Storeroom Lock	ML2057 NSA CMK	630	RU
1	Cylinder	100200AT P GMK GGMK Z09	19	MC
1	Surface Closer	CPS8501	689	NO

UNIVERSITY OF GUELPH BUILDING #046 RENOVATION  
GUELPH, ON

**Set: 54.0**

Single D234a, corridor C202 to universal washroom WR234, 965 x 2135 x 45, Hollow Metal x , RH,

3	Hinges	T4A3786 Size to Suit (NRP at Outswing Doors)	652	MK
1	Storeroom Lock	21 8206 LNL x less strike	US32	SA
1	Cylinder	100200AT GMK GGMK (key switch)	19	MC
1	Cylinder	100200AT P GMK GGMK Z20	19	MC
1	Electric Strike	F2364 (fail safe)	630	RCI
1	Push Plate	70C x 152mm x 762mm x CFC x TAPE x B4E (RH)	630	RO
1	Concealed Overhead Stop	6-X36	630	RF
1	Auto Door Operator	SW200i-IS-99-CL	628	BM
1	Kick Plate	K1050 8" x WIDTH 4BE CSK	US32D	RO
1	Universal Washroom Call System	CX-WC13AXFM		OT
1	Key Switch	MKA	628	OT
1	Universal Emergency Call System Kit	CX-WEC10K2	630	OT
1	Relay	RB-4-24		SU
1	Door Position Switch	1076-D		OT
1	ElectroLynx Harness (In Frame)	QC-C1500P		MK
1	ElectroLynx Harness (In Door)	QC-CX00 LENGTH		MK
1	Emergency Instructional Signage	CM-SE21		00
1	Power Supply	BPS-24-1		SU
1	Mortar Box	TA-6410 (to suit door contact location)		OT
1	Mortar Box	TA-6410 (to suit door operator location)		OT
1	Mortar Box	TA-6410 (to suit electric strike location)		OT

Notes: Mortar boxes welded in place by HM frame supplier  
Template overhead stop to maximum degree of opening allowable by site conditions

**Mode of Operation**

Door normally closed and latched. Outside occupancy indicator GREEN. Door can be opened manually by pushing door open or by pushing operator wall switch. Once inside room and with door closed, pressing Push-To-Lock button locks door and disables corridor side wall switch, and changes LED on occupancy indicator to RED from GREEN.

Egress by pushing / pulling door open or by pushing inside wall switch.

Key switch inside secures bathroom if service work required.  
Pressing inside wall mounted mushroom button activates washroom and corridor mounted lights and horn. Free egress at all times.

UNIVERSITY OF GUELPH BUILDING #046 RENOVATION  
GUELPH, ON

**Set: 55.0**

Pair DST201, existing stairwell ST201 from corridor C202, 1930 x 2135 x 45, Hollow Metal x ,  
RHRA/LHR, 45 min

6	Hinges	T4A3786 Size to Suit (NRP at Outswing Doors)	652	MK
1	Removable Mullion	12-L980	PC	SA
1	Electrified Rim Exit	12 21 55 8876-24v ETL	US32D	SA
1	Electrified Rim Exit	12 21 55 8874-24v ETL	US32D	SA
1	Cylinder	100200AT P GMK GGMK Z20	19	MC
1	Cylinder	100403VT P GMK GGMK	19	MC
2	Concealed Overhead Stop	6-X36	630	RF
2	Surface Closer	7500 (pull side mount)	689	NO
2	Kick Plate	K1050 8" x WIDTH 4BE CSK	US32D	RO
1	Gasketing	S773BL		PE
2	Sweep	18061CNB TKSP8 WIDTH		PE
2	Door Position Switch	1076-D		OT
2	ElectroLynx Harness (In Frame)	QC-C1500P		MK
2	ElectroLynx Harness (In Door)	QC-CX00 LENGTH		MK
2	Electric Power Transfer	CEPT-10		SU
1	Wiring Diagrams	POINT TO POINT		00
2	Mortar Box	TA-6410 (to suit current transfer location)		OT

Notes: Mortar boxes welded in place by HM frame supplier  
Template overhead stop to maximum degree of opening allowable by site conditions

Mode of Operation

Doors normally closed and locked. Presentation of valid card will unlock exit device trim  
levers. Entry by turning levers and pulling doors open.  
Free egress at all times.

UNIVERSITY OF GUELPH BUILDING #046 RENOVATION  
GUELPH, ON

**Set: 56.0**

Pair DST202, existing stairwell ST202 from corridor C201, 2030 x 2135 x 45, Hollow Metal x ,  
RHRA/LHR, 45 min

6	Hinges	T4A3786 Size to Suit (NRP at Outswing Doors)	652	MK
1	Removable Mullion	12-L980	PC	SA
1	Electrified Rim Exit	12 21 55 8876-24v ETL	US32D	SA
1	Electrified Rim Exit	12 21 55 8874-24v ETL	US32D	SA
1	Cylinder	100200AT P GMK GGMK Z20	19	MC
1	Cylinder	100403VT P GMK GGMK	19	MC
2	Surface Closer	7500 (pull side mount)	689	NO
2	Kick Plate	K1050 8" x WIDTH 4BE CSK	US32D	RO
2	Wall Stop	405	US26D	RO
1	Gasketing	S773BL		PE
2	Sweep	18061CNB TKSP8 WIDTH		PE
2	Door Position Switch	1076-D		OT
2	ElectroLynx Harness (In Frame)	QC-C1500P		MK
2	ElectroLynx Harness (In Door)	QC-CX00 LENGTH		MK
2	Electric Power Transfer	CEPT-10		SU
1	Wiring Diagrams	POINT TO POINT		00
2	Mortar Box	TA-6410 (to suit current transfer location)		OT
1	Mortar Box	TA-6410 (to suit door contact location)		OT

Notes: Mortar boxes welded in place by HM frame supplier

Mode of Operation

Doors normally closed and locked. Presentation of valid card will unlock exit device trim  
levers. Entry by turning levers and pulling doors open.  
Free egress at all times.

UNIVERSITY OF GUELPH BUILDING #046 RENOVATION  
GUELPH, ON

**Set: 57.0**

Single DST203, existing stairwell ST203 from corridor C206, 965 x 2135 x 45, Hollow Metal x , LHR,  
45 min

3	Hinge (heavy weight)	T4A3386 Size to Suit (NRP at Outswinging Doors)	US32D	MK
1	Electrified Rim Exit	12 21 55 8876-24v ETL	US32D	SA
1	Cylinder	100403VT P GMK GGMK	19	MC
1	Surface Closer	7500 (pull side mount)	689	NO
1	Kick Plate	K1050 8" x WIDTH 4BE CSK	US32D	RO
1	Wall Stop	405	US26D	RO
1	Gasketing	S773BL		PE
1	Sweep	18061CNB TKSP8 WIDTH		PE
1	Door Position Switch	1076-D		OT
1	ElectroLynx Harness (In Frame)	QC-C1500P		MK
1	ElectroLynx Harness (In Door)	QC-CX00 LENGTH		MK
1	Electric Power Transfer	CEPT-10		SU
1	Card Reader	HID multiCLASS SE RP40		HID
1	Wiring Diagrams	POINT TO POINT		00
1	Mortar Box	TA-6410 (to suit current transfer location)		OT
1	Mortar Box	TA-6410 (to suit door contact location)		OT

Notes: Mortar boxes welded in place by HM frame supplier

Mode of Operation

Door normally closed and locked. Presentation of valid card will unlock exit device trim lever. Entry  
by turning lever and pulling door open.  
Free egress at all times.

**Set: 58.0**

Single D302, exterior from existing mechanical room 302, 915 x 1842 x 57, Aluminum x , LHR,

1	Continuous Hinge	MCK-12HD x Dr Height	CL	MK
1	Mortise Deadlock	MS1850S-050 1-1/2" BS 1	628	AD
2	Cylinder	100200AT P GMK GGMK Z02	19	MC
1	Cylinder Pull	90	US26D	RO
1	Closer	4041XP SCUSH	689	LC
1	Adapter Plate	4040XP-18PA	689	LC
1	Threshold	252x3AFG WIDTH		PE
1	Sweep	18061CNB TKSP8 WIDTH		PE
1	Door Position Switch	1076-D		OT

Notes: Balance of perimeter weather strip by aluminum door supplier.

**Set: 59.0**

Description: Power Distribution - power supplies to be mounted on north wall of vestibule 117

1	Cylinder	100200AT GMK GGMK (key switch)	19	MC
1	Key switch	MKA2 (mag lock override / reset - to be installed by main fire alarm annunciator panel)		SU
5	Power Supply	BPS-24-10 x B-24-5(2) (electric locksets and exit devices)		SU
1	Power Supply	BPS-24-4 x CFAR-24 (mag locks)		SU
	Note	low voltage trunk wire from each opening to power supply room supplied and installed by University of Guelph		OT

**Set: 60.0**

Description: KEYS and KEYING

10	Cut Keys	Medeco M3 GMK		MC
40	Cut Keys	Medeco M3 MK		MC
	Cut Keys	Medeco M3 Change Keys 2 key / lock		MC
2	Key Cabinet	1205A		LU
15	Cut Keys	Corbin Russwin Cut Construction Key		RU

**Set 61.0**

Description: Elevator cab

1	Card Reader	HID multiCLASS SE RP40		HID
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END OF SECTION 087100

## **PART 1 - GENERAL**

### **1.1 REFERENCES**

- .1 ASTM International:
  - .1 ASTM E119 Methods for Fire Tests of Building Construction and Materials.
  - .2 ASTM E152 Methods of Fire Tests of Door Assemblies.
  - .3 ASTM E163 Methods for Fire Tests of Window Assemblies.
  - .4 ASTM E2074: Standard Test Method for Fire Tests of Door Assemblies, including Positive Pressure Testing of Side-hinged and Pivoted Swinging Door Assemblies.
  - .5 ASTM E2110-1: Standard Test for Positive Pressure of Fire Tests of Window Assemblies.
- .2 Canadian General Standards Board (CGSB):
  - .1 CAN/CGSB-12.1-M90, Tempered or Laminated Safety Glass.
  - .2 CAN/CGSB-12.2-M91, Flat, Clear Sheet Glass.
  - .3 CAN/CGSB-12.3-M91, Flat, Clear Float Glass.
  - .4 CAN/CGSB-12.4-M91, Heat Absorbing Glass.
  - .5 CAN/CGSB-12.8-97, Insulating Glass Units.
  - .6 CAN/CGSB-12.8-97 (Amendment), Insulating Glass Units.
  - .7 CAN/CGSB-12.10-M76, Glass, Light and Heat Reflecting.
- .3 Standard Council of Canada:
  - .1 ULC Standard CAN4-S101: Fire Tests of Building Construction and Materials.
  - .2 ULC Standard CAN4-S104: Fire Tests of Door Assemblies.
  - .3 ULC Standard CAN4-S106: Fire Tests of Window Assemblies.
- .4 Environmental Choice Program (ECP):
  - .1 CCD-045-95(R2005), Sealants and Caulking Compounds.
- .5 Glass Association of North American (GANA):
  - .1 GANA Glazing Manual - 2008.
  - .2 GANA Laminated Glazing Reference Manual - 2009.
  - .3 FGMA – Sealant Manual.
- .6 National Fire Protection Association (NFPA):
  - .1 NFPA 80, 2016 Edition: Fire Doors and Windows.
  - .2 NFPA 251: Fire Tests of Building Construction and Materials.
  - .3 NFPA 252: Fire Tests of Door Assemblies.
  - .4 NFPA 257, 2012 Edition: Fire Tests of Window Assemblies.
- .7 Underwriters Laboratories, Inc. (UL):
  - .1 UL 9: Standard for Safety of Fire Tests of Window Assemblies.
  - .2 UL 10B: Standard for Safety of Fire Tests of Door Assemblies.
  - .3 UL 10C: Standard for Safety of Positive Pressure Fire Tests of Door Assemblies.
  - .4 UL 263: Fire Tests of Building Construction and Materials.
  - .5 UL 752-2005: Standard for Safety for Bullet-Resisting Equipment.

- .8 Consumer Product Safety Commission (CPSC):
  - .1 CPSC 16 CFR 1201: Safety Standard for Architectural Glazing Materials.
- .9 American National Standards Institute (ANSI):
  - .1 ANSI Z97.1: Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test.

## 1.2 SYSTEM DESCRIPTION

- .1 Performance Requirements:
  - .1 Fire Rating: 20, 45, 60, 90 or 120 minutes as specified.
  - .2 Fire Resistive Wall Assembly Certifications: 60-120 minute fire resistive wall assemblies tested in accordance with ASTM E119, NFPA 251, UL 263 and ULC-S101.
  - .3 Fire Resistive Door Assembly Certifications: 60-90 minute fire resistive door assemblies tested in accordance with ASTM E119, NFPA 251, UL 263 and ULC-S101.
  - .4 Fire Protective Door Assembly Certifications: 20-45 minute fire protective door assemblies shall be tested in accordance with NFPA 80, NFPA 252, ASTM E152, ASTM E2074, UL 10B, UL 10C and CAN4-S104.
  - .5 Fire Protective Window Assembly Certifications: 20-45 minute fire protective window assemblies shall be tested in accordance with NFPA 80, NFPA 257, ASTM E163, ASTM E2010, UL 9 and CAN4-S106.
  - .6 Ballistic Resistance: Can be customized to meet up to Level 8 (7.62mm Rifle Lead Core Full Metal Copper Jacket Military Ball or .308 Caliber).
  - .7 Testing Laboratory: Fire test shall be conducted by a nationally recognized independent testing laboratory.
- .2 Listings and Labels:
  - .1 Fire rated framing system shall be under current follow-up service by a nationally recognized independent laboratory approved by OSHA and maintain a current listing or certification. Assemblies shall be labeled in accordance with limits of listings.
- .3 Appearance:
  - .1 Fire rated wall/door assembly shall have a neat finished appearance with minimum joints at decorative cover intersections.
- .4 Size glass to withstand wind loads, dead loads and positive and negative live loads acting normal to plane of glass to a design pressure as measured in accordance with ANSI/ASTM E330.
- .5 Provide glass type and thickness in accordance the OBC.
- .6 Limit glass deflection to 1/200 flexural limit of glass with full recovery of glazing materials.

## 1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for glass, sealants, and glazing accessories and include product characteristics, performance criteria, physical size, finish and limitations.

- .3 Shop Drawings:
  - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Ontario, Canada.
- .4 Samples:
  - .1 Submit for review and acceptance of each unit.
  - .2 If requested, samples may be returned for inclusion into work.
  - .3 Submit duplicate 12" x 12" size samples of glazing units and sealant material.
- .5 Certificates: submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.
- .6 Test Reports: certified test reports showing compliance with specified performance characteristics and physical properties.
  - .1 Submit testing and analysis of glass under provisions of Section 01 45 00 - Quality Control.
  - .2 Submit shop inspection and testing for glass.

#### **1.4 CLOSEOUT SUBMITTALS**

- .1 Submit in accordance with Section 01 78 00 – Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for glazing for incorporation into manual.

#### **1.5 QUALITY ASSURANCE**

- .1 Fire-rated ceramic clear glazing (wireless):
  - .1 Glazing Standards: GAMA Glazing Manual and FGMA Sealant Manual.
  - .2 Each lite shall bear permanent, no removable label of UL certifying it for use in tested and rated fire protective assemblies.

#### **1.6 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 – Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials off ground indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect glazing and frames from nicks, scratches, and blemishes.
  - .3 Protect prefinished aluminum surfaces with wrapping strippable coating.
  - .4 Replace defective or damaged materials with new.
- .4 Ordering: Comply with manufacturer's ordering instructions and lead-time requirements to avoid construction delays.
- .5 Delivery: Deliver materials to specified destinations in manufacturer's or distributor's packaging undamaged, complete with installation instructions.

## **1.7 FABRICATION DIMENSIONS**

- .1 Field Measurements: Verify actual measurements for openings by field measurements before fabrication. Show recorded measurements on shop drawings. Coordinate field measurements and fabrication schedule with construction progress to avoid construction delays.

## **1.8 AMBIENT CONDITIONS**

- .1 Ambient Requirements:
  - .1 Install glazing when ambient temperature is 10 degrees C minimum. Maintain ventilated environment for 24 hours after application.
  - .2 Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

## **1.9 WARRANTY**

- .1 Warrant the following types of glass against defects in materials and workmanship for the period indicated, commencing from the date of Substantial Performance of the work:
  - .1 Fire Rated assemblies: five (5) years
- .2 Warranty to cover full replacement including stops, trims, caulking, sealants, all at no cost to the Owner.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS – FIRE RATED DOOR, OPENING AND WALL ASSEMBLY**

- .1 Manufacturer of Framing System: GPX Architectural Series Framing as manufactured and distributed by SAFTI FIRSTTM Fire Rated Glazing Solutions.
- .2 Manufacturer of Glazing Material: (SuperLite TM II-XL) (SuperLite TM II-XL IGU) as manufactured and distributed by SAFTI FIRST TM Fire Rated Glazing Solutions.
- .3 Fire rated glass and framing must be provided by a single-source, US manufacturer. Distributors of fire rated glass and framing are not to be considered as manufacturers.
- .4 Substitutions: No substitutions permitted.

### **2.2 MATERIALS – FRAMING**

- .1 Fire resistive, temperature rise framing system rated for 20 to 120 minutes, as indicated.
- .2 Properties:
  - .1 Frame thickness: 2-1/2" Standard. 3", 4-1/8" and 5" also available.
  - .2 Internal framing: Internal tube steel framing shall conform to ASTM A501. Formed steel retainers shall be galvanized conforming to ASTM A527.
  - .3 Insulation: The framing system shall insulate against the effects of fire, smoke and heat transfer from either side. The perimeter of the framing system to the rough opening shall be firmly packed with mineral wool fire stop insulation or appropriately rated intumescent sealant.

- .4 Fasteners: Type recommended by manufacturer.
- .5 Framing covers: Powder coated extruded aluminum alloy 6063-T5 (standard) or aluminum alloy 5052 when anodized. Ornamental metal (finish specified by the Architect: stainless steel, bronze, etc.). Wood or wood veneer.
- .6 Glazing accessories: The glazing material perimeter shall be separated from the perimeter framing system with approved flame retardant glazing tape. The SuperLite™ glazing panel shall be caulked continuously around the edge to the tube steel frame utilizing neutral cure silicone.

### 2.3 MATERIALS – GLASS

- .1 Assemblies shall be glazed with SuperLite™ glazing products. If assembly is required to meet ASTM E 119, SuperLite™ II-XL will be used.
- .2 Properties:
  - .1 Individual Lites shall be permanently identified with a listing mark.
  - .2 Glazing material installed in “Hazardous Locations” (subject to human impact) shall be certified to meet the applicable requirements for fire rated assemblies referenced in ANSI Z97.1 Standard for Safety Glazing Materials Used In Buildings and/or CPSC 16 CFR 1201 Safety Standard for Architectural Glazing Materials.
  - .3 Temperature rise on the unexposed side of glazing material shall be limited to 250 degrees Fahrenheit when required.
  - .4 Visible daylight transmission: Varies by glazing type. Refer to SuperLite™ product data for more information.
  - .5 STC rating shall be a minimum of Varies by glazing type. Refer to SuperLite™ product data for more information.
- .3 Logo: Each piece of fire rated glazing shall be labeled with a permanent logo.

### 2.4 FABRICATION

- .1 Assemblies shall be furnished assembled (should configurations and job site conditions allow).
- .2 Door assemblies shall be factory prepared for field mounting of hardware.
- .3 Fabrication Dimensions: Fabricate to approved dimensions. The general contractor shall guarantee dimensions within required tolerance. Obtain approved shop drawings prior to fabrication.

### 2.5 FINISHES

- .1 Comply with NAAMM’s “Metal Finishes Manual for Architectural and Metal Products” for recommendations for applying and designing finishes.
- .2 Covers shall be chemically cleaned and pretreated; then, finished with:
  - .1 Clear Anodized.
- .3 Protect finishes on exposed surfaces from damage by applying strippable, temporary protective covering before shipping.
- .4 Variations in appearance of abutting or adjacent pieces are acceptable. Noticeable variations in the same piece are not acceptable.

## **2.6 DOOR HARDWARE FOR SINGLE AND PAIRED DOORS**

- .1 Hardware shall be supplied with the fire door. Hardware selection shall be from door manufacturer's standard recommended hardware groups as specified below. Please call manufacturer for custom hardware.
- .2 Refer to Section 08 70 00 - Door Hardware

## **PART 3 - EXECUTION**

### **3.1 MANUFACTURER'S INSTRUCTIONS**

- .1 Compliance: Comply with manufacturer's written data, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.

### **3.2 EXAMINATION**

- .1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for glazing installation in accordance with manufacturer's written instructions.
  - .1 Visually inspect substrate:
    - .1 Verify that openings for glazing are correctly sized and within tolerance.
    - .2 Verify that surfaces of glazing channels or recesses are clean, free of obstructions, and ready to receive glazing.
  - .2 Inform Consultant of unacceptable conditions immediately upon discovery.
  - .3 Proceed with installation only after unacceptable conditions have been remedied.

### **3.3 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.

### **3.4 INSTALLATION**

- .1 Fire wall/door installation shall be by a licensed contractor and in strict accordance with the approved shop drawings.
- .2 Comply with referenced FGMA standards and instructions of manufacturers of glass, glazing sealants, and glazing compounds.
- .3 Protect glass from edge damage during handling and installation. Inspect glass during installation and discard pieces with edge damage that could affect glass performance.
- .4 Set units of glass in each series with uniformity of pattern, draw, bow, and similar characteristics.
- .5 Cut glazing tape to length and set against permanent stops, flush with sight lines to fit openings exactly, with stretch allowance during installation.

- .6 Place setting blocks located at quarter points of glass with edge block not more than 6 inches from corners.
- .7 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.
- .8 Place glazing tape on free perimeter of glazing in same manner described above.
- .9 Install removable stop and secure without displacement of tape.
- .10 Use specified glazing compound, without adulteration; bed glazing material in glazing compound; entirely fill all recess and spaces. Provide visible glazing compound with smooth and straight edges.
- .11 Install so that appropriate UL markings remain permanently visible.

### **3.5 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 – Cleaning.
  - .1 Leave Work area clean at end of each day.
    - .1 Remove traces of primer, caulking.
    - .2 Remove glazing materials from finish surfaces.
    - .3 Remove labels.
    - .4 Clean glass using approved non-abrasive cleaner in accordance with manufacturer's instructions.
  - .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

### **3.6 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 After installation, mark each light with an "X" by using removable plastic tape or paste.
  - .1 Do not mark heat absorbing or reflective glass units.
- .3 Repair damage to adjacent materials caused by glazing installation.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 REFERENCES**

- .1 ASTM International:
  - .1 ASTM C 542/A542M-13, Standard Specification for Lock-Strip Gaskets.
  - .2 ASTM D 790-10, Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
  - .3 ASTM D 1003-13, Standard Test Method for Haze and Luminous Transmittance of Plastics.
  - .4 ASTM D 1929-14, Standard Test Method for Determining Ignition Temperature of Plastics.
  - .5 ASTM D 2240-05 (2010), Standard Test Method for Rubber Property - Durometer Hardness.
  - .6 ASTM E 84-15a, Standard Test Method for Surface Burning Characteristics of Building Materials.
  - .7 ASTM E 330/E330M-14, Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference.
  - .8 ASTM E 546-14, Standard Test Method for Frost/Dew Point of Sealed Insulating Glass Units.
  - .9 ASTM E 576-14, Standard Test Method for Frost/Dew Point of Sealed Insulating Glass Units in the Vertical Position.
  - .10 ASTM E 2190-10, Standard Specification for Insulating Glass Unit Performance and Evaluation.
  - .11 ASTM F 1233-08(2013), Standard Test Method for Security Glazing Materials and Systems.
- .2 Canadian General Standards Board (CGSB):
  - .1 CAN/CGSB-12.1-M90, Tempered or Laminated Safety Glass.
  - .2 CAN/CGSB-12.2-M91, Flat, Clear Sheet Glass.
  - .3 CAN/CGSB-12.3-M91, Flat, Clear Float Glass.
  - .4 CAN/CGSB-12.4-M91, Heat Absorbing Glass.
  - .5 CAN/CGSB-12.6-M91, Transparent (One-Way) Mirrors.
  - .6 CAN/CGSB-12.8-97, Insulating Glass Units.
  - .7 CAN/CGSB-12.8-97 (Amendment), Insulating Glass Units.
  - .8 CAN/CGSB-12.9-M91, Spandrel Glass.
  - .9 CAN/CGSB-12.10-M76, Glass, Light and Heat Reflecting.
  - .10 CAN/CGSB-12.11-M90, Wired Safety Glass.
  - .11 CAN/CGSB-12.12-M90, Plastic Safety Glazing Sheets.
  - .12 CAN/CGSB-12.13-M91, Patterned Glass.
- .3 Standard Council of Canada:
  - .1 ULC Standard CAN4-S106-M80 (R1985): Fire Tests of Window Assemblies.
- .4 Environmental Choice Program (ECP):
  - .1 CCD-045-95(R2005), Sealants and Caulking Compounds.
- .5 Glass Association of North American (GANA):
  - .1 GANA Glazing Manual - 2008.
  - .2 GANA Laminated Glazing Reference Manual - 2009.
- .6 National Fire Protection Association (NFPA):
  - .1 NFPA 80, 2016 Edition: Fire Doors and Windows.
  - .2 NFPA 257, 2012 Edition: Fire Tests of Window Assemblies.

- .7 Underwriters Laboratories, Inc. (UL):
  - .1 UL 9 – Fire Tests of Window Assemblies.
- .8 Underwriters' Laboratories of Canada (ULC):
  - .1 CAN-ULC S104-15, Standard Method for Fire Tests of Door Assemblies.
  - .2 ULC CAN4-S106-M80 (R1985), Standard Method for Fire Tests of Window and Glass Block Assemblies.

## 1.2 SYSTEM DESCRIPTION

- .1 Performance Requirements:
  - .1 Provide continuity of building enclosure air / vapour using glass and glazing materials as follow:
    - .1 Utilize inner light of multiple light sealed units for continuity of air and vapour seal.
  - .2 Fire-rated ceramic clear glazing (wireless):
    - .1 Fire-rated glass ceramic clear and wireless glazing material listed for use in non-impact safety-rated locations such as transoms and borrowed lights with fire rating requirements ranging from 20 to 90 minutes with required hose stream test.
    - .2 Passes positive pressure test standards UBC 7-2 and UBC 7-4.
- .2 Size glass to withstand wind loads, dead loads and positive and negative live loads acting normal to plane of glass to a design pressure as measured in accordance with ANSI/ASTM E330.
- .3 Provide glass type and thickness in accordance the OBC.
- .4 Limit glass deflection to 1/200 flexural limit of glass with full recovery of glazing materials.

## 1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for glass, sealants, and glazing accessories and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
  - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Ontario, Canada, for curtainwall locations.
- .4 Samples:
  - .1 Submit for review and acceptance of each unit.
  - .2 If requested, samples may be returned for inclusion into work.
  - .3 Submit duplicate 12" x 12" size samples of glazing units and sealant material.
- .5 Certificates: submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.
- .6 Test Reports: certified test reports showing compliance with specified performance characteristics and physical properties.
  - .1 Submit testing and analysis of glass under provisions of Section 01 45 00 - Quality Control.
  - .2 Submit shop inspection and testing for glass.

#### **1.4 CLOSEOUT SUBMITTALS**

- .1 Submit in accordance with Section 01 78 00 – Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for glazing for incorporation into manual.

#### **1.5 QUALITY ASSURANCE**

- .1 Fire-rated ceramic clear glazing (wireless):
  - .1 Glazing Standards: GAMA Glazing Manual and FGMA Sealant Manual.
  - .2 Each lite shall bear permanent, no removable label of UL certifying it for use in tested and rated fire protective assemblies.
- .2 Acoustic Testing:
  - .1 Refer to Section 09 21 16 Gypsum Board Assemblies.

#### **1.6 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 – Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials off ground indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect glazing and frames from nicks, scratches, and blemishes.
  - .3 Protect prefinished aluminum surfaces with wrapping strippable coating.
  - .4 Replace defective or damaged materials with new.

#### **1.7 AMBIENT CONDITIONS**

- .1 Ambient Requirements:
  - .1 Install glazing when ambient temperature is 10 degrees C minimum. Maintain ventilated environment for 24 hours after application.
  - .2 Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

#### **1.8 WARRANTY**

- .1 Warrant the following types of glass against defects in materials and workmanship for the period indicated, commencing from the date of Substantial Performance of the work:
  - .1 Insulating glass: ten (10) years
- .2 Warranty to cover full replacement including stops, trims, caulking, sealants, all at no cost to the Owner.

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS**

- .1 Design Criteria:
  - .1 Ensure continuity of building enclosure vapour and air barrier using glass and glazing materials as follow:
    - .1 Utilize inner light of multiple light sealed units for continuity of air and vapour seal.
  - .2 Thickness and glass types specified and as indicated on drawings are minimum. Provide glass thicknesses in float, heat-strengthened or tempered glass to ASTM E330 and as required to suit wind loads, dead loads and positive and negative live loads, thermal stresses, building codes and as required by manufacturer's recommendations. Confirm any proposed substitutions from the specified glass with Consultant.
  - .3 Limit glass deflection to 1/200 flexural limit of glass with full recovery of glazing materials.
- .2 Flat Glass:
  - .1 Float glass: to CAN/CGSB-12.3, colour clear.
- .3 Heat strengthened glass: ASTM C1048-976. Perform heat strengthening using the horizontal tong-free method.
- .4 Safety glass: to CAN/CGSB-12.1, transparent complete with polished edges, to minimum thickness as follows:
  - .1 Type 1: tempered, 6 mm / 1/4" thick minimum.
  - .2 Type 2: laminated with 0.76 mm / 5/64" minimum PVB interlayer, 6 mm / 1/4" thick.
- .5 Silvered mirror glass: plate glass to CAN/CGSB-12.5, 6 mm / 1/4" thick.
- .6 One-way mirrored glass: to CAN/CGSB-12.6, 6 mm / 1/4" thick coated float glass developed for use as a one-way mirror.
  - .1 Acceptable product: 'Mirropane' as manufactured by Pilkington Building Products (LOF), PPG Canada Inc., Viracon Inc., or approved alternate
- .7 Spandrel glass: to CAN/CGSB-12.9, 6 mm / 1/4" thick heat, tempered complete with opacifier coating, colour as later selected by Consultant from manufacturer's complete colour range.
  - .1 Acceptable product: 'Opaci-Coat 300' by Industrial Control Development Inc., or approved alternate.
- .8 Insulating Glass Units:
  - .1 Insulating glass units: to CAN/CGSB-12.8, double unit, 1" overall thickness, safety glass both lights where indicated.
    - .1 Glass: to CAN/CGSB-12.3 CAN/CGSB-12.1 CAN/CGSB-12.2 CAN/CGSB-12.4 CAN/CGSB-12.10.
    - .2 Glass thickness: to requirements of OBC for condition and glazing type indicated, but to minimum type and thickness as indicated.
      - .1 Curtain Wall Insulated Units: overall thickness 1", with 1/4" exterior pane.
    - .3 Inter-cavity space thickness: to suit overall thickness and glass thickness, argon filled, with non-conductive warm edge spacers.
    - .4 Glass coating: Sputter Low "E" on no. 2 surface. Inert gas fill: argon.
    - .5 Colour: clear .

- .9 Interior Back Painted Glass: to CAN/CGSB-12.9
  - .1 6mm thick heat tempered complete with opacified coating
  - .2 Custom colour as later selected by Consultant.
  - .3 Acceptable Product: 'Opaci-Coat 3000' by Industrial Control Development inc. or approved alternate.
- .10 Glazing Film: dimensionally stable, decorative translucent film with uniform appearance of acid etched glass with a soft frosted appearance, size to suit.
  - .1 Acceptable manufacturer: '7725-314 Dusted Crystal' by 3M or equivalent by Madico, Inc. as distributed by Window Film Systems, or, or LLumar, or approved alternate.
- .11 Sealant: in accordance with Section 07 92 00 - Joint Sealants.

## 2.2 FIRE PROTECTIVE GLASS

- .1 Ceramic fire-rated and impact-safety rated glass: polished premium surface, 1/4" with applied safety film to CAN-ULC S104, ULC CAN4-S106 and ANZI-97 Cat II.
  - .1 Acceptable manufacturer's:
    - .1 Keralite as distributed by F1 Glazing Solutions, Etobicoke, Ontario, phone number 1-416-768-6873, email fultonF1@gmail.com.
    - .2 Pyran Platinum as distributed by Glassopolis, phone number 1 800 262 9600, web site <http://www.glassopolis.com>
    - .3 Firelite as distributed by Technical Glass Products Milton, Ontario, phone number 1 800 426 0279, web site [sales@fireglass.com](mailto:sales@fireglass.com), or approved alternate.
    - .4 Or approved alternate.
  - .2 Maximum sheet sizes based on surface finish:
    - .1 Premium: 48 inches by 96 inches.
  - .3 Labeling: Permanently label each piece of fire-rated ceramic clear glass with the UL logo and fire rating in sizes up to 2.145 m<sup>2</sup> / 23 ft<sup>2</sup> and with manufacturer's label only for sizes that exceed the listing (as approved by the local authority having jurisdiction).
  - .4 Fire Rating: Fire rating listed and labeled by UL for fire rating scheduled at opening locations on drawings, when tested in accordance with ASTM E2074-00 and ASTM E2010-01 ULC Standards CAN4 S-104 and CAN4 S-106 NFPA 257 and UL 9 and UL 10B.
  - .5 Accessories:
    - .1 Glazing Tape: 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 square inches for 90-minute ratings must be glazed with fire-rated glazing tape supplied by manufacturer.
    - .2 Glazing Compound: DAP 33 putty.
    - .3 Silicone Sealant: 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); Use (Exposure) NT; Uses (Substrates) G, A, and O as applicable.
    - .1 Available Products: Dow Corning 795 - Dow Corning Corp., or Silglaze-II 2800 - General Electric Co., or Spectrem 2 - Tremco Inc., or approved alternate.
    - .4 Setting Blocks: Neoprene, EPDM, or silicone; tested for compatibility with glazing compound; of 70 to 90 Shore A hardness.
    - .5 Cleaners, Primers, and Sealers: Type recommended by manufacturer of glass and gaskets.

## 2.3 ACCESSORIES

- .1 Setting blocks: EPDM Shore A durometer hardness to ASTM D 2240 as recommended by manufacturer to suit glazing method, glass light weight and area.
- .2 Spacer shims: neoprene Shore A durometer hardness to ASTM D 2240, 3" long x one half height of glazing stop x thickness to suit application. Self-adhesive on one face.
- .3 Glazing tape:
  - .1 Preformed butyl compound with integral resilient tube spacing device, 10-15 Shore A durometer hardness to ASTM D 2240; coiled on release paper; 1/4" wide x 1/8" thick size; black colour.
  - .1 Acceptable product: 'Polyshim II Tape', by Tremco.
- .4 Glazing splines: resilient polyvinyl chloride, extruded shape to suit glazing channel retaining slot, black colour.
- .5 Glazing clips: manufacturer's standard type.
- .6 Lock-strip gaskets: to ASTM C 542.
- .7 Stainless Steel standoffs: 25mm diameter x 19mm, 316 stainless steel standoff
  - .1 Finish: brushed stainless steel
  - .2 Accessories: brushed stainless steel cap
  - .3 Acceptable Products: 'SOB1034BS' and 'CAP1BS' by C.R. Laurence or approved equal.

## **PART 3 - EXECUTION**

### 3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: Comply with manufacturer's written data, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.

### 3.2 EXAMINATION

- .1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for glazing installation in accordance with manufacturer's written instructions.
  - .1 Visually inspect substrate:
    - .1 Verify that openings for glazing are correctly sized and within tolerance.
    - .2 Verify that surfaces of glazing channels or recesses are clean, free of obstructions, and ready to receive glazing.
  - .2 Inform Consultant of unacceptable conditions immediately upon discovery.
  - .3 Proceed with installation only after unacceptable conditions have been remedied.

### **3.3 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.

### **3.4 INSTALLATION: EXTERIOR WET/DRY METHOD (PREFORMED TAPE AND SEALANT)**

- .1 Perform work in accordance with GANA Glazing Manual and GANA Laminated Glazing Reference Manual for glazing installation methods.
- .2 Cut glazing tape to length and set against permanent stops, 1/4" below sight line. Seal corners by butting tape and dabbing with sealant.
- .3 Apply heel bead of sealant along intersection of permanent stop with frame ensuring full perimeter seal between glass and frame to complete continuity of air and vapour seal.
- .4 Place setting blocks at 1/4 points, with edge block maximum 6" from corners.
- .5 Rest glazing on setting blocks and push against tape and heel head of sealant with sufficient pressure to attain full contact at perimeter of light or glass unit.
- .6 Install removable stops with spacer strips inserted between glazing and applied stops 1/4" below sight line. Place glazing tape on glazing light or unit with tape 5/8" below sight line.
- .7 Fill gap between glazing and stop with sealant to depth equal to bite of frame on glazing, maximum 3/8" below sight line.
- .8 Apply cap head of sealant along void between stop and glazing, to uniform line, flush with sight line. Tool or wipe sealant surface smooth.

### **3.5 INSTALLATION: INTERIOR - DRY METHOD (TAPE AND TAPE)**

- .1 Perform work in accordance with GANA Glazing Manual and GANA Laminated Glazing Reference Manual for glazing installation methods.
- .2 Cut glazing tape to length and set against permanent stops, projecting 1/16" above sight line.
- .3 Place setting blocks at 1/4 points, with edge block maximum 6" from corners.
- .4 Rest glazing on setting blocks and push against tape for full contact at perimeter of light or unit.
- .5 Place glazing tape on free perimeter of glazing in same manner described.
- .6 Install removable stop without displacement of tape. Exert pressure on tape for full continuous contact.
- .7 Knife trim protruding tape.

### **3.6 INSTALLATION: ONE-WAY MIRRORS**

- .1 Install one-way mirrors in accordance with adhesive manufacturer's instructions.
- .2 Place one-way mirror with reflective coating on the subject's (observed people) side.

### **3.7 FIRE PROTECTIVE GLASS**

- .1 Comply with referenced FGMA standards and instructions of manufacturers of glass, glazing sealants, and glazing compounds.
- .2 Protect glass from edge damage during handling and installation. Inspect glass during installation and discard pieces with edge damage that could affect glass performance.
- .3 Set units of glass in each series with uniformity of pattern, draw, bow, and similar characteristics.
- .4 Cut glazing tape to length and set against permanent stops, flush with sight lines to fit openings exactly, with stretch allowance during installation.
- .5 Place setting blocks located at quarter points of glass with edge block not more than 6 inches from corners.
- .6 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.
- .7 Place glazing tape on free perimeter of glazing in same manner described above.
- .8 Install removable stop and secure without displacement of tape.
- .9 Use specified glazing compound, without adulteration; bed glazing material in glazing compound; entirely fill all recess and spaces. Provide visible glazing compound with smooth and straight edges.
- .10 Install so that appropriate UL markings remain permanently visible.

### **3.8 INSTALLATION: MIRRORS**

- .1 Set mirrors with adhesive, applied in accordance with adhesive manufacturer's instructions.
- .2 Set mirrors with custom frame as indicated. Anchor rigidly to wall construction.
- .3 Set in custom frame.
- .4 Place plumb and level.

### **3.9 INSTALLATION: GLAZING FILM**

- .1 Installation: Install plastic film with adhesive, applied in accordance with film manufacturer's instructions.
- .2 Place without air bubbles, creases or visible distortion.
- .3 Fit tight to glass perimeter with razor cut edge.

### **3.10 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 – Cleaning.
  - .1 Leave Work area clean at end of each day.
    - .1 Remove traces of primer, caulking.
    - .2 Remove glazing materials from finish surfaces.
    - .3 Remove labels.
    - .4 Clean glass using approved non-abrasive cleaner in accordance with manufacturer's instructions.
  - .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

### **3.11 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 After installation, mark each light with an "X" by using removable plastic tape or paste.
  - .1 Do not mark heat absorbing or reflective glass units.
- .3 Repair damage to adjacent materials caused by glazing installation.

### **3.12 SCHEDULE**

- .1 Exterior Entrance Doors, Sidelights, Windows, Transoms and Curtain Wall, unless otherwise indicated: Insulating Glass Units, glass types as indicated.
- .2 Interior Screens and Transoms: glass types as indicated unless otherwise noted.
- .3 Labeled Doors and Screens: as indicated on door and screen schedule.
- .4 Mirrors: where indicated.
- .5 One-way Mirrors:
  - .1 Install one-way mirrors where indicated on drawings.
- .6 Fire Protective Glazing:
  - .1 Install fire-rated ceramic clear glazing where indicated on drawings.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 REFERENCES**

- .1 The Aluminum Association Inc. (AAI)
  - .1 AAI DAF-45-2003, Designation System for Aluminum Finishes - 9th Edition.
- .2 Air Movement and Control Association International (AMCA)
  - .1 AMCA 500-D-12, Laboratory Methods of Testing Dampers for Rating.
  - .2 AMCA 500-L-12, Laboratory Methods of Testing Louvers for Rating.
  - .3 AMCA 501-09, Application Manual for Air Louvers.
  - .4 AMCA 511-10(Rev.8-13), Certified Ratings Program for Air Control Devices.
- .3 American National Standards Institute (ANSI)
  - .1 ANSI H35.1/H35.1M-2013, Alloy and Temper Designation Systems for Aluminum.
- .4 American Society for Testing and Materials International (ASTM)
  - .1 ASTM A 167-99(2009), Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
  - .2 ASTM A653/A653M-15, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
  - .3 ASTM A 1008/A 1008M-15, Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, and High-Strength Low-Alloy with Improved Formability, Solution Hardened and Bake Hardenable.
  - .4 ASTM B 32-08(2014), Standard Specification for Solder Metal.
  - .5 ASTM B 209-14, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
  - .6 ASTM B 221-14, Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
  - .7 ASTM B 370-14, Standard Specification for Copper Sheet and Strip for Building Construction.
  - .8 ASTM D 523-14, Standard Test Method for Specular Gloss.
  - .9 ASTM D 822/D822M-13, Standard Practice for Filtered Open-Flame Carbon-Arc Exposure of Paint and Related Coatings.
- .5 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-1.213-2004, Etch Primer (Pre-treatment Coating of Tie Coat) for Steel and Aluminum.
  - .2 CAN/CGSB 93.1-M85, Sheet Aluminum Alloy, Prefinished, Residential.

### **1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2 Submit WHMIS MSDS - Material Safety Data Sheets in accordance with Section 01 35 29– Health and Safety Requirements and manufacturer's instructions.
- .3 Shop Drawings:
  - .1 Indicate fabrication and erection details, including anchorage, accessories, and finishes.
  - .2 Show frame detail, screening and finish.

- .3 Where colour is not indicated, submit manufacturer's standard colours to Consultant for selection.
- .4 Samples:
  - .1 Submit duplicate samples of each type of louvre and vent showing colour and finish.
  - .2 Show frame detail, screening and finish.
  - .3 Where colour is not indicated, submit manufacturer's standard colours to Consultant for selection.
- .5 Quality Assurance Submittals: submit following in accordance with Section 01 45 00 – Quality Control.
  - .1 Instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence, and cleaning.
- .6 Closeout Submittals:
  - .1 Provide operation and maintenance data for manual or motorized operated louvres for incorporation into manual specified in Section 01 78 00 – Closeout Submittals.

### **1.3 DELIVERY, STORAGE AND HANDLING**

- .1 Packing, shipping, handling and unloading:
  - .1 Deliver, store and handle in accordance with Section 01 61 00 – Common Product Requirements.
  - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
  - .3 Deliver materials to the site in undamaged condition.
- .2 Storage and Protection:
  - .1 Store materials off ground and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Protect louvres from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS**

- .1 Weather resistant louvres, with bird screens made to withstand a wind load of not less than 1.44 kilopascals.
- .2 Wall louvres: complete with AMCA certified ratings program seal for air performance and water penetration in accordance with AMCA 500-D, AMCA 500-L and AMCA 511.
- .3 Ratings to indicate water penetration of 0.06 kilograms or less per square metre of free area at free velocity of 244 metres per minute
- .4 Galvanized steel sheet: commercial quality to ASTM A 653/A 653M with Z275 zinc coating.
- .5 Aluminum sheet: to ASTM B 209 ANSI H35.1/H35.1M, alloy 3003 5005 with temper as required for forming mill finish plain pattern utility sheet.
- .6 Aluminium extrusions: to AAI DAF-45 ANSI H35.1/H35.1M, AA 6063-T5, ASTM B 221, alloy 6063 T52.

- .7 Stainless steel sheet: to ASTM A 167, Type 304 with brushed finish.
- .8 Fasteners: same material as fabricated items.
- .9 Gaskets: vinyl.
- .10 Primer: to CAN/CGSB-1.213 for aluminum surfaces.
- .11 Prefinished steel sheet:
- .12 Door louvres: Refer to Division 25

## 2.2 MECHANICAL ALUMINUM LOUVRES

- .1 Exterior Wall Louvres unless otherwise noted (horizontal blades):
  - .1 Extruded Aluminum Wall Louvre, stationary, 6063 alloy frame and storm proof drainable blades with sliding interlocking mullions, 2 mm thick x 100 mm deep / 5/64" thick x 4" deep, size to suit condition size and shape as indicated, complete louvre assembly to have 40 - 50 % free vent area.
    - .1 Acceptable material: 'Model A4097', by Construction Specialties Inc., or equivalent by K.N. Crowder, E.H. Price, or M.W. McGill, or approved alternate.
    - .2 Finish for all exposed exterior surfaces including blank-off panels.
  - .2 Finish for all exposed exterior surfaces including blank-off panels.
    - .1 Kynar 500, 3-coat 70% to AAMA 2605, dry film thickness 2.0 mil based fluoropolymer coating.
  - .3 Colour: to match adjacent exterior cladding.
- .2 Exterior Wall Louvres for Mechanical Room and Electrical Room (vertical blades):
  - .1 Extruded aluminum wall louver, stationary, size and shape as indicated with combination vertical and horizontal drainable blades with vertical storm-proof blades and interlocking frames, 3 mm thick x 100 mm deep / 1/8" thick x 4" deep, complete louvre assembly to have 40 - 50 % free vent area.
  - .2 Curtain wall adapter for integration into new curtain wall. Refer to Section 08 44 13 - Glazed Aluminum Curtain Walls
  - .3 Acceptable material: 'Model 'RS-4600', by Construction Specialties Inc., or equivalent by K.N. Crowder, E.H. Price, or M.W. McGill, or approved alternate.
  - .4 Finish for all exposed exterior surfaces including blank-off panels.
    - .1 Kynar 500, 3-coat 70% to AAMA 2605, dry film thickness 2.0 mil based fluoropolymer coating.
  - .5 Colour: to match adjacent exterior cladding.
- .3 Aluminum Angles: Design and fabricate aluminum angles in accordance with OBC and manufacturer's requirements.
- .4 Sill extensions: extruded aluminum, depth to suit wall condition, concealed clip anchors, drip deflectors at sill ends.
- .5 Insulated Blank-off Panels 3" thick rigid polyisocyanurate board insulation, faced both sides with 20 ga. thick aluminum sheet, perimeter of panel framed with extruded aluminum section, close cell perimeter gasket. Coordinate with Mechanical.
- .6 Bird screens: crimped aluminum wire cloth secured to 1/16" thick extruded aluminum frame mitered at corners and secured with corner locks, 1/2" size mesh.

- .7 Condensation Gutters: aluminum condensation gutters, broke formed aluminum sheet, full length, of type and size and profile indicated, 16 ga. thick anodized aluminum c/w watertight formed 1/2" high upstand, chairs and anchoring devices.

### **PART 3 - EXECUTION**

#### **3.1 MANUFACTURER'S INSTRUCTIONS**

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.

#### **3.2 INSTALLATION**

- .1 Install louvres and vents where indicated.
- .2 Install in accordance with CAN/CSA-A440.
- .3 Arrange components to prevent abrupt variation in colour.
- .4 Install wall louvres using jamb fasteners as appropriate for wall construction and in accordance with manufacturer's recommendations.
- .5 Install louvres. Do not exceed 3 mm in 3.0 m / 1/8" in 10'-0" variation from plumb and level.
- .6 Provide deflection heads where indicated and to other locations where deflection is anticipated.
- .7 Set adjustable louvre blades for uniform alignment in open and closed positions.
- .8 Adjust louvres so moving parts operate smoothly.
- .9 Attach bird insect screen to inside face of louvre or vent.
- .10 Install insulated blank-off panels at unused portions of louvres.
- .11 Repair damage to louvres and vents to match original finish.

#### **3.3 CLEANING**

- .1 Proceed in accordance with Section 01 74 11 - Cleaning.
- .2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

#### **3.4 PROTECTION**

- .1 Where aluminum contacts metal other than zinc, paint dissimilar metal with primer and two coats of aluminum paint.
- .2 Paint metal in contact with mortar, concrete, or other masonry materials with alkali-resistant coatings such as heavy-bodied bituminous paint.
- .3 Paint wood or other absorptive materials that may become repeatedly wet and in contact with metal with two coats of aluminum paint or coat of heavy-bodied bituminous paint.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 REFERENCES**

- .1 Aluminum Association (AA):
  - .1 AA DAF 45-03(R2009), Designation System for Aluminum Finishes.
- .2 ASTM International:
  - .1 ASTM C475/C475M-15, Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board.
  - .2 ASTM C 514-04(2014), Standard Specification for Nails for the Application of Gypsum Board.
  - .3 ASTM C 557-03(2009) e1, Standard Specification for Adhesives for Fastening Gypsum Wallboard to Wood Framing.
  - .4 ASTM C 840-13, Standard Specification for Application and Finishing of Gypsum Board.
  - .5 ASTM C 954-15, Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs From 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness.
  - .6 ASTM C 1002-14, Standard Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs.
  - .7 ASTM C 1047-11, Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base.
  - .8 ASTM C 1280-13a, Standard Specification for Application of Gypsum Sheathing.
  - .9 ASTM C 1177/C 1177M-13, Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing.
  - .10 ASTM C 1178/C 1178M-13, Standard Specification for Glass Mat Water-Resistant Gypsum Backing Board.
  - .11 ASTM C 1396/C 1396M-14a, Standard Specification for Gypsum Wallboard.
- .3 Association of the Wall and Ceilings Industries International (AWCI):
  - .1 AWCI Levels of Gypsum Board Finish-97.
- .4 Canadian General Standards Board (CGSB):
  - .1 CAN/CGSB-51.34-M86(R1988), Vapour Barrier, Polyethylene Sheet for Use in Building Construction.
  - .2 CAN/CGSB-71.25-M88, Adhesive, for Bonding Drywall to Wood Framing and Metal Studs.
- .5 Underwriters' Laboratories of Canada (ULC):
  - .1 CAN/ULC-S102-10, Standard Method of Test of Surface Burning Characteristics of Building Materials and Assemblies.

### **1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for gypsum board assemblies and include product characteristics, performance criteria, physical size, finish and limitations.

### 1.3 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store, and handle materials in accordance with Section 01 61 00 – Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store gypsum board assemblies materials level off ground, indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect gypsum board assemblies from nicks, scratches, and blemishes.
  - .3 Protect from weather, elements and damage from construction operations.
  - .4 Handle gypsum boards to prevent damage to edges, ends or surfaces.
  - .5 Protect prefinished aluminum surfaces with wrapping or strippable coating. Do not use adhesive papers or sprayed coatings which bond when exposed to sunlight or weather.
  - .6 Replace defective or damaged materials with new.

### 1.4 AMBIENT CONDITIONS

- .1 Maintain temperature 10°C minimum, 21°C maximum for 48 hours prior to and during application of gypsum boards and joint treatment, and for 48 hours minimum after completion of joint treatment.
- .2 Apply board and joint treatment to dry, frost free surfaces.
- .3 Ventilation: ventilate building spaces as required to remove excess moisture that would prevent drying of joint treatment material immediately after its application.

### 1.5 QUALITY CONTROL

- .1 Mock-up:
  - .1 Construct mock-up in accordance with Section 01 45 00 – Quality Control.
  - .2 Construct one room, as directed by Consultant.
  - .3 Room to be complete with all doors, ceilings, and finishes that impact the acoustic performance of the space.
  - .4 Mock-up may be part of finished work.
  - .5 Allow 48 hours for review of mock-up by Consultant.
  - .6 Perform acoustic testing specified.
  - .7 When accepted, mock-up with demonstrated minimum standard of quality required for this work.
- .2 Acoustic Testing
  - .1 Prior to issuance of substantial performance, noise insulation measurements shall be taken of the following:
    - .1 Mock-up room.
    - .2 Four test locations as directed by Consultant, after completed installation of mechanical and electrical work but prior to mechanical and electrical system commissioning.
    - .3 Four test locations as directed by Consultant, after completed commissioning of mechanical and electrical work.

- .2 The purpose of the test is to verify that the partition construction will meet the noise insulation requirements for the project.
- .3 Measurements shall be taken in accordance to ASTM E336-17.
- .4 A full report in accordance to ASTM E336 is not required, however, at a minimum, the following shall be reported:
  - .1 Source and Receiver room dimensions
  - .2 Description and photos of the test setup, test specimen, source and receiver rooms.
  - .3 Receiver room reverberation time and background sound in one-third octave bands from 125 Hz to 4 kHz
  - .4 Apparent Transmission Loss (ATL) in one-third octave bands from 125 Hz to 4 kHz
  - .5 Apparent Sound Transmission Class (ASTC) rating.
- .5 To confirm compliance with the intent of the partition design, the measured ASTC rating shall not be more than 5 dB below the partition composite STC rating.
- .6 Any notable flanking paths shall be noted in the test report, and suggestions for potential remediation measures provided.

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS**

- .1 Standard Board: to ASTM C36/C1396 and CAN/CSA-A82.27 regular and Type X, thickness as indicated, 4'-0" wide x maximum practical length, ends square cut, edges rounded and bevelled.
  - .1 Acceptable products:
    - .1 'Sheetrock Brand Gypsum Panels' by CGC.
    - .2 'ProRoc by CertainTeed Gypsum, Inc.
    - .3 'Tough Rock Fireguard Gypsum Board', by Georgia-Pacific.
    - .4 'Firecheck' by Lafarge Canada Inc.
    - .5 Or approved alternate.
- .2 Water/Mold Resistant Board: to ASTM C1396, ASTM D3273 and CAN/CSA-A82.27, moisture and mold resistant board, thickness as indicated Type X, 1200 mm / 4'-0" wide x maximum practical length.
  - .1 Acceptable products:
    - .1 'Mold Tough Interior Panel' by CGC.
    - .2 'M2Tech Moisture and Mold Resistant Gypsum Board' by CertainTeed Gypsum, Inc.
    - .3 'Tough Rock Mold-Guard Gypsum Board', by Georgia-Pacific.
    - .4 'Fire Watercheck' by Lafarge Canada Inc.
    - .5 Or approved alternate.
- .3 Cement Board: moisture and mold resistant to ASTM D3273, thickness as indicated, 36" x 60".
  - .1 Acceptable products:
    - .1 'Durock Next Gen Cement Board' by CGC.
    - .2 'Fiber Cement Underlayment/Backer Board' by CertainTeed Gypsum, Inc.
    - .3 'Durock Cement Board Next Gen' by USG.
    - .4 Or approved alternate.

- .4 Tile Backer Board: moisture and mold resistant, fully embedded glass mat gypsum tile backer to , ASTM D3273 , ASTM C1278., 15.9 mm / 5/8" thick Type X, 1200 mm / 4'-0" wide x maximum practical length.
  - .1 Acceptable products:
    - .1 'Fiberrock Acua-Tough Tile Backerboard' by CGC.
    - .2 'Diamondback GlasRoc Tile Backer' by CertainTeed Gypsum, Inc.
    - .3 'DensShield Tile Backer', by Georgia-Pacific.
    - .4 Or approved alternate.
- .5 Abuse Board: abuse resistant gypsum panels, to ASTM C 1396, and CAN/CSA-A82.27, thickness as indicated, Type X.
  - .1 Acceptable products:
    - .1 'Sheetrock Abuse-Resistant Gypsum Panels' by CGC.
    - .2 'ProRoc Abuse Resistant Gypsum Board' by CertainTeed Gypsum, Inc.
    - .3 Sheetrock Brand Abuse-Resistant Gypsum Panels by USG.
    - .4 'Tough Rock Fireguard Abuse Board', by Georgia-Pacific.
    - .5 'Protecta AR 100' by Lafarge Canada Inc.
    - .6 Or approved alternate.
- .6 Exterior Sheathing (Fiberglass Faced Gypsum Board): to ASTM C1177 regular and Type X, thickness as indicated, 1220 mm / 4'-0" wide x maximum practical length.
  - .1 Acceptable products:
    - .1 'Securock Glass-Mat Sheathing', by CGC.
    - .2 'Glasroc Sheathing by CertainTeed Gypsum, Inc.
    - .3 'Dens-Glass Sheathing', by Georgia Pacific.
    - .4 'Firecheck Sheathing' by Lafarge Canada Inc.
    - .5 Or approved alternate.
- .7 Gypsum Liner Board: Gypsum board meeting fire rating requirements indicated, labeled by ULC.
  - .1 Acceptable products:
    - .1 'Sheetrock' by CGC.
    - .2 'Shaft Liner Type X' by CertainTeed.
    - .3 'Densglass Shaf liner' by Georgia Pacific.
    - .4 'Firecheck Shaftliner' by Lafarge Canada Inc.
    - .5 Or approved alternate
- .8 Metal Furring Runners, Hangers, Tie Wires, Inserts, Anchors: to CSA A82.30-M1980.
- .9 Drywall Furring Channels: hat shaped, zinc-coated by hot-dip process 25 ga. base thickness, 7/8" x 2 3/4" x 25 ga. core thickness galvanized steel channels for screw attachment of gypsum board.
  - .1 Acceptable Product: 'D-1001 Drywall Furring Channels' by Bailey Metal Products Limited, or approved alternate.
- .10 Resilient Channels Clips Drywall Furring: 1/2" x 2 1/4" x 25 ga. base steel thickness galvanized steel for resilient attachment of gypsum board.
  - .1 Acceptable product: 'RC Plus' by Bailey Metal Products Limited, or approved alternate.
- .11 Reveal Moldings: 13 mm reveal, depth to suit application
  - .1 Type 1: 13 mm reveal, depth to suit application
    - .1 Acceptable product: "Z Reveal" by Fry Reglet or approved equal.
  - .2 Type 2: 13 mm reveal, depth to suit application
    - .1 Acceptable product: "Reveal" by Fry Reglet or approved equal.

- .12 Acoustic Trim: acoustic isolation trim at both sides of gypsum board assemblies at connection to exterior window mullions:
  - .1 Acceptable product: "Mull-It Over" by Mull-It Over Products.
- .13 Steel Drill Screws: to ASTM C 1002.
- .14 Stud Adhesive: to CAN/CGSB-71.25 ASTM C 557.
- .15 Casing Beads, Corner Beads, J Beads, Control Joints and Edge Trim: to ASTM C 1047, fill type only (non-fill type will not be accepted), 25 ga. base thickness, perforated flanges, one piece length per location.
- .16 Special Beads, Trims and Profiles: to provide reveals as indicated, fill type only (non-fill type will not be accepted), 0.5 mm / 25 ga. base thickness commercial grade sheet steel with Z275 zinc finish to ASTM A653/A653M, perforated flanges; one piece length per location.
- .17 Sealants: in accordance with Section 07 92 00 - Joint Sealants Acoustic sealant: in accordance with Section 07 92 00 - Joint Sealants.
- .18 Polyethylene Dust Barrier: to CAN/CGSB-51.34, Type 2, 0.10 mm / 10 mil thick.
- .19 Insulating Strip: rubberized, moisture resistant, 3mm / 1/8" thick closed cell neoprene strip, 12mm / 1/2" wide, with self-sticking permanent adhesive on one face, lengths as required.
- .20 Joint Reinforcement for Water Resistant Board and Tile Backer Board: glass-fiber mesh tape, alkali-resistant self-adhering glass-fibre tape, 50 mm / 2" wide, 10 by 10 or 10 by 20 threads/inch.
- .21 Joint Compound: to ASTM C 475, asbestos-free. acceptable products:
  - .1 Interior use, all locations unless otherwise noted: 'All Purpose Joint Compound', by CGC, or 'ProRoc All Purpose Joint Compound' by CertainTeed, or 'Rapid Coat' by Lafarge Canada Inc., or approved alternate.
  - .2 Interior use, all locations to receive Water / Mold Resistant Board: 'Mold Resistant Lite All-Purpose Joint Compound' by CertainTeed, or approved alternate.
  - .3 Interior use, all locations to receive abuse board or cement board: 'Durabond 90', by CGC, or 'ProRoc Moisture and Mold Resistant 90' by CertainTeed, or 'Rapid Coat 90' by Lafarge Canada Inc., or approved alternate.
  - .4 Exterior use: 'Durabond 90', by CGC, or 'ProRoc Moisture and Mold Resistant 90' by CertainTeed, or 'Rapid Coat 90' by Lafarge Canada Inc., or approved alternate.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- .1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for gypsum board assemblies' installation in accordance with manufacturer's written instructions.
  - .1 Examine work of other trades that gypsum board assemblies will be applied, for conformity to drawings. Visually inspect substrate.
  - .2 Inform Consultant of unacceptable conditions immediately upon discovery.
  - .3 Proceed with installation only after unacceptable conditions have been remedied.

### 3.2 ERECTION

- .1 Do application and finishing of gypsum board to ASTM C 840 except where specified otherwise.
- .2 Do application of gypsum sheathing to ASTM C 1280.
- .3 Erect hangers and runner channels for suspended gypsum board ceilings to ASTM C 840 except where specified otherwise.
- .4 Support light fixtures by providing additional ceiling suspension hangers within 6" of each corner and at maximum 2'-0" around perimeter of fixture.
- .5 Install work level to tolerance of 1:1200.
- .6 Frame with furring channels, perimeter of openings for access panels, light fixtures, diffusers, grilles.
- .7 Install 22 mm x 64 mm / 7/8" x 2 1/2" drywall furring channels parallel to, and at exact locations of steel stud partition header track.
- .8 Install drywall resilient channels parallel to, and at exact locations of steel stud partition header track.
- .9 Furr for gypsum board faced vertical bulkheads within and at termination of ceilings.
- .10 Furr above suspended ceilings for gypsum board fire and sound stops and to form plenum areas as indicated.
- .11 Install wall furring for gypsum board wall finishes to ASTM C 840, except where specified otherwise.
- .12 Furr openings and around built-in equipment, cabinets, access panels, on four sides. Extend furring into reveals. Check clearances with equipment suppliers.
- .13 Furr duct shafts, beams, columns, pipes and exposed services where indicated.
- .14 Erect drywall resilient furring transversely across studs or joists between the layers of gypsum board, spaced maximum 610mm / 2'-0" on centre and not more than 150mm / 6" from ceiling/wall juncture. Secure to each support with 11 mm / 7/16" pan framing screws.
- .15 Install 150mm / 6" continuous strip of 12.7mm / 1/2" gypsum board along base of partitions where resilient furring installed.

### 3.3 APPLICATION

- .1 Apply gypsum board after bucks, anchors, blocking, sound attenuation, electrical and mechanical work has been approved.
- .2 At metal deck locations where gypsum board assemblies are identified to be installed to underside of structure, scribe top of gypsum board to fit tightly into metal deck profile.
- .3 Apply single or double layer gypsum board to metal furring or framing using screw fasteners for first layer, screw fasteners for second layer. Maximum spacing of screws 300 mm / 12" on centre.
  - .1 Single-layer application:
    - .1 Apply gypsum board on ceilings prior to application of walls to ASTM C 840.
    - .2 Apply gypsum board vertically or horizontally, providing sheet lengths that will minimize end joints.

- .2 Double-layer application:
  - .1 Install gypsum board for base layer and exposed gypsum board for face layer.
  - .2 Apply base layer to ceilings prior to base layer application on walls; apply face layers in same sequence. Offset joints between layers at least 250mm/10".
  - .3 Apply base layers at right angles to supports unless otherwise indicated.
- .4 Apply base layer on walls and face layers vertically with joints of base layer over supports and face layer joints offset at least 10" with base layer joints. Apply single layer gypsum board to concrete block surfaces, where indicated, using laminating adhesive.
  - .1 Comply with gypsum board manufacturer's recommendations.
  - .2 Brace or fasten gypsum board until fastening adhesive has set.
  - .3 Mechanically fasten gypsum board at top and bottom of each sheet.
- .5 Exterior Soffits and Ceilings: install Gypsum Sheathing perpendicular to supports; stagger end joints over supports. Install with 1/4" gap where boards abut other work.
- .6 Standard Board: to all locations unless otherwise noted.
- .7 Apply Tile Backer Board to all walls identified to receive ceramic tile. Apply water resistant sealant to edges, ends, cut outs which expose gypsum core and to fastener heads. Do not apply joint treatment on areas to receive tile finish.
- .8 Apply Abuse Board to all walls where indicated from floor level to top of all door frames with Standard Board above, using screw fasteners at maximum spacing of 305 mm / 12" o/c.
- .9 Apply water/mold resistant gypsum board in washrooms, kitchens, janitors closets, where adjacent to slop sinks, at all window head and jamb returns and where indicated. Apply water-resistant sealant to edges, ends, cut-outs which expose gypsum core and to fastener heads.
- .10 Apply 12mm / 1/2" diameter bead of acoustic sealant continuously around periphery of each face of partitioning to seal gypsum board/structure junction where partitions abut fixed building components. Seal full perimeter of cut-outs around electrical boxes, ducts, in partitions where perimeter sealed with acoustic sealant.
- .11 Install ceiling boards in direction that will minimize number of end-butt joints. Stagger end joints at least 250mm / 10".
- .12 Install gypsum board on walls vertically to avoid end-butt joints. At stairwells and similar high walls, install boards horizontally with end joints staggered over studs, except where local codes or fire-rated assemblies require vertical application.
- .13 Install gypsum board with face side out.
- .14 Do not install damaged or damp boards.
- .15 Locate edge or end joints over continuous supports. Stagger vertical joints over different studs on opposite sides of wall.
- .16 Install Exterior Sheathing to receive air/vapour sound and free of sharp protrusions, gaps, and voids exceeding 3/4" in width. Use repair materials and methods acceptable to air/vapour barrier membrane manufacturer. For voids that exceed 13 mm / 1/2" in width refer also Sections 07 26 70 Vapour Retarders, 07 27 70 Air Barriers and 07 28 70 Air/Vapour Barrier for void coverings.
  - .1 Provide metal framing backing as required to accept air/vapour barrier void coverings.

### 3.4 INSTALLATION

- .1 Erect accessories straight, plumb or level, rigid and at proper plane. Use full length pieces where practical. Make joints tight, accurately aligned and rigidly secured. Mitre and fit corners accurately, free from rough edges. Secure at 150mm / 6" on centre and/or using contact adhesive for full length as indicated.
- .2 Install fill type casing beads around perimeter of suspended ceilings.
- .3 Install fill type casing beads where gypsum board butts against surfaces having no trim concealing junction and where indicated. Seal joints with sealant.
- .4 Install insulating strips continuously at edges of gypsum board and casing beads abutting metal window and exterior door frames, to provide thermal break.
- .5 Install shadow mould at gypsum board/ceiling juncture as indicated. Minimize joints; use corner pieces and splicers.
- .6 Construct control joints of preformed units two back-to-back casing beads set in gypsum board facing and supported independently on both sides of joint.
- .7 Provide continuous polyethylene dust barrier behind and across control joints.
- .8 Locate control joints at approximate 30'-0" spacing on long corridor runs and at approximate 50' spacing on ceilings to Consultant approval.
- .9 Install control joints straight and true.
- .10 Splice corners and intersections together and secure to each member with 3 screws.
- .11 Install access doors to electrical and mechanical fixtures specified in respective sections.
  - .1 Rigidly secure frames to furring or framing systems.
- .12 Finish face panel joints and internal angles with joint system consisting of joint compound, joint tape and taping compound installed according to manufacturer's directions and feathered out onto panel faces.
- .13 Gypsum Board Finish: finish gypsum board walls and ceilings to following levels in accordance with AWCI Levels of Gypsum Board Finish:
  - .1 Levels of finish:
    - .1 Level 1: embed tape for joints and interior angles in joint compound. Surfaces to be free of excess joint compound; tool marks and ridges are acceptable.
      - .1 Provide Level 1 finish for plenum areas above ceilings, in attics or in areas where the assembly will be concealed.
    - .2 Level 2: embed tape for joints and interior angles in joint compound and apply one separate coat of joint compound over joints, angles, fastener heads and accessories; surfaces free of excess joint compound; tool marks and ridges are acceptable.
      - .1 Provide Level 2 finish for water resistant gypsum backing board is used as a substrate for tile, and at fire separations in concealed spaces such as above finished ceilings.
    - .3 Level 3: N/A.
    - .4 Level 4: embed tape for joints and interior angles in joint compound and apply three separate coats of joint compound over joints, angles, fastener heads and accessories; surfaces smooth and free of tool marks and ridges.
      - .1 Provide Level 4 finish for light textures or wall coverings are to be applied.

- .5 Level 5: embed tape for joints and interior angles in joint compound and apply three separate coats of joint compound over joints, angles, fastener heads and accessories; apply a thin skim coat of joint compound to entire surface; surfaces smooth and free of tool marks and ridges.
  - .1 Provide Level 5 finish for all locations unless otherwise indicated.
- .14 Apply skim coat of joint compound as follows:
  - .1 Mix joint compound for skim coating slightly thinner than for joint taping.
  - .2 Apply thin skim coat to provide a light, thin coating of joint compound to entire surface using trowel or drywall broad knife to fill surface texture differences, variations or tool marks to following locations:
    - .1 Walls scheduled to receive gloss, semi-gloss or eggshell paints.
    - .2 On long walls with side lighting where differences in texture between finished sanded compound and gypsum board surface would be noticeable.
    - .3 All abuse board scheduled to be painted.
  - .3 Allow skim coat to dry completely.
  - .4 Remove ridges by light sanding or wiping with damp cloth.
- .15 Finish corner beads, control joints and trim as required with two coats of joint compound and one coat of taping compound, feathered out onto panel faces.
- .16 Fill screw head depressions with joint and taping compounds to bring flush with adjacent surface of gypsum board so as to be invisible after surface finish is completed.
- .17 Sand lightly to remove burred edges and other imperfections. Avoid sanding adjacent surface of board.
- .18 Completed installation to be smooth, level or plumb, free from waves and other defects and ready for surface finish.
- .19 Apply one coat of white primer sealer over surface to be textured. When dry apply textured finish in accordance with manufacturer's instructions.

### 3.5 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 – Cleaning.
  - .1 Leave Work area clean at end of each day.
  - .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 – Cleaning.

### 3.6 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by gypsum board assemblies' installation.

### 3.7 SCHEDULES

- .1 Construct fire rated assemblies to ULC design numbers where indicated. In case of conflict between the provisions of the tested assembly and the assembly noted in the contract documents, the more stringent provisions shall apply.
- .2 Install the following gypsum board types to the following locations:
  - .1 Standard Board: to all locations unless otherwise noted.
  - .2 Water/Mold Resistant Board: to all gypsum board assembly wall types in washrooms and all window head and jamb returns.
  - .3 Tile Backer Board: to all gypsum board assembly wall types to receive ceramic tile.
  - .4 Cement board: where indicated.
  - .5 Abuse resistant gypsum: waiting areas.
- .3 Exterior grade gypsum sheathing unless noted otherwise
- .4 All other materials as indicated on drawings.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 REFERENCES**

- .1 American Society for Testing and Materials International, (ASTM).
  - .1 ASTM C 645-14, Specification for Nonstructural Steel Framing Members.
  - .2 ASTM C 754-15, Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products.
- .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
  - .1 Material Safety Data Sheets (MSDS).
- .3 The Master Painters Institute (MPI)
  - .1 Architectural Painting Specification Manual - current edition.
  - .1 MPI #26, Primer, Galvanized Metal, Cementitious.

### **1.2 REGULATORY REQUIREMENTS**

- .1 Where fire resistant ratings are specified for Work of this section, carry out Work in strict accordance with fire test report data as per manufacturers written recommendations for ULC tested procedures. Work shall include, but is not limited to, fire separations, infill panels for Work of other sections with a fire resistance rating, backing for equipment located in a fire separation, shaft walls and shaft wall construction where indicated.
- .2 Prior to proceeding with Work, submit to the Consultant, product data and application requirements for ULC tested systems for all shaft wall construction for vertical and horizontal applications.

### **1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for metal framing and include product characteristics, performance criteria, physical size, finish and limitations.

### **1.4 QUALITY ASSURANCE**

- .1 Test Reports: certified test reports showing compliance with specified performance characteristics and physical properties.
- .2 Certificates: product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.
- .3 Acoustic Testing:
  - .1 Refer to Section 09 21 16 Gypsum Board Assemblies.

## **1.5 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 – Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials off ground, indoors, in dry location, and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect metal framing from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS**

- .1 Non-Load Bearing Channel Stud Framing: to ASTM C 645, stud size as indicated, roll formed, hot dipped galvanized steel sheet, for screw attachment of gypsum board. Knock-out service holes at 460mm /18" centres. Provide roll formed minimum gauge thickness for wall types as follows:
  - .1 25 gauge for all board types in non-loadbearing walls unless otherwise indicated.
  - .2 20 gauge for all non-loadbearing walls identified with a fire resistance rating.
  - .3 20 gauge for all non-loadbearing walls identified to receive Abuse Board or Cement Board.
- .2 Floor and Ceiling Tracks: to ASTM C 645, in widths to suit stud sizes, 1 1/4" flange height.
- .3 Deflection Ceiling Track: purpose made with 2 1/2" leg x width to suit stud depth, pre-punched 1 1/2" long slots spaced at 1" o/c.
  - .1 Acceptable product: 'Multi-slot MST 250' by Bailey Metal Products Limited, or approved alternate.
- .4 Metal Channel Stiffener: Size to suit, 1/16" thick cold rolled steel, coated with rust inhibitive coating.
- .5 Acoustical Sealant: In accordance with Section 07 92 00 – Joint Sealing.
- .6 Insulating Strip: rubberized, moisture resistant 3 mm / 16 ga. thick closed cell neoprene strip, 12 mm / 1/2" wide, with self-sticking adhesive on one face, lengths as required.
- .7 Acoustic insulating gasket: rubberized, moisture resistant 6 mm. thick closed cell neoprene strip, width to suit stud, with self-sticking adhesive on one face, lengths as required.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for non-structural metal framing application in accordance with manufacturer's written instructions.
  - .1 Visually inspect substrate.
  - .2 Inform Consultant of unacceptable conditions immediately upon discovery.
  - .3 Proceed with installation only after unacceptable conditions have been remedied.

### 3.2 ERECTION

- .1 Refer to Section 05 41 00 – Structural Metal Stud Framing, for all exterior wall framing.
- .2 Align partition tracks at floor and ceiling and secure at 610mm / 24" on centre maximum.
- .3 Install damp proof course under stud shoe tracks of partitions on slabs on grade.
- .4 Install acoustic isolation gasket under stud shoe and top track of interior partitions.
- .5 Place studs vertically at 600mm / 24" on centre and not more than 50mm/2" from abutting walls, and at each side of openings and corners. Position studs in tracks at floor and ceiling. Cross brace steel studs as required to provide rigid installation to manufacturer's instructions.
- .6 Erect metal studding to tolerance of 1:1000.
- .7 Attach studs to bottom and ceiling track using screws.
  - .1 Where walls are to accommodate deflection, erect studs using purpose made deflection ceiling tracks.
- .8 Coordinate simultaneous erection of studs with installation of service lines. When erecting studs ensure web openings are aligned.
- .9 Coordinate erection of studs with installation of door/window frames and special supports or anchorage for work specified in other Sections.
- .10 Provide two studs extending from floor to ceiling at each side of openings wider than stud centres specified.
  - .1 Secure studs together, 50mm / 2" apart using column clips or other approved means of fastening placed alongside frame anchor clips.
- .11 Install heavy gauge single jamb studs at openings.
- .12 Erect track at head of door/window openings and sills of sidelight/window openings to accommodate intermediate studs. Secure track to studs at each end, in accordance with manufacturer's instructions. Install intermediate studs above and below openings in same manner and spacing as wall studs.
- .13 Frame openings and around built-in equipment, cabinets, access panels, on four sides. Extend framing into reveals. Check clearances with equipment suppliers.
- .14 Provide 40mm / 1 5/8" stud or furring channel secured between studs as required to accommodate wood blocking for attachment of fixtures behind lavatory basins, toilet and bathroom accessories, and other fixtures including grab bars and towel rails, attached to steel stud partitions. Coordinate with Section 06 08 99 Rough Carpentry.
- .15 Install steel studs or furring channel between studs for attaching electrical and other boxes.
- .16 Extend partitions to ceiling height except where noted otherwise on drawings.
- .17 Maintain clearance under beams and structural slabs to avoid transmission of structural loads to studs.
  - .1 Use 2 1/2" leg purpose made deflection ceiling tracks as specified.

- .18 Install continuous insulating strips to isolate studs from uninsulated surfaces.
- .19 Install two continuous beads of acoustical sealant continuous insulating strip under studs and tracks around perimeter of sound control partitions.

### **3.3 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

### **3.4 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by non-structural metal framing application.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 REFERENCES**

- .1 American National Standards Institute (ANSI)/Ceramic Tile Institute (CTI):
  - .1 ANSI A108.1-99, Specification for the Installation of Ceramic Tile (Includes ANSI A108.1A-C, 108.4-.13, A118.1-.10, ANSI A136.1).
  - .2 CTI A118.3-92, Specification for Chemical Resistant, Water Cleanable Tile Setting and Grouting Epoxy and Water Cleanable Tile Setting Epoxy Adhesive (included in ANSI A108.1).
  - .3 CTI A118.4-92, Specification for Latex Cement Mortar (included in ANSI A108.1).
  - .4 CTI A118.5-92, Specification for Chemical Resistant Furan Resin Mortars and Grouts for Tile Installation (included in ANSI A108.1).
  - .5 CTI A118.6-92, Specification for Ceramic Tile Grouts (included in ANSI A108.1).
- .2 American Society for Testing and Materials International (ASTM):
  - .1 ASTM C 144-11, Specification for Aggregate for Masonry Mortar.
  - .2 ASTM C 207-06(2011), Specification for Hydrated Lime for Masonry Purposes.
  - .3 ASTM C 847-14a, Specification for Metal Lath.
  - .4 ASTM C979/C979M-10, Specification for Pigments for Integrally Coloured Concrete.
- .3 Canadian General Standards Board (CGSB):
  - .1 CAN/CGSB-51.34-M86 (R1988), Vapour Barrier, Polyethylene Sheet for Use in Building Construction.
  - .2 CGSB 71-GP-22M-78, Adhesive, Organic, for Installation of Ceramic Wall Tile.
  - .3 CAN/CGSB-75.1-M88, Tile, Ceramic.
  - .4 CAN/CGSB-25.20-95, Surface Sealer for Floors.
- .4 Canadian Standards Association (CSA International):
  - .1 CSA A123.3-05(R2015), Asphalt Saturated Organic Roofing Felt.
  - .2 CAN/CSA-A3000-13, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).
- .5 Terrazzo Tile and Marble Association of Canada (TTMAC):
  - .1 Tile Specification Guide 09 30 00 2006/2007, Tile Installation Manual.
  - .2 Tile Maintenance Guide 2000.

### **1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Provide product data in accordance with Section 01 33 00 - Submittal Procedures.
  - .1 Include manufacturer's information on:
    - .1 Ceramic tile, marked to show each type, size, and shape required.
    - .2 Chemical resistant mortar and grout (Epoxy and Furan).
    - .3 Cementitious backer unit.
    - .4 Dry-set cement mortar and grout.
    - .5 Divider strip.
    - .6 Elastomeric membrane and bond coat.
    - .7 Reinforcing tape.

- .8 Levelling compound.
  - .9 Latex cement mortar and grout.
  - .10 Commercial cement grout.
  - .11 Organic adhesive.
  - .12 Slip resistant tile.
  - .13 Waterproofing isolation membrane.
  - .14 Fasteners.
- .3 Provide samples in accordance with Section 01 33 00 - Submittal Procedures.
- .1 Base tile: submit x 12" sample of each colour, texture, size, and pattern of tile.
  - .2 Floor tile: submit full tile sample panels of each colour, texture, size, and pattern of tile.
  - .3 Wall tile: submit full tile sample of each colour, texture, size and pattern of tile.
  - .4 Trim shapes, bullnose cap and cove including bullnose cap and base pieces at internal and external corners of vertical surfaces, each type, colour, and size.
  - .5 Adhere tile samples to 7/16" thick plywood and grout joints to represent project installation.

### 1.3 QUALITY ASSURANCE

- .1 Quality Assurance Submittals:
- .1 Manufacturer's Instructions: manufacturer's installation instructions.
  - .2 Tile installer shall have a minimum of 10 years experience and be a member in good standing with the TTMAC and the TTMGO.

### 1.4 DELIVERY, STORAGE AND HANDLING

- .1 Packing, Shipping, Handling, and Unloading:
- .1 Deliver, store, and handle materials in accordance with Section 01 61 00 -Common Product Requirements.

### 1.5 AMBIENT CONDITIONS

- .1 Maintain air temperature and structural base temperature at ceramic tile installation area above 12°C for 48 hours before, during, and 48 hours after, installation.
- .2 Do not install tiles at temperatures less than 12°C or above 38°C.
- .3 Do not apply epoxy mortar and grouts at temperatures below 15°C or above 25°C.

### 1.6 MAINTENANCE

- .1 Extra Materials:
- .1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
  - .2 Provide minimum 2% of each type and colour of tile required for project for maintenance use. Store where directed.
  - .3 Maintenance material same production run as installed material.

## **PART 2 - PRODUCTS**

### **2.1 FLOOR TILE**

- .1 Porcelain Floor Tile (CFT):
  - .1 Acceptable product: 'Brit Stone' by Coem, supplied by Centura Tile.
  - .2 Size: 24" x 48".
  - .3 Colour: 'Ivory'.
  - .4 Installation: stacked.

### **2.2 WALL TILE**

- .1 Porcelain/Ceramic Wall Tile (CWT):
  - .1 Type 1 (CWT-1):
    - .1 Acceptable product: 'Verve' by Centura Tile.
    - .2 Size: 10" x 12" herringbone mosaic.
    - .3 Colour: 'Silver'.
    - .4 Installation: chevron.
  - .2 Type 2 (CWT-2):
    - .1 Acceptable product: 'Penny Round' by Centura Tile.
    - .2 Size: 12" x 12" mosaic.
    - .3 Colour: 'White Glossy'.
    - .4 Installation: stacked.
  - .3 Type 3 (CWT-3):
    - .1 Acceptable product: 'Vision' by Centura Tile.
    - .2 Size: 4" x 12".
    - .3 Colour: 'Glossy White'.
    - .4 Installation: stack bond.

### **2.3 BASE TILE**

- .1 Ceramic Base Tile (CBT):
  - .1 4" cut tile from same tile as adjacent floor tile.

### **2.4 TRIM SHAPES**

- .1 Corner Joint: clear satin anodized aluminum, profile for inside corners, and at floor and wall transitions, coved-shaped capable of absorbing movement, c/w corner, end cap adaptors, and all accessories for complete system.
  - .1 Acceptable product: for floor/wall transitions and for inside wall corners, c/w corner and end cap adaptors, 'DILEX-AHK', by Schluter, or approved alternate.
- .2 Transition Trim: purpose made metal extrusion; satin aluminum beads and trims at all outside corners, floor, wall and floor base transitions, and edge protection.
  - .1 At locations where ceramic floor tile meets adjacent floor finishes.
    - .1 Acceptable product: 'Satin anodized aluminum Schlüter – Schiene', by Schlüter or approved alternate.

- .2 At locations where ceramic floor tile is not flush with the adjacent floor finishes.
  - .1 Acceptable product: 'Satin anodized aluminum Schlüter – Renu-U or Reno-V', by Schlüter or approved alternate.
- .3 At all outside corner locations, terminating exposed tile edges and above all ceramic floor tile bases.
  - .1 Acceptable product: 'Anodized aluminum Schlüter – Jolly', by Schlüter or approved alternate.

## 2.5 TILE UNDERLAYMENT

- .1 Tile Underlayment (Waterproof Membrane): 0.508 mm / 20-mil thick, sheet applied or liquid applied polyethylene waterproof membrane and vapour retarder for tiled floors, walls and ceilings, anchoring fleece laminated to both sides, water vapor permeance of 0.18 perms, as listed by cUPC and evaluated by ICC-ES.
  - .1 Accessories: as required for a complete system as recommended by manufacturer to provide waterproof membrane including but not limited to preformed seamless inside / outside corners, seamless corners for waterproofing floor / wall / ceiling / shower base connections, prefabricated sections with overmolded rubber gaskets to seal pipe protrusions through the waterproofing membrane (e.g., at showerheads and faucets) and protect moisture-sensitive backing panels at the mixing valve.
    - .1 Acceptable product: 'Kerdi', by Schlüter, 'Hydro-ban' by Laticrete or approved alternate.
- .2 Tile Underlayment (Acoustic Membrane):
  - .1 Accessories: as required for a complete system as recommended by the manufacturer.
    - .1 Acceptable product: "QuietDown High Bond" by Symar as distributed by KN Rubber
    - .2 Company, or approved alternate.

## 2.6 MORTAR AND ADHESIVE MATERIALS

- .1 Cement: to CAN/CSA-A3000.
- .2 Sand:
  - .1 To ASTM C 144.
  - .2 Crushed or pit run consisting of hard durable particles free from clay lumps, cementation, organic material, frozen material and other deleterious materials.
  - .3 Gradations to be within limits specified when tested to ASTM C136. Sieve sizes to CAN/CGSB 8.1.
  - .4 Table:

Sieve Designation	% Passing
4.75 mm / # 4	100
2.36 mm / # 8	95 - 100
1.18 mm / # 16	60 - 100
0.600 mm / # 30	35 - 80
0.300 mm / # 50	15 - 50
0.150 mm / # 100	2 - 15
0.075 mm / # 200	0 - 5

- .3 Hydrated lime: to ASTM C207.
- .4 Latex additive: formulated for use in cement mortar.
- .5 Water: potable and free of minerals which are detrimental to mortar and grout mixes.
- .6 Dry set mortar:
  - .1 To ANSI A108.1
  - .2 Water retentive cement mortar.
- .7 Elastomeric adhesive: to CGSB 71 GP 29M.
- .8 Epoxy adhesive: to CGSB 71 GP 30M, Type 1.
- .9 Modified mortar adhesive: to CGSB 71 GP 30M, Type 2.
- .10 Furan resin mortar to ANSI/CTI A108.1.
- .11 Colour pigment: non fading mineral oxides, unaffected by lime or cement and which will not stain tile.

## 2.7 BOND COAT

- .1 Floor and wall tile: to ANSI A118.4 and A118.11, polymer-modified, sag-resistant mortar having the following physical characteristics:
  - .1 28 Day Shear Strength for impervious ceramic tile (porcelain) mosaics: 2.59 to 3.45 MPa.
  - .2 Acceptable product: '56SR', by Flextile Ltd., or equivalent by Mapei, or equivalent by Latacrete, or approved alternate.

## 2.8 WALL GROUT

- .1 Colouring Pigments:
  - .1 Pure mineral pigments, limeproof and nonfading, complying with ASTM C 979.
  - .2 Colouring pigments to be added to grout by manufacturer.
  - .3 Job coloured grout are not acceptable.
  - .4 Use in Commercial Cement Grout, Dry-Set Grout, and Latex Cement Grout.
  - .5 Colour: not more than one (1) colour as later selected by Consultant from manufacturer's standard colour range.
- .2 Epoxy Grout: 100% solids epoxy grout, stain resistant, crack and shrink resistant, mold and mildew resistant, to ANSI A118.3, not more than three (3) colours as later selected by Consultant.
  - .1 Initial Cure: 24 hours.
  - .2 Final Cure: 7 days.
  - .3 Tensile Strength: 8.4 MPa.
  - .4 Compressive Strength: 60.0 MPa.
  - .5 Thermal Shock: 3.9 MPa.
  - .6 Shore D Hardness (24hr.): 85.
  - .7 Linear Shrinkage: 0%.
  - .8 Specific Gravity (paste): 1.40.
  - .9 Acceptable product: 'Flex-Epoxy 100' by Flextile, or equivalent by Mapei, or Latacrete, or approved alternate.

## 2.9 FLOOR GROUT

- .1 Epoxy Grout: 100% solids epoxy grout, stain resistant, crack and shrink resistant, mold and mildew resistant, to ANSI A118.3, not more than one (1) colour as later selected by Consultant, having the following characteristics:
  - .1 Final Cure: 7 days.
  - .2 Tensile Strength: 8.4 MPa.
  - .3 Compressive Strength: 60.0 MPa.
  - .4 Thermal Shock: 3.9 MPa.
  - .5 Shore D Hardness (24hr.): 85.
  - .6 Linear Shrinkage: 0%.
  - .7 Specific Gravity (paste): 1.40.
  - .8 Acceptable product: 'Flex-Epoxy 100' by Flextile, or equivalent by Mapei, or Latacrete, or approved alternate.

## 2.10 ACCESSORIES

- .1 Reinforcing Mesh: 2" x 2" x 1/16" x 1/16" galvanized steel wire mesh, welded fabric design, in flat sheets.
- .2 Sealant: in accordance with Section 07 92 00 - Joint Sealants.
- .3 Floor Sealer and Protective Coating: for intended use to tile and grout manufacturer's recommendations.

## 2.11 MIXES

- .1 Cement:
  - .1 Scratch coat: 1 part cement, 1/5 to 1/2 parts hydrated lime to suit job conditions, 4 parts sand, 1 part water, and latex additive where required. Adjust water volume depending on water content of sand.
  - .2 Slurry bond coat: cement and water mixed to creamy paste. Latex additive may be included.
  - .3 Mortar bed for floors: 1 part cement, 4 parts sand, 1 part water. Adjust water volume depending on water content of sand. Latex additive may be included.
  - .4 Mortar bed for walls and ceilings: 1 part cement, 1/5 to 1/2 parts hydrated lime to suit job conditions, 4 parts sand and 1 part water. Adjust water volume depending on water content of sand. Latex additive may be included.
  - .5 Levelling coat: 1 part cement, 4 parts sand, minimum 1/10 part latex additive, 1 part water including latex additive.
  - .6 Bond or setting coat: 1 part cement, 1/3 part hydrated lime, 1 part water.
  - .7 Measure mortar ingredients by volume.
- .2 Mix bond and levelling coats, and grout to manufacturer's instructions.
- .3 Adjust water volumes to suit water content of sand.

## **2.12 PATCHING AND LEVELLING COMPOUND**

- .1 Cement base, acrylic polymer compound, manufactured specifically for resurfacing and leveling concrete floors. Products containing gypsum are not acceptable.
- .2 Have not less than the following physical properties:
  - .1 Compressive strength - 25 MPa.
  - .2 Tensile strength - 7 MPa.
  - .3 Flexural strength - 7 MPa.
  - .4 Density - 1.9.
- .3 Capable of being applied in layers up to 2", being brought to feather edge, and being trowelled to smooth finish.
- .4 Ready for use in forty-eight (48) hours after application.

## **2.13 CLEANING COMPOUNDS**

- .1 Specifically designed for cleaning masonry and concrete and which will not prevent bond of subsequent tile setting materials including patching and leveling compounds and elastomeric waterproofing membrane and coat.
- .2 Materials containing acid or caustic material are not acceptable.

## **PART 3 - EXECUTION**

### **3.1 MANUFACTURER'S INSTRUCTIONS**

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.

### **3.2 WORKMANSHIP**

- .1 Do tile work in accordance with TTMAC Tile Installation Manual 2006/2007, "Ceramic Tile", except where specified otherwise.
- .2 Tile Underlayment (Waterproof Membrane): Install tile underlayment at all floor tile locations.
  - .1 Prepare substrate as per manufacturer's recommendations.
  - .2 Install all products as per manufacturer's standard installation instructions.
  - .3 Apply membrane in two coats. Apply first coat to minimum thickness of 25 mils wet. Apply second coat 25 mils wet film thickness to achieve total combined thickness of 50 mils wet, curing to dry film thickness of 30 mils.
- .3 Tile Underlayment (Acoustic Membrane): Install tile underlayment at second floor Lounge 217.
  - .1 Prepare substrate as per manufacturer's recommendations.
  - .2 Install all products as per manufacturer's standard installation instructions.
- .4 Apply tile to clean and sound surfaces.
- .5 Fit tile around corners, fitments, fixtures, drains and other built-in objects. Maintain uniform joint appearance. Cut edges smooth and even. Do not split tiles.

- .6 Maximum surface tolerance 1:800.
- .7 Make joints between tile uniform and approximately 1/16" wide, plumb, straight, true, even and flush with adjacent tile. Ensure sheet layout not visible after installation. Align patterns.
- .8 Lay out tiles as indicated on drawings.
- .9 Sound tiles after setting and replace hollow-sounding units to obtain full bond.
- .10 Make internal angles square, external angles rounded.
- .11 Use round edged tiles at termination of wall tile panels, except where panel abuts projecting surface or differing plane.
- .12 Install divider strips at junction of tile flooring and dissimilar materials.
- .13 Allow minimum twenty-four (24) hours after installation of tiles, before grouting.
- .14 Clean installed tile surfaces after installation and grouting cured.
- .15 Control Joints:
  - .1 Make control joints at 25' in each direction and at abutting dissimilar materials. Make joint width same as tile joints. Fill control joints with sealant in accordance with Section 07 92 00 - Joint Sealants.
  - .2 Install control joints as recommended by material manufacturer. Set control joints slightly lower than finish tile surface.

### **3.3 FLOOR AND WALL TILE**

- .1 Do tile work in accordance with Installation Manual 200, "Ceramic Tile", produced by Terrazzo Tile and Marble Association of Canada (TTMAC), except where specified otherwise.

### **3.4 FLOOR SEALER AND PROTECTIVE COATING**

- .1 Apply in accordance with manufacturer's instructions.

### **3.5 FIELD QUALITY CONTROL**

- .1 Manufacturer's Field Services:
  - .1 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.

### **3.6 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 – Cleaning.
  - .1 Leave Work area clean at end of each day.
  - .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 – Cleaning.
    - .1 Clean flooring, wall and base surfaces to manufacturer's printed instructions.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 SUMMARY**

- .1 Section Includes:
  - .1 Materials and application of acoustical units for direct application or for application and installation within a suspended ceiling.

### **1.2 REFERENCES**

- .1 American Society for Testing and Materials International (ASTM)
  - .1 ASTM C 423-09a, Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method
  - .2 ASTM E 1264-14, Standard Classification for Acoustical Ceiling Products.
  - .3 ASTM E 1477-98a (2013), Standard Test Method for Luminous Reflectance Factor of Acoustical Materials by Use of Integrating-Sphere Reflectometers.
- .2 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-51.34-M86, Vapour Barrier, Polyethylene Sheet, for Use in Building Construction and Amendment No. 1 1988.
  - .2 CAN/CGSB-92.1-M89, Sound Absorptive Prefabricated Acoustical Units.
- .3 Canadian Standards Association (CSA International)
  - .1 CSA B111-1974(R2003), Wire Nails, Spikes and Staples.
- .4 Department of Justice Canada (Jus)
  - .1 Canadian Environmental Protection Act (CEPA), 1999, c. 33.
  - .2 Transportation of Dangerous Goods Act (TDGA), 1992, c. 34.
- .5 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).
- .6 Underwriter's Laboratories of Canada (ULC)
  - .1 CAN/ULC-S102-10, Surface Burning Characteristics of Building Materials and Assemblies.

### **1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit samples in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product Data: Submit WHMIS MSDS in accordance with 01 35 29 –Health and Safety Requirements and manufacturer's instructions.
- .3 Submit duplicate full size samples of each type acoustical units.

## **1.4 QUALITY ASSURANCE**

- .1 Regulatory Requirements:
  - .1 Fire-resistance rated floor/ceiling and roof/ceiling assembly: certified by Canadian Certification Organization accredited by Standards Council of Canada.
- .2 Acoustic Testing:
  - .1 Refer to Section 09 21 16 Gypsum Board Assemblies.

## **1.5 DELIVERY, STORAGE AND HANDLING**

- .1 Storage and Protection:
  - .1 Protect acoustic panels from dampness. Arrange for delivery after work causing abnormal humidity has been completed.
  - .2 Store acoustic panels indoors, in dry, well ventilated room, off floor, in accordance with manufacturer's recommendations.
  - .3 Protect acoustic panels from scratches, handling marks and other damage.
  - .4 Store acoustic panels away from direct sunlight.

## **1.6 ENVIRONMENTAL REQUIREMENTS**

- .1 Permit wet work to dry before beginning to install.
- .2 Maintain uniform minimum temperature of 15 degrees C and humidity of 20-40% before and during installation.
- .3 Store materials in work area 48 hours prior to installation.
- .4 Store and manage hazardous materials in accordance with Section 00 14 01 - Special Project Requirements.

## **1.7 EXTRA MATERIALS**

- .1 Provide extra materials of acoustic units in accordance with Section 01 78 00 – Closeout Submittals.
- .2 Provide acoustical units amounting to 10% of gross ceiling area for each pattern and type required for project.
- .3 Ensure extra materials are from same production run as installed materials.
- .4 Clearly identify each type of acoustic unit, including colour and texture.
- .5 Deliver to Owner, upon completion of the work of this section.
  - .1 Store where directed by Owner.

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS**

- .1 Acoustic units for suspended ceiling system, Type 1 (ACT 1): to CAN/CGSB-92.1, non-fire rated, wet-formed mineral fibre acoustic ceiling panels with factory applied vinyl latex paint:
  - .1 Type Square tegular.
  - .2 Class A.
  - .3 Pattern as noted on drawings , Class A.
  - .4 Textures: smooth.
  - .5 Flame spread rating of 25 or less in accordance with CAN/ULC-S102.
  - .6 Smoke developed 50 or less in accordance with CAN/ULC-S102.
  - .7 Minimum Ceiling Attenuation Class (CAC) rating 35, in accordance with ASTM E 1264
  - .8 Minimum Sound Absorption NRC rating 0.7
  - .9 Light Reflectance (LR) range of 0.90.
  - .10 Edge type: 9/16 square tegular.
  - .11 Colour: white.
  - .12 Size: 24" x 24" x 1" thick.
  - .13 Acceptable material: 'Calla' by Armstrong.
- .2 Acoustic units for suspended ceiling system, Type 1 (ACT 1): to CAN/CGSB-92.1, non-fire rated, wet-formed mineral fibre acoustic ceiling panels with factory applied vinyl latex paint:
  - .1 Type Square tegular.
  - .2 Class A.
  - .3 Pattern as noted on drawings , Class A.
  - .4 Textures: smooth.
  - .5 Flame spread rating of 25 or less in accordance with CAN/ULC-S102.
  - .6 Smoke developed 50 or less in accordance with CAN/ULC-S102.
  - .7 Minimum Ceiling Attenuation Class (CAC) rating 35, in accordance with ASTM E 1264
  - .8 Minimum Sound Absorption NRC rating 0.7
  - .9 Light Reflectance (LR) range of 0.90.
  - .10 Edge type: 9/16 square tegular.
  - .11 Colour: white.
  - .12 Size: 48" x 48" x 1" thick.
  - .13 Acceptable material: 'Lyra with Plant-based Binder High CAC' by Armstrong.
- .3 Adhesive: low VOC type recommended by acoustic unit manufacturer.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- .1 Do not install acoustical panels and tiles until work above ceiling has been reviewed by Consultant.

### **3.2 INSTALLATION**

- .1 Install acoustical panels and tiles in ceiling suspension system.

### **3.3 APPLICATION**

- .1 Install acoustic units to clean, dry and firm substrate.
- .2 Install acoustical units. Refer to reflected ceiling plan.
- .3 Scribe acoustic units to fit adjacent work. Butt joints tight.

### **3.4 INTERFACE WITH OTHER WORK**

- .1 Coordinate with Section 09 53 00.01 – Acoustical Suspension.
- .2 Coordinate ceiling work to accommodate components of other sections, such as light fixtures, diffusers, speakers, sprinkler heads, to be built into acoustical ceiling components.

### **3.5 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 – Cleaning.
  - .1 Leave Work area clean at end of each day.
  - .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 – Cleaning.
    - .1 Clean flooring and base surfaces to flooring manufacturer's printed instructions.

### **3.6 SCHEDULE**

- .1 Refer to Room Finish Schedule and Reflected Ceiling Plans.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 REFERENCES**

- .1 ASTM International
  - .1 ASTM C635/C635M-13a, Standard Specifications for the Manufacture, Performance and Testing of Metal Suspension Systems for Acoustical Tile and Lay-In Panel Ceilings.
  - .2 ASTM C636/C636M-13, Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels.
- .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).

### **1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for acoustical suspension and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Samples:
  - .1 Submit for review and acceptance of each unit.
  - .2 Submit one representative model of each type ceiling suspension system.
  - .3 Ceiling system to show basic construction and assembly, treatment at walls, recessed fixtures, splicing, interlocking, finishes, acoustical unit installation.

### **1.3 CLOSEOUT SUBMITTALS**

- .1 Submit in accordance with Section 01 78 00 – Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for acoustical suspension for incorporation into manual.

### **1.4 QUALITY ASSURANCE**

- .1 Fire-resistance rated suspension system: certified by a Canadian Certification Organization accredited by Standards Council of Canada.
- .2 Certifications: submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

## **1.5 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store, and handle materials in accordance with Section 01 61 00 – Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials off ground, indoors, in dry location, and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect acoustical ceiling tiles and tracks from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.

## **PART 2 - PRODUCTS**

### **2.1 DESIGN CRITERIA**

- .1 Design Requirements: maximum deflection: 1/360th of span to ASTM C 635/ASTM C635M deflection test.

### **2.2 MATERIALS**

- .1 Heavy duty system to ASTM C 635/ASTM C635M.
- .2 Basic Materials for Suspension System: commercial quality cold rolled steel zinc coated.
- .3 Suspension System: non fire rated, made up as follows:
  - .1 2 directional exposed tee bar grid.
  - .2 2 directional concealed tee spline.
  - .3 Concealed tee access spline.
  - .4 Concealed tongue and groove runner.
  - .5 Concealed H runner, tee spline, and flat steel spline.
  - .6 Concealed zee runner and flat steel spline.
  - .7 Metal pan special tee system.
- .4 Exposed tee bar grid components: shop painted satin sheen white. Components die cut. Main tee with double web, rectangular bulb and 1" rolled cap on exposed face. Cross tee with rectangular bulb; web extended to form positive interlock with main tee webs; lower flange extended and offset to provide flush intersection.
- .5 Hanger Wire: galvanized soft annealed steel wire:
  - .1 3/16" diameter for access tile ceilings.
  - .2 To ULC design requirements for fire rated assemblies.
- .6 Hanger Inserts: purpose made.

- .7 Acceptable Material: 9/16 dimensional T system: 'Interlude XL HRC' by Armstrong or approved alternate. Surface Finish: prefinished baked polyester, or enamel.
- .8 Accessories:
  - .1 Splices, clips, wire ties, retainers and wall moulding flush reveal, to complement suspension system components, as recommended by system manufacturer.
  - .2 Perimeter trims: aluminum
    - .1 Material: Aluminum, finish as later selected by consultant from manufacturer's standard range.
    - .2 Blind Pocket: 5" x 5" x 5" perimeter pocket with connection to extension/face plate
    - .3 Faceplate: 4" faceplate with acoustical flange complete with slotted pattern of 2 slots at 3/4" x 23".
    - .4 Faceplate: 4" faceplate with gypsum wallboard flange complete with slotted pattern of 2 slots at 3/4" x 23"
    - .5 Closure clips and endcaps as required.
    - .6 Gypsum to acoustic ceiling tile transitions, depth as required to suit application.
    - .7 Acceptable product: 'Axiom Perimeter Trims' by Armstrong or approved alternate.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- .1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for acoustical ceiling tile and track installation in accordance with manufacturer's written instructions.
  - .1 Examine work of other trades that acoustical suspension systems will be applied, for conformity to drawings.
  - .2 Visually inspect substrate.
  - .3 Inform Consultant of unacceptable conditions immediately upon discovery.
  - .4 Proceed with installation only after unacceptable conditions have been remedied.

#### **3.2 INSTALLATION**

- .1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.
- .2 Installation: to ASTM C 636/C 636M except where specified otherwise.
- .3 Install suspension system to manufacturer's instructions and Certification Organizations tested design requirements.
- .4 Do not erect ceiling suspension system until work above ceiling has been inspected by Consultant.
- .5 Secure hangers to overhead structure using attachment methods acceptable to Consultant.
- .6 Install hangers spaced at maximum 4'-0" centres and within 6" from ends of main tees.
- .7 Lay out according to reflected ceiling plan. Report all discrepancies immediately upon discovery to Consultant prior to commencing with work for acoustical suspension systems.

- .8 Ensure suspension system is coordinated with location of related components.
- .9 Install wall moulding to provide correct ceiling height.
- .10 Completed suspension system to support super-imposed loads, such as lighting fixtures, diffusers, grilles and speakers.
- .11 Support at light fixtures diffusers with additional ceiling suspension hangers within 6" of each corner and at maximum 2'-0" around perimeter of fixture.
- .12 Interlock cross member to main runner to provide rigid assembly.
- .13 Frame at openings for light fixtures, air diffusers, speakers and at changes in ceiling heights.
- .14 Install access splines to provide 50% ceiling access.
- .15 Finished ceiling system to be square with adjoining walls and level within 1:1000.
- .16 Install system to seismic requirements in accordance with manufacturer's written instructions.

### **3.3 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 – Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 – Cleaning.
  - .1 Touch up scratches, abrasions, voids and other defects in painted surfaces.

### **3.4 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by acoustical suspension installation.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 REFERENCES**

- .1 American Society for Testing and Materials International (ASTM):
  - .1 ASTM F 1066-(2014) e1, Standard Specification for Vinyl Composition Floor Tile.
  - .2 ASTM F 1344-15, Standard Specification for Rubber Floor Tile.
- .2 Canadian General Standards Board (CGSB):
  - .1 CAN/CGSB-25.20-95, Surface Sealer for Floors.
  - .2 CAN/CGSB-25.21-95, Detergent-Resistant Floor Polish.
- .3 Health Canada/Workplace Hazardous Materials Information System (WHMIS):
  - .1 Material Safety Data Sheets (MSDS).

### **1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Test Reports:
  - .1 Submit two (2) copies of ASTM 1869 Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.
  - .2 Submit two (2) copies of ASTM F2170 Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes.
- .3 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for resilient tile flooring and include product characteristics, performance criteria, physical size, finish and limitations.
- .4 Samples:
  - .1 Submit duplicate samples, 6" x 6".
- .5 Closeout Submittals:
  - .1 Provide maintenance data for resilient flooring for incorporation into manual specified in Section 01 78 00 – Closeout Submittals.

### **1.3 MAINTENANCE MATERIAL SUBMITTALS**

- .1 Extra Materials:
  - .1 Provide maintenance materials of resilient tile flooring, base and adhesive in accordance with Section 01 78 00 – Closeout Submittals.
  - .2 Provide 100 ft² of each colour, pattern and type flooring material required for this project for maintenance use.
  - .3 Extra materials from same production run as installed materials.
  - .4 Identify each container of floor tile and each container of adhesive.
  - .5 Deliver to Owner, upon completion of the work of this section.
  - .6 Store where directed by Owner.

## **1.4 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 – Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: 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 specified materials from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.

## **1.5 SITE CONDITIONS**

- .1 Ambient Conditions:
  - .1 Maintain air temperature and structural base temperature at flooring installation area above 20 degrees C for 48 hours before, during and for 48 hours after installation.

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS**

- .1 Resilient Sheet Flooring (RSF1): to ASTM F 1913-98, CAN/ULC S102-2M88, sheet Flooring with all necessary accessories for complete installation, 2.0 mm / 5/64", antibacterial and fungicidal, non-directional, homogeneous vinyl:
  - .1 Acceptable Product: 'Forbo Sphera Element' by Centura, colour 'Greige'..
- .2 Resilient Base (RB): 3 mm / 1/8" thick, coloured vinyl base, flat base; colour as later selected by Consultant from manufacturers full colour range. Not more than three (3) colours.
  - .1 100 mm / 4" high to all locations unless otherwise indicated.
  - .2 Acceptable manufacturer: Johnsonite, Tightlock or approved alternate.
- .3 Primers and adhesives: types recommended by flooring manufacturer for specific material on applicable substrate, above, at or below grade.
- .4 Sub-floor filler and leveller: as recommended by flooring manufacturer for use with their product.
- .5 Transition trim:
  - .1 Metal edge strips: aluminum extruded, smooth, mill finish with lip to extend under floor finish, shoulder flush with top of adjacent floor finish.
- .6 Cleaner, Sealer and Finisher: as recommended by flooring manufacturer's printed instructions.

### **PART 3 - EXECUTION**

#### **3.1 MANUFACTURER'S INSTRUCTIONS**

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.

#### **3.2 INSPECTION**

- .1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for resilient sheet flooring work in accordance with manufacturer's written instructions.
  - .1 Examine substrate and work of other trades that resilient flooring systems will be applied, for conformity to drawings.
  - .2 Conduct the following tests on concrete slab before product installation:
    - .1 ASTM F1869: Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.
    - .2 ASTM F2170: Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes.
- .2 Inform Consultant of unacceptable conditions immediately upon discovery.
  - .1 Proceed with installation only after unacceptable conditions have been remedied.
- .3 Ensure concrete floors are dry and prepped for flooring installation, by using test methods recommended by tile manufacturer.

#### **3.3 SUB-FLOOR TREATMENT**

- .1 Remove sub-floor ridges and bumps. Fill low spots, cracks, joints, holes and other defects with sub-floor filler; trowel and float to leave smooth, flat hard surface. Prohibit traffic until filler cured and dry.
- .2 Prime or Seal concrete slab. Prepare and finish to resilient flooring manufacturer's printed instructions.

#### **3.4 SUB FLOOR FILLER AND LEVELER**

- .1 Where resilient flooring abuts other flooring of different thickness, provide cementitious underlayment allowing for smooth and level transition between finished floor surfaces.
- .2 Mix, apply and finish underlayment in accordance with latex admixture manufacturer's recommendations.

### 3.5 GENERAL

- .1 Provide adaptors, filler strips, edge guards, transition strips, & reducers to manufacturers written instructions, at all locations where floor covering changes material, or terminates. Provide cove caps at top of all integral (flash cove) floor bases.
- .2 Install resilient flooring on all floor surfaces including under all millwork and equipment.

### 3.6 APPLICATION: FLOORING

- .1 Acclimatize subfloor, all flooring material and adhesive for forty eight (48) hours prior, during and after the installation by maintaining the room temperature between 18°C / and 24°C.
- .2 Provide high ventilation rate, with maximum outside air, during installation, and for 48 hours after installation. If possible, vent directly to outside. Do not let contaminated air recirculate through district or whole building air distribution system. Maintain extra ventilation for at least one month following building occupation.
- .3 Apply adhesive uniformly using recommended trowel in accordance with flooring manufacturer's instructions. Do not spread more adhesive than can be covered by flooring before initial set takes place.
- .4 Lay flooring with seams parallel to building lines to produce minimum number of seams. Border widths minimum 1/3 width of full material.
- .5 Run sheets in direction of traffic. Double cut sheet joints and continuously seal heat weld according to manufacturer's printed instructions.
- .6 Heat weld seams of vinyl sheet flooring in accordance with manufacturer's printed instructions.
- .7 As installation progresses and after installation, roll flooring with roller to ensure full adhesion using methods and roller weight to manufacturer's written recommendations.
- .8 Install feature strips and floor markings where indicated. Fit joints tightly.
- .9 Install flooring in pan type floor access covers. Maintain floor pattern.
- .10 Unless otherwise indicated, cut flooring around fixed objects.
  - .1 Continue flooring over areas which will be under built-in furniture.
  - .2 Continue flooring through areas to receive plumbing fixtures such as but not limited to water closets without interrupting floor pattern. Caulk joint neatly with clear opaque sealant in accordance with Section 07 92 00 Joint Sealants for sealant type.
  - .3 Continue flooring through areas to receive movable type partitions without interrupting floor pattern.
  - .4 Continue flooring through areas to receive millwork without interrupting floor pattern.
- .11 Terminate flooring at centerline of door in openings where adjacent floor finish or colour is dissimilar.
- .12 Install metal edge strips at unprotected or exposed edges where flooring terminates.

### 3.7 BASE APPLICATION

- .1 Lay out base to keep number of joints at minimum. Base joints at maximum length available or at internal or premoulded corners.
- .2 Clean substrate and prime with one coat of adhesive.
- .3 Apply adhesive to back of base.
- .4 Set base against wall and floor surfaces tightly by using 6.5 lbs. hand roller.
- .5 Install straight and level to variation of 1:1000.
- .6 Scribe and fit to door frames and other obstructions. Use premoulded end pieces at flush door frames.
- .7 Cope internal corners. Use formed straight base material for external corners of other angles, minimum 12" each leg. Wrap around toeless base at external corners.

### 3.8 FIELD QUALITY CONTROL

- .1 Manufacturer's Field Services:
  - .1 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.

### 3.9 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
  - .1 Clean flooring and base surfaces to flooring manufacturer's printed instructions.
- .3 Remove excess adhesive from floor, base and wall surfaces without damage.
- .4 Clean, seal and wax floor and base surface to flooring manufacturer's instructions. In carpeted areas clean, seal and wax base surface before carpet installation.
- .5 Coordinate with Owner for the cleaning, sealing and polishing of resilient floors by Owner immediately after installation.
- .6 Provide verification to Owner's and Consultant satisfaction that floors have been installed in accordance with manufacturer's directions prior to requesting acceptance.

### 3.10 PROTECTION

- .1 Protect new floors from time of final set of adhesive after initial waxing until final inspection.
- .2 Prohibit traffic on floor for 48 hours after installation.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 REFERENCES**

- .1 ASTM International:
  - .1 ASTM C 241/C 241M-15e1, Standard Test Method for Abrasion Resistance of Stone Subject to Foot Traffic.
  - .2 ASTM D 2370-98(R2010), Standard Test Method for Tensile Properties of Organic Coatings.
- .2 Canadian General Standards Board (CGSB):
  - .1 CAN/CGSB-51.34-M86 (R1988), Vapour Barrier, Polyethylene Sheet for Use in Building Construction.
  - .2 CAN/CGSB-25.20-95, Surface Sealer for Floors.
- .3 CSA Group:
  - .1 CSA A23.1/A23.2-09 (R2014), Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.
  - .2 CSA A3000-13, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).
- .4 Health Canada/Workplace Hazardous Materials Information System (WHMIS):
  - .1 Material Safety Data Sheets (MSDS).
- .5 Terrazzo, Tile and Marble Association of Canada (TTMAC):
  - .1 Maintenance Guide.
  - .2 TTMAC/CSCTEK-AID 09 40 00, Portland Cement Terrazzo Digest.
  - .3 TTMAC 2012/2014 Specification Guide 09 30 00 Tile Installation Manual.
  - .4 TTMAC 09 66 00 Terrazzo Installation Manual.

### **1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for Portland cement terrazzo flooring and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2 Submit four (4) copies of TTMAC Maintenance Guide for inclusion in operations and maintenance manual prepared and submitted in accordance with Section 01 78 00 - Closeout Submittals. Provide specific warning of maintenance practices or materials that may damage or disfigure finished work.
  - .3 Submit WHMIS MSDS sheets for floor sealer products.
- .3 Samples:
  - .1 Submit duplicate 300 x 300 x 20 mm / 12" x 12" x 3/4" thick samples of each colour terrazzo.

### 1.3 CLOSEOUT SUBMITTALS

- .1 Provide maintenance data as set out in TTMAC publication for terrazzo work for incorporation into manual specified in Section 01 78 00 – Closeout Submittals.

### 1.4 QUALITY ASSURANCE

- .1 Qualifications:
  - .1 Installer: trained and experienced in tile work. Company must be registered as members in good standing with Terrazzo, Tile and Marble Association of Canada. If requested by, Consultant submit listing of at least three previously completed projects of similar size and scope.
- .2 Supplier: a member in good standing with Terrazzo, Tile and Marble Association of Canada, providing materials meeting the minimum standards of TTMAC.
- .3 Mock-ups: construct mock-ups in accordance with Section 01 45 00 – Quality Control.
  - .1 Provide mock-up for evaluation of surface finishes and workmanship.
  - .2 Construct mock-up 10 m<sup>2</sup> / 100 ft<sup>2</sup> of Portland cement terrazzo including one inside corner, one outside corner, change of material, and transition to existing terrazzo.
  - .3 Construct mock-up where directed.
  - .4 Allow 48 hours for inspection of mock-up by Consultant before proceeding with work.
  - .5 When accepted, mock-up will demonstrate minimum standard for this work. Mock-up may remain as part of finished work to Consultant approval.

### 1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 – Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials off ground indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect specified materials from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.

### 1.6 SITE CONDITIONS

- .1 Safety: comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of materials.
- .2 Ventilation:
  - .1 Provide continuously during and after installation. Run system 24 hours per day during installation; provide continuous ventilation for 7 days after completion of installation.
  - .2 Ventilate enclosed spaces in accordance with Section 01 51 00 - Temporary Utilities.
- .3 Temperature:
  - .1 Maintain air temperature and structural base temperature at terrazzo installation area above 12 degrees C for 24 hours prior to, during, and for 24 hours following installation.

## **PART 2 – PRODUCTS**

### **2.1 MATERIALS**

- .1 Cement:
  - .1 To CAN/CSA-A3000.
  - .2 Type 10, grey for underbed.
  - .3 White for topping.
  - .4 6 % air-entrainment.
- .2 Sand, fine and coarse aggregates:
  - .1 To CSA-A23.1/A23.2
  - .2 Clean, washed, locally available.
  - .3 Oval aggregate.
- .3 Water: potable.
- .4 Marble chips:
  - .1 Graded in accordance with TTMAC standard.
  - .2 Abrasion resistance to ASTM C 241.
  - .3 No deleterious or foreign matter.
  - .4 Colour: colour and texture to match existing.
- .5 Pigments:
  - .1 Compatible with Portland cement.
  - .2 Alkali-resistant, colour-stable.
  - .3 Lime-proof mineral.
- .6 Epoxy bonding agent: two components, epoxy resin and epoxy hardener conforming to following performance properties after cure schedule of 28 days at 25 degrees C.
  - .1 Viscosity: mixed viscosity not less than 0.04 Pa.s or more than 0.5 Pa.s.
  - .2 Gel time: not less than half hour at 20 degrees C.
  - .3 Flexibility: Gardiner flexibility test, passes bending over 12 mm mandrel, without cracking.
  - .4 Elongation: ASTM D 2370, minimum 10%.
  - .5 Bond strength: 2 MPa, with 100% concrete failure at minimum coverage, test concrete specimen minimum compressive strength 20 MPa.
  - .6 Coverage: 0.3 L/m<sup>2</sup> minimum, dry film thickness not less than 0.2 mm.
- .7 Divider Strips: "L" shape, 16 gauge thick material to match existing with depth to suit required floor thickness.
- .8 Accessories: base caps and base divider strips, separator strips, purpose made and of same material to match divider strips.
- .9 Reinforcing steel: billet steel, grade 300, plain, deformed bars.
- .10 Welded steel wire fabric: to 50 x 50 x 1.6 x 1.6 mm wire, galvanized, in flat sheets only.
- .11 Slip sheet: polyethylene sheet to CAN/CGSB-51.34, Type 2, 0.05 mm thick.

- .12 Non-slip aggregate: aluminum oxide of size and colour to match marble chips. Curing compound: to manufacturer's standard.
- .13 Cleaning compound: to TTMAC standard as recommended by manufacturer.
- .14 Sealants:
  - .1 To CAN/CGSB-25.20.
  - .2 Sealants: Refer to Section 07 92 00 – Joint Sealants.
- .15 Finishing compound: to TTMAC standard 3001.

## **2.2 MIXES**

- .1 Slurry coat: cement and water mixed to creamy paste.
- .2 Underbed: 1 part cement to 4 parts sand by volume.
- .3 Terrazzo topping: colour and texture to match existing.

## **PART 3 – EXECUTION**

### **3.1 MANUFACTURER'S INSTRUCTIONS**

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.

### **3.2 EXAMINATION**

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for Portland cement terrazzo flooring installation in accordance with manufacturer's written instructions.
  - .1 Visually inspect substrate and inform Consultant of unacceptable conditions immediately upon discovery.
  - .2 Proceed with installation only after unacceptable conditions have been.

### **3.3 INSPECTION**

- .1 Examine area to receive terrazzo for defects in existing work which may affect proper execution of terrazzo work.
- .2 Ensure tolerances of concrete slab work do not deviate from tolerance set for finished terrazzo floor.
- .3 Terrazzo contractor to start work only when all defects are corrected.

### **3.4 INSTALLATION**

- .1 Do terrazzo's work in accordance with TTMAC 09 66 00 Terrazzo Installation Manual.
- .2 Install terrazzo after concrete slabs have cured 28 days.

- .3 Install divider strips true and level to detailed pattern.
- .4 Install covers at building expansion joints.
- .5 Install control joints above control joints in subfloor.
- .6 Slope finished terrazzo floors to drains.
- .7 Produce terrazzo finished surfaces to match existing.
- .8 Floors:
  - .1 Monolithic terrazzo: provide 16 mm minimum terrazzo topping bonded to concrete base slab.
  - .2 Bonded terrazzo: to TTMAC detail No. 1.
  - .3 Floating standard terrazzo: to TTMAC detail No. 2.
  - .4 Venetian terrazzo: to TTMAC detail No. 2V.
  - .5 Epoxy bonded terrazzo: provide 16 mm maximum topping and epoxy concrete adhesive underbed bonded to concrete base slab.
- .9 Bases:
  - .1 Terrazzo bases: to match existing.

### 3.5 FIELD QUALITY CONTROL

- .1 Manufacturer's Field Services:
  - .1 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.

### 3.6 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 – Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 – Cleaning.
  - .1 Clean flooring and base surfaces to flooring manufacturer's printed instructions.
- .3 Remove excess adhesive from floor, base and wall surfaces without damage.
- .4 Clean, seal and wax floor and base surface to flooring manufacturer's instructions. In carpeted areas clean, seal and wax base surface before carpet installation.

### 3.7 CLEANING

- .1 Proceed in accordance with Section 01 74 11 – Cleaning.
- .2 Clean, seal and finish terrazzo surfaces to TTMAC recommendations.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 REFERENCES**

- .1 Canadian General Standards Board (CGSB):
  - .1 CAN/CGSB-1.186-1996, High Performance Glazed Coating System, Interior.
- .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS):
  - .1 Material Safety Data Sheets (MSDS).

### **1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Manufacturer's Instructions, Recommendations and Technical Data:
  - .1 For each type of product indicated, include manufacturer's technical data, application instructions, and recommendations.
  - .2 Indicate special handling criteria, installation sequence, cleaning procedures.
- .3 Provide product data in accordance with Section 01 33 00 - Submittal Procedures.
  - .1 Submit WHMIS MSDS - Material Safety Data Sheets in accordance with Section 01 35 29 – Health and Safety Requirements and manufacturer's instructions. WHMIS MSDS acceptable to Labour Canada and Health and Welfare Canada for high build glazed coatings. Indicate VOC content.
- .4 Provide samples in accordance with Section 01 33 00 – Submittal Procedures.
  - .1 Submit duplicate 8" x 16" samples of each colour and finish and decorative effects, coating applied to smooth hardboard.
- .5 Provide installer / applicator certification from manufacturer complete with a list of completed projects of similar size and complexity.
- .6 Closeout Submittals:
  - .1 Provide maintenance data for coatings for incorporation into manual specified in Section 01 78 00 – Closeout Submittals.

### **1.3 QUALITY ASSURANCE**

- .1 Installer Qualifications: Engage an installer / applicator that is experienced in applying resinous flooring systems similar in material, design, and extent to those indicated for this Project.
  - .1 Installer / applicator must be certified in writing by resinous flooring manufacturer as qualified to apply resinous flooring systems indicated and have completed at least 10 projects of similar size and complexity.
- .2 Source Limitations: Obtain primary resinous flooring materials, including primers, resins, hardening agents, grouting coats, and topcoats, through one source from a single manufacturer, with not less than ten years of successful experience in manufacturing and installing principal materials described in this section. Provide secondary materials, including patching and fill material, joint sealant, and repair materials, of type and from source recommended by manufacturer of primary materials.

- .3 Manufacturer Field Technical Service Representatives: Resinous flooring manufacture shall retain the services of Field Technical Service Representatives who are trained specifically on installing the system to be used on the project.
  - .1 Field Technical Services Representatives shall be employed by the system manufacture to assist in the quality assurance and quality control process of the installation and shall be available to perform field problem solving issues with the installer.
- .4 Construct mock-ups in accordance with Section 01 45 00 – Quality Control.
  - .1 Apply full-thickness coating of each finish and decorative effect to 100 sq.ft. area of surface to be treated.
  - .2 Allow 48 hours for inspection of mock-up by Consultant before proceeding with coating work.
  - .3 When accepted, mock-up will demonstrate minimum standard for this work. Mock-up may remain as part of finished work to Consultant approval.
- .5 Site Meetings: as part of Manufacturer's Services described in PART 3 - FIELD QUALITY CONTROL, schedule site visits, to review Work, at stages listed.
  - .1 After delivery and storage of products, and when preparatory Work is complete, but before installation begins.
  - .2 Twice during progress of Work at 25% and 60% complete.
  - .3 Upon completion of Work, after cleaning is carried out.

#### **1.4 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
  - .1 Deliver and store materials in manner to prevent damage and deterioration from moisture, heat, cold, direct sunlight, or other detrimental effects.
  - .2 Ensure materials remain in original wrapping and containers until used.

#### **1.5 SITE CONDITIONS**

- .1 Safety:
  - .1 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of materials.
  - .2 Ensure no open flame heating devices are used.
  - .3 Discourage occupancy of treated space until volatile materials are no longer being emitted and there is no odour.
  - .4 Provide adequate respiratory protection to exposed individuals.
- .2 Ventilation:
  - .1 Provide ventilation continuously during and after coating application. Run system 24 hours per day during application; provide continuous ventilation for 7 days after completion of application.
- .3 Environmental Limitations:
  - .1 Comply with resinous flooring manufacturer's written instructions for substrate temperature, ambient temperature, moisture, ventilation, and other conditions affecting resinous flooring application.
  - .2 Maintain material and substrate temperature between 18 and 30 degrees C during resinous flooring application and for not less than 24 hours after application.

- .4 Lighting:
  - .1 Provide permanent lighting or, if permanent lighting is not in place, simulate permanent lighting conditions during resinous flooring application.
- .5 Close spaces to traffic during resinous flooring application and for not less than 24 hours after application, unless manufacturer recommends a longer period.
- .6 Concrete substrate shall be properly cured for a minimum of 30 days. A vapor barrier must be present for concrete subfloors on or below grade. Otherwise, an osmotic pressure resistant grout must be installed prior to the resinous flooring.

## 1.6 WARRANTY

- .1 Manufacture shall furnish a single, written warranty covering both material and workmanship for a period of four (4) full years from date of installation or provide a joint and several warranty signed on a single document by material manufacturer and applicator jointly and severally warranting the materials and workmanship for a period of Four (4) full years from date of substantial completion.

## **PART 2 - PRODUCTS**

### 2.1 MATERIALS

- .1 Available Products: Subject to compliance with requirements.
- .2 Confirm inclusion of 25mil body coat, and broadcast quartz into primer increasing bond strength. Products that may be incorporated into the work include:
- .3 Acceptable resinous flooring system:
  - .1 Stonhard, Inc.; Stontec UTF®. Basis of Design.
- .4 System Characteristics:
  - .1 Colour and Pattern: Select from manufactures standard patterns as noted on drawing.
  - .2 Wearing Surface: Standard.
  - .3 Overall System Thickness: 6mm Nominal.
- .5 System Components: Manufacturer's standard components that are compatible with each other and as follows:
  - .1 Primer:
    - .1 Material Basis: Stonhard UTF Primer.
    - .2 Resin: Urethane.
    - .3 Formulation Description: (2) two component, low viscosity, urethane.
    - .4 Application Method: Squeegee and nap roller.
    - .5 Number of Coats: one (1).
    - .6 Aggregates: Broadcast quartz into wet primer coat.
- .6 Body Coat(s):
  - .1 Material Basis: Stontec UTF Undercoat.
  - .2 Resin: Polyaspartic Urethane.

- .3 Formulation Description: three (3) component polyaspartic urethane resin, aliphatic isocyanate and filler.
- .4 Application Method: Squeegee and medium nap roller.
  - .1 Thickness of Coats: 25-30 mils with standard primer coat.
  - .2 Number of Coats: One (1).
- .7 Broadcast:
  - .1 Material Basis: Stontec Flakes.
  - .2 Formulation Description: Decorative flake ( 1 /16" or 14).
  - .3 Type: Tweed (chips to be mixed in Mfg. facility).
  - .4 Finish: Broadcast to rejection.
  - .5 Number of Coats: one (1).
- .8 Topcoat:
  - .1 Material Basis: Stontec UTF Sealer.
  - .2 Resin: Urethane.
  - .3 Formulation Description: (2) two component, UV resistant, aliphatic polyaspartic urethane.
  - .4 Type: Clear.
  - .5 Finish: Gloss.
  - .6 Number of Coats: two (2).
- .9 Note: Components listed above are the basis of design intent; all bids will be compared to this standard including resin chemistry, colour, wearing surface, thickness, and installation procedures, including number of coats. Contractor shall be required to comply with all the requirements of the Specifications and all of the components required by the Specifications, whether or not such products are specifically listed above.
- .10 System Physical Properties:
  - .1 Provide resinous flooring system with the following minimum physical property requirements when tested according to test methods indicated:
    - .1 Compressive Strength: 10,000 psi after 7 days per ASTM C 579.
    - .2 Tensile Strength: 1,750 psi per ASTM C 307.
    - .3 Flexural Strength: 4,000 psi per ASTM C 580.
    - .4 Water Absorption :< 1% per ASTM C 413.
    - .5 Impact Resistance :> 160 in. lbs. per ASTM D 2794.
    - .6 Flammability: Class 1 per ASTM E-648.
    - .7 Hardness: 85 to 90, Shore D per ASTM D 2240.
- .11 Accessory Materials:
  - .1 Patching and Fill Material: Resinous product as per resinous flooring manufacturer written recommendation to suit application.
  - .2 Joint Sealant: Type recommended or produced by resinous flooring manufacturer for type of service and joint condition indicated, including but not limited to joint fill material and concrete crack treatment.
  - .3 Adaptors, Filler strips, Edge Guards, Transition Strips, Reducers and Cove Caps: thickness and width to suit floor thickness and condition,
    - .1 Acceptable manufacture: Johnsonite, or approved alternate.

## **2.2 MIXES**

- .1 Mix coatings according to manufacturer's instructions.

## **PART 3 - EXECUTION**

### **3.1 MANUFACTURER'S INSTRUCTIONS**

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.

### **3.2 EXAMINATION**

- .1 Examine conditions, substrates and work to receive work of this Section.
  - .1 Coordinate with Section 01 71 00 - Examination and Preparation.
- .2 Examine substrate surfaces to receive high-build glazed coatings.
  - .1 Visually inspect substrate prior to commencing with Work of this section, in presence of Consultant.
  - .2 Inform Consultant of unacceptable conditions immediately upon discovery.
  - .3 Proceed with installation only after unacceptable conditions have been remedied.
- .3 Verification of Conditions:
  - .1 Verify that:
    - .1 Substrate conditions which have been previously installed under other sections or contracts, are acceptable for product installation in accordance with manufacturer's instructions prior to installation resinous epoxy flooring coatings.
    - .2 Field conditions are acceptable and are ready to receive work.
  - .2 Commencing installation means acceptance of existing substrates.

### **3.3 PREPARATION**

- .1 Prepare surfaces in accordance with CAN/CGSB-1.186 and coating material manufacturer's instructions.
- .2 Substrate shall be sound, non-dusting, and free of grease, oil, dirt and other matter detrimental to adhesion and appearance of coating. Provide clean, dry, and neutral Ph. substrate for resinous flooring application.
- .3 Mechanically prepare substrates as follows:
  - .1 Mechanically prepare with the use of Diamond grinding equipment to provide surface sound concrete surfaces free of laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants incompatible with resinous flooring. Or,
  - .2 Shot-blast surfaces with an apparatus that abrades the concrete surface, contains the dispensed shot within the apparatus, and recirculates the shot by vacuum pickup.
  - .3 Comply with ASTM C 811 requirements, unless manufacturer's written instructions are more stringent.

- .4 Repair damaged and deteriorated concrete according to resinous flooring manufacturer's written recommendations.
- .5 Verify that concrete substrates are dry.
  - .1 Perform in situ probe test, ASTM F 2170. Proceed with application only after substrates do not exceed a maximum potential equilibrium relative humidity of 80 percent.
  - .2 Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with application only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. of slab in 24 hours.
  - .3 Perform additional moisture tests recommended by manufacturer. Proceed with application only after substrates pass testing.
- .6 Verify that concrete substrates have neutral Ph and that resinous flooring will adhere to them. Perform tests recommended by manufacturer. Proceed with application only after substrates pass testing.
- .7 Resinous Materials: Mix components and prepare materials according to resinous flooring manufacturer's written instructions.
- .8 Use patching and fill material to fill holes and depressions in substrates according to manufacturer's written instructions.
- .9 Treat control joints and other nonmoving substrate cracks to prevent cracks from reflecting through resinous flooring according to manufacturer's written recommendations. Allowances should be included for Stonflex MP7 joint fill material.
- .10 Mask surrounding surfaces to provide neat, clean juncture lines.
- .11 Protect adjacent surfaces and equipment from damage by overspray.

### 3.4 APPLICATION

- .1 General: Apply components of resinous flooring system according to manufacturer's written instructions to produce a uniform, monolithic wearing surface of thickness indicated.
  - .1 Coordinate application of components to provide optimum adhesion of resinous flooring system to substrate, and optimum intercoat adhesion.
  - .2 Cure resinous flooring components according to manufacturer's written instructions. Prevent contamination during application and curing processes.
  - .3 At substrate expansion and isolation joints, provide joint in resinous flooring to comply with resinous flooring manufacturer's written recommendations.
    - .1 Apply joint sealant to comply with manufacturer's written recommendations.
- .2 Mix and apply primer over properly prepared substrate with strict adherence to manufacturer's installation procedures and coverage rates
- .3 Broadcast: Immediately broadcast quartz silica aggregate into the primer using manufacturer's specially designed spray caster. Strict adherence to manufacturer's installation procedures and coverage rates is imperative.
- .4 Integral Cove Base: Apply cove base mix to wall surfaces before applying flooring. Apply according to manufacturer's written instructions and details including those for taping, mixing, priming, troweling, sanding, and top coating of cove base. Round internal and external corners. Refer to detail drawings.

- .5 Body coat: Mix base material according to manufacturer's recommended procedures. Uniformly spread mixed material over previously primed substrate using manufacturer's installation tool. Roll material with strict adherence to manufacturer's installation procedures and coverage rates.
- .6 Broadcast: Immediately broadcast decorative flakes into the body coat. Strict adherence to manufacturer's installation procedures and coverage rates is imperative.
- .7 First Sealer: Remove excess un-bonded flakes by lightly brushing and vacuuming the floor surface. Mix and apply sealer with strict adherence to manufacturer's installation procedures.
- .8 Second sealer: Lightly sand first sealer coat. Mix and apply second sealer coat with strict adherence to manufacturer's installation procedures.
- .9 Terminations:
  - .1 Chase edges to "lock" the flooring system into the concrete substrate along lines of termination.
  - .2 Penetration Treatment: Lap and seal resinous system onto the perimeter of the penetrating item by bridging over compatible elastomer at the interface to compensate for possible movement.
  - .3 Trenches: Continue flooring system into trenches to maintain monolithic protection. Treat cold joints to assure bridging of potential cracks.
  - .4 Treat floor drains by chasing the flooring system to lock in place at point of termination.
- .10 Joints and Cracks:
  - .1 Treat control joints to bridge potential cracks and to maintain monolithic protection.
  - .2 Treat cold joints and construction joints to bridge potential cracks and to maintain monolithic protection on horizontal and vertical surfaces as well as horizontal and vertical interfaces.
  - .3 Discontinue floor coating system at vertical and horizontal contraction and expansion joints by installing backer rod and compatible sealant after coating installation is completed. Provide sealant type recommended by manufacturer for traffic conditions and chemical exposures to be encountered.

### **3.5 FIELD QUALITY CONTROL**

- .1 Manufacturer's Field Services:
  - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.
  - .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, as directed in PART 1 - QUALITY ASSURANCE.

### **3.6 CLEANING, PROTECTING AND CURING**

- .1 Proceed in accordance with Section 01 74 11 - Cleaning.
  - .1 Clean surfaces to coating manufacturer's printed instructions.
- .2 Cure resinous flooring materials in compliance with manufacturer's directions, taking care to prevent contamination during stages of application and prior to completion of curing process. Close area of application for a minimum of 18 hours.

- .3 Protect resinous flooring materials from damage and wear during construction operation. Where temporary covering is required for this purpose, comply with manufacturer's recommendations for protective materials and method of application.
- .4 Remove temporary covering and clean resinous flooring just prior to final inspection. Use cleaning materials and procedures recommended by resinous flooring manufacturer.

### **3.7 SCHEDULES**

- .1 Refer to Room Finish Schedule for locations of resinous epoxy flooring system.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 REFERENCES**

- .1 American Association of Textile Chemists and Colorists (AATCC)
  - .1 AATCC Test Method 16.3-2014, Colorfastness to Light.
  - .2 AATCC Test Method 23-2010, Colorfastness to Burn Gas Fumes.
  - .3 AATCC 125-2013, Colorfastness to Perspiration and Light (Reaffirmed and Editorial Revision 2009).
  - .4 AATCC 128-2009, Wrinkle Recovery of Fabrics: Appearance Method.
  - .5 AATCC Test Method 129-2011, Colourfastness to Ozone in the Atmosphere Under High Humidities.
  - .6 AATCC Test Method 134-2011, Electrostatic Propensity of Carpets.
  - .7 AATCC Test Method 171-2010, Carpets: Cleaning of; Hot Water Extraction Method.
  - .8 AATCC Test Method 175-2013, Stain Resistance: Pile Floor Coverings.
  - .9 AATCC Test Method 189-2012, Fluorine Content of Carpet Fibers.
- .2 ASTM International
  - .1 ASTM D 297-15, Standard Test Methods for Rubber Products-Chemical Analysis.
  - .2 ASTM D 1335-12, Standard Test Method for Tuft Bind of Pile Yarn Floor Coverings.
  - .3 ASTM D 2661-14, Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) Schedule 40 Plastic Drain, Waste, and Vent Pipe and Fittings.
  - .4 ASTM D 1667-05(2011), Standard Specification for Flexible Cellular Materials-Vinyl Chloride Polymers and Copolymers (Closed-Cell Foam).
  - .5 ASTM D 3574-11, Standard Test Methods for Flexible Cellular Materials - Slab, Bonded, and Molded Urethane Foams.
  - .6 ASTM D 3936-12, Standard Test Method for Resistance to Delamination of the Secondary Backing of Pile Yarn Floor Covering.
- .3 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-4.2 No. 11.1-94(R2013), Textile Test Methods - Bursting Strength - Diaphragm Pressure Test.
  - .2 CAN/CGSB-4.2 No. 12.2-2012, Textile Test Methods - Tearing Strength - Trapezoid Method.
  - .3 CAN/CGSB-4.2 No. 22-2004, Textile Test Methods - Colourfastness to Rubbing (Crocking).
  - .4 CAN/CGSB-4.2 No.27.6-2015, Textile Test Methods - Flame Resistance - Methemine Tablet Test for Textile Floor Coverings.
  - .5 CAN/CGSB-4.2 No. 76-94/ISO 2551: 1981, IDT (R2013) Textile Test Methods - Machine-Made Textile Floor Coverings - Determination of Dimensional Changes Due to the Effects of Varied Water and Heat Conditions.
  - .6 CAN/CGSB-4.2 No.77.1-94/ISO 4919:1978(R2012), Textile Test Methods - Carpets - Determination of Tuft Withdrawal Force.
  - .7 CAN/CGSB-4.129-93(R1997), Carpets for Commercial Use.
- .4 Carpet and Rug Institute (CRI)
  - .1 CRI Carpet Installation Standard 2009.
  - .2 CRI Green Label Indoor Air Quality Testing Program.
  - .3 CRI Green Label Plus Indoor Air Quality Testing Program.

- .5 Health Canada
  - .1 C.R.C., c.923-10, Hazardous Products Act - Carpet Regulations, Part II of Schedule 1.
- .6 Health Canada / Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).
- .7 National Floor Covering Association (NFCA)
  - .1 National Floor Covering Specification Manual 2007.
- .8 Underwriters' Laboratories of Canada (ULC)
  - .1 CAN/ULC-S102-07, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
  - .2 CAN/ULC-S102.2-10, Standard Method of Test for Surface Burning Characteristics of Flooring, Floor Coverings and Miscellaneous Materials and Assemblies.

## 1.2 ADMINISTRATIVE REQUIREMENTS

- .1 Sequencing: sequence with other work in accordance with Section 01 32 16 Construction Progress Schedule - Bar Chart. Comply with manufacturer's written recommendations for sequencing construction operations.

## 1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for each carpet tile undercushion adhesive carpet protection subfloor patching compound and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Samples:
  - .1 Submit for review and acceptance of each unit.
  - .2 Submit duplicate samples of each type of carpet tile specified and duplicate tiles for each colour selected.
- .4 Certificates: submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.
- .5 Qualification Statements:
  - .1 Compliance: to CAN/ULC-S102 and CAN/ULC-S102.2.
  - .2 Testing: passes testing requirements of:
    - .1 Green Label Plus Indoor Air Quality Testing Program.
  - .3 Tuft bind: meets requirements of CAN/CGSB-4.129 when tested to CAN/CGSB-4.2 No.77.1.

#### **1.4 CLOSEOUT SUBMITTALS**

- .1 Submit in accordance with Section 01 78 00 – Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for installed products for incorporation into manual.
- .3 Warranty Documentation: submit warranty documents specified.

#### **1.5 MAINTENANCE MATERIAL SUBMITTALS**

- .1 Extra stock materials in accordance with Section 01 78 00 Closeout Submittals: deliver to Owner extra materials from same production run as products installed. Package products with protective covering and identify with descriptive labels. Comply with Section 01 78 00 - Closeout Submittals.
  - .1 Quantity: provide minimum 2% of:
    - .1 Carpet tile.
    - .2 Floor base.
    - .3 Adhesives.
  - .2 Delivery, storage and protection: comply with Owner's requirements for delivery, storage and protection of extra materials.

#### **1.6 QUALITY ASSURANCE**

- .1 Regulatory Requirements:
  - .1 Prequalification: compliance with Health Canada regulations under "Hazardous Products Act", Part II of Schedule 1, to CAN/CGSB-4.2 No. 27.6.
- .2 Qualifications:
  - .1 Manufacturer: capable of providing field service representation during construction and approving application method.
  - .2 Flooring Contractor:
    - .1 Experienced in performing work of this Section who has specialized in installation of work similar to that required for this project.
    - .2 Certified by carpet manufacturer prior to tender submission.
    - .3 Must not sub-contract labour without written approval of Consultant.
    - .4 Responsible for proper product installation, including floor testing and preparation as specified and in accordance with carpet manufacturer's written instructions.

#### **1.7 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 – Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

- .3 Storage and Handling Requirements:
  - .1 Store materials off ground, indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store materials protected from exposure to harmful weather conditions and at temperature conditions recommended by manufacturer.
  - .3 Store and protect carpet tile and adhesive in original containers or wrapping with manufacturer's seals and labels intact.
  - .4 Store carpet and adhesive at minimum temperature of 18 degrees C and relative humidity of maximum 65% for minimum of 48 hours before installation.
  - .5 Prevent damage to materials during handling and storage. Keep materials under cover and free from dampness.
  - .6 Safety: comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of hazardous materials.
  - .7 Replace defective or damaged materials with new.

## 1.8 SITE CONDITIONS

- .1 Ambient Conditions:
  - .1 Moisture: ensure substrate is within moisture limits and alkalinity limits recommended by manufacturer. Prepare moisture testing and provide report to Consultant.
  - .2 Temperature: maintain ambient temperature of not less than 18 degrees C from 48 hours before installation to at least 48 hours after completion of work.
  - .3 Relative humidity: maintain between 10% and 65% for 48 hours before, during and 48 hours after installation.
  - .4 Install carpet after space is enclosed and weatherproof, wet-work in space is completed and nominally dry, work above ceilings is complete.

## 1.9 WARRANTY

- .1 Manufacturer's warranty: submit, for Consultant's acceptance, manufacturer's standard warranty document executed by authorized company official. Manufacturer's warranty is in addition to and does not limit other rights Owner may have under Contract Documents.
- .2 Warranty period: 1 year, commencing on date of substantial performance of work.
  - .1 Warranty covers labour and repair or replacement of defective components for 1 year after date of substantial performance.

## PART 2 - PRODUCTS

### 2.1 CARPET TILE MATERIAL (CPT)

- .1 Carpet Tile:
  - .1 Performance.
    - .1 Indoor Air Quality: Green label Plus Certified # GLP0820.
    - .2 Backing: Standard type, GlacBac Tile.
  - .2 Carpet tile dimensions: 500mm x 500m.

- .3 Construction: Tufted Textured Loop.
  - .4 Soil / Stain protected
  - .5 Yarn System 100% Recycled Content Type 6. Nylon.
  - .6 Dye Method: 100% Solution Dyed.
  - .7 Total Recycled Content: 61%.
  - .8 Product Specifications:
    - .1 Pile Thickness: 0.103".
    - .2 Pile Density: 6,291 oz/yd<sup>3</sup>.
  - .9 Colours and Patterns: Garbanzo (Schmick).
  - .10 Acceptable product: 'Extra-Curricular, Cartera Collection" by Interfaceflor Canada.
- .2 Adhesive:
- .1 Pressure sensitive adhesive connectors.
    - .1 Acceptable product: Tactiles adhesive connectors by Interfaceflor Canada.

## **2.2 RUBBER BASE (RB)**

- .1 Rubber Base:
  - .1 1/8" thick, coloured rubber base, flat base at carpeted areas and coved base elsewhere, colour as later selected by Consultant from manufacturer standard colour range. Not more than four (4) colours.
    - .1 4" high at all locations, unless otherwise indicated.
  - .2 Acceptable manufacturer: Johnsonite, Tightlock or approved alternate.

## **PART 3 – EXECUTION**

### **3.1 INSTALLERS**

- .1 Use experienced and qualified technicians to carry out assembly and installation of tile carpet.

### **3.2 EXAMINATION**

- .1 Examine conditions, substrates and work to receive work of this Section, co-ordinate with Section 01 71 00 - Examination and Preparation.
- .2 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for carpet tile installation in accordance with manufacturer's written instructions.
  - .1 Inform Consultant of unacceptable conditions immediately upon discovery.
  - .2 Proceed with installation only after unacceptable conditions have been remedied.

### 3.3 PREPARATION

- .1 Subfloor Preparation:
  - .1 Inspect concrete and determine special care required to make it a suitable for carpet.
  - .2 Fill and level cracks 1/8" wide or protrusions over 1/16" with appropriate and compatible latex polymer fortified patching compound.
  - .3 Comply with manufacturer's written recommendations for maximum patch thickness.
  - .4 Prime large patch areas with compatible primer.
  - .5 Ensure concrete substrates are cured, clean and dry.
  - .6 Ensure concrete substrates are free of paint, dirt, grease, oil, curing or parting agents, and other contaminants, including sealers, that interfere with the bonding of adhesive.
  - .7 Where powdery or porous concrete surface is encountered, apply primer compatible with adhesive to provide a suitable surface for glue-down installation.
- .2 Surface Preparation: prepare surface in accordance with manufacturer's written recommendations and co-ordinate with Section 01 71 00 - Examination and Preparation.
  - .1 Prepare floor surfaces in accordance with CRI Carpet Installation Standard.
- .3 Tile Carpeting Preparation:
  - .1 Pre-condition carpeting: following manufacturer's written instructions.

### 3.4 INSTALLATION

- .1 Install carpet tiles in accordance with manufacturer's written instructions, and CRI Carpet Installation Standard and co-ordinate with Section 01 73 00 - Execution.
- .2 Co-ordinate tile carpeting work with work of other trades, for proper time and sequence to avoid construction delays.
- .3 Install carpet tile after finishing work is completed but before demountable office partitions and telephone and electrical pedestal outlets are installed.
- .4 Install carpet tile as per manufacturer's recommendation. This can include quarter-turn 90 degree format, monolithic, random, quarter turn ashlar, horizontal, and herringbone or vertical ashlar.
- .5 Snugly join carpet tiles in completed installation.
  - .1 Measure distance covered by 11 carpet tiles (10 joints) and ensures distance is in compliance with manufacturer specifications.
  - .2 Do not trap yarn between carpet tiles.
- .6 Apply thin film of pressure-sensitive adhesive according to manufacturer's recommendations.
- .7 Ensure finished installation presents smooth wearing surface free from conspicuous seams, burring and other faults.
- .8 Use material from same dye lot.
  - .1 Ensure colour, pattern and texture match within visual areas.
  - .2 Maintain constant pile direction.
- .9 Fit around architectural, mechanical, electrical and telephone outlets, and furniture fitments, around perimeter of rooms into recesses, and around projections.

- .10 Extend carpet tiles into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.
- .11 Install carpet tiles smooth and free from bubbles, puckers, and other defects.
- .12 Protect exposed carpet tile edges at transition to other flooring materials with suitable transition strips.

### **3.5 BASE APPLICATION**

- .1 Lay out base to keep number of joints at minimum. Base joints at maximum length available or at internal or premoulded corners.
- .2 Clean substrate and prime with one coat of adhesive.
- .3 Apply adhesive to back of base.
- .4 Set base against wall and floor surfaces tightly by using 3 kg/ 6.5 lbs. hand roller.
- .5 Install straight and level to variation of 1:1000.
- .6 Scribe and fit to door frames and other obstructions. Use premoulded end pieces at flush door frames.
- .7 Cope internal corners. Use premoulded corner units for right angle external corners. Use formed straight base material for external corners of other angles, minimum 300 mm each leg. Wrap around toeless base at external corners.
- .8 Install toeless type base before installation of carpet on floors.

### **3.6 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 – Cleaning.
  - .1 Leave Work area clean at end of each day.
  - .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 – Cleaning.
    - .1 Vacuum carpets clean immediately after completion of installation.

### **3.7 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Prohibit traffic on carpet for period of 24 hours minimum after installation and until adhesive is cured.
- .3 Install carpet protection to satisfaction of Consultant.
- .4 Repair damage to adjacent materials caused by tile carpeting installation.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 REFERENCES**

- .1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).
- .2 The Master Painters Institute (MPI)
  - .1 Architectural Painting Specification Manual - February 2004.
  - .2 Standard GPS-1-05, MPI Green Performance Standard for Painting and Coatings.
- .3 National Fire Code of Canada.
- .4 Society for Protective Coatings (SSPC)
  - .1 Systems and Specifications, SSPC Painting Manual 2005.

### **1.2 QUALITY ASSURANCE**

- .1 Qualifications:
  - .1 Contractor: to have a minimum of five (5) years proven satisfactory experience. When requested, provide list of last three comparable jobs including, job name and location, specifying authority, and project manager.
  - .2 Journeymen: Qualified journeypersons as defined by local jurisdiction to be engaged in painting work
  - .3 Apprentices: may be employed provided they work under direct supervision of qualified journeyperson in accordance with trade regulations.
  - .4 Conform to latest MPI requirements for exterior painting work including preparation and priming.
  - .5 Materials: in accordance with MPI Painting Specification Manual "Approved Product" listing and from a single manufacturer for each system used.
  - .6 Paint materials such as linseed oil, shellac, and turpentine to be highest quality product of an approved manufacturer listed in MPI Painting Specification Manual and to be compatible with other coating materials as required.
  - .7 Retain purchase orders, invoices and documents to prove conformance with noted MPI requirements when requested by Consultant.
  - .8 Standard of Acceptance:
    - .1 Walls: No defects visible from a distance of 3'-0" at 90 degrees to surface.
    - .2 Soffits: No defects visible from floor at 45 degrees to surface when viewed using final lighting source.
    - .3 Final coat to exhibit uniformity of colour and uniformity of sheen across full surface area.

### **1.3 PERFORMANCE REQUIREMENTS**

- .1 Environmental Performance Requirements:
  - .1 Provide paint products meeting MPI "Environmentally Friendly" E2, E3 ratings based on VOC (EPA Method 24) content levels.
  - .2 Green Performance in accordance with MPI Standard GPS-1.

#### 1.4 SCHEDULING

- .1 Submit work schedule for various stages of painting to Consultant for approval. Submit schedule minimum of 48 hours in advance of proposed operations.
- .2 Obtain written authorization from Consultant for changes in work schedule.
- .3 Schedule painting operations to prevent disruption of occupants in and about building.

#### 1.5 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2 Submit WHMIS MSDS - Material Safety Data Sheets in accordance with Section 01 35 29 – Health and Safety Requirements and manufacturer's instructions.
- .3 Upon completion, submit records of products used. List products in relation to finish system and include the following:
  - .1 Product name, type and use.
  - .2 Manufacturer's product number.
  - .3 Colour numbers.
  - .4 MPI Environmentally Friendly classification system rating.
  - .5 Manufacturer's Material Safety Data Sheets (MSDS).
- .4 Provide samples in accordance with Section 01 33 00 - Submittal Procedures.
  - .1 Submit duplicate 8" x 12" sample panels of each paint, stain, clear coating, special finish with specified paint or coating in colours, gloss/sheen and textures required to MPI Painting Specification Manual standards submitted on the following substrate materials:
    - .1 1/8" plate steel for finishes over metal surfaces.
    - .2 1/2" birch plywood for finishes over wood surfaces.
    - .3 1/2" gypsum board for finishes over gypsum board and other smooth surfaces.
    - .4 3/8" maple for finishes over wood surfaces.
  - .2 When approved, samples will become acceptable standard of quality for appropriate on-site surface with one of each sample retained on-site.
  - .3 Submit full range of available colours where colour availability is restricted.

#### 1.6 QUALITY CONTROL

- .1 Provide mock-up in accordance with Section 01 45 00 – Quality Control.
- .2 When requested by Consultant or Paint Inspection Agency, prepare and paint designated surface, area, room or item to requirements specified herein, with specified paint or coating showing selected colours, number of coats, gloss/sheen, textures and workmanship to MPI Painting Specification Manual standards for review and approval. When approved, surface, area, room and/or items shall become acceptable standard of finish quality and workmanship for similar on-site work.

## **1.7 MAINTENANCE**

- .1 Extra Materials:
  - .1 Submit maintenance materials in accordance with Section 01 78 00 – Closeout Submittals.

## **1.8 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 – Common Product Requirements, supplemented as follows:
  - .1 Deliver and store materials in original containers, sealed, with labels intact.
  - .2 Labels: to indicate:
    - .1 Manufacturer's name and address.
    - .2 Type of paint or coating.
    - .3 Compliance with applicable standard.
    - .4 Colour number in accordance with established colour schedule.
  - .3 Remove damaged, opened and rejected materials from site.
  - .4 Provide and maintain dry, temperature controlled, secure storage.
  - .5 Observe manufacturer's recommendations for storage and handling.
  - .6 Store materials and supplies away from heat generating devices.
  - .7 Store materials and equipment in well ventilated area with temperature range 7 degrees C to 30 degrees C.
  - .8 Store temperature sensitive products above minimum temperature as recommended by manufacturer.
  - .9 Keep areas used for storage, cleaning and preparation, clean and orderly to approval of Consultant. After completion of operations, return areas to clean condition to approval of Consultant.
  - .10 Remove paint materials from storage only in quantities required for same day use.
  - .11 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling storage, and disposal of hazardous materials.
  - .12 Fire Safety Requirements:
    - .1 Provide one 9 kg Type ABC dry chemical fire extinguisher adjacent to storage area.
    - .2 Store oily rags, waste products, empty containers and materials subject to spontaneous combustion in ULC approved, sealed containers and remove from site on a daily basis.
    - .3 Handle, store, use and dispose of flammable and combustible materials in accordance with the National Fire Code of Canada.

## **1.9 AMBIENT CONDITIONS**

- .1 Heating, Ventilation and Lighting:
  - .1 Ventilate enclosed spaces.
  - .2 Do not perform painting work unless adequate and continuous ventilation and sufficient heating facilities are in place to maintain ambient air and substrate temperatures above 10 degrees C for 24 hours before, during and after paint application until paint has cured sufficiently.
  - .3 Where required, provide continuous ventilation for seven days after completion of application of paint.

- .4 Provide temporary ventilating and heating equipment where permanent facilities are not available or supplemental ventilating and heating equipment if ventilation and heating from existing system is inadequate to meet minimum requirements.
- .5 Perform no painting work unless a minimum lighting level of 323 Lux is provided on surfaces to be painted. Adequate lighting facilities to be provided by General Contractor.
- .2 Temperature, Humidity and Substrate Moisture Content Levels:
  - .1 Unless specifically pre-approved by and product manufacturer, perform no painting work when:
    - .1 Ambient air and substrate temperatures are below 10 degrees C.
    - .2 Substrate temperature is over 32 degrees C unless paint is specifically formulated for application at high temperatures.
    - .3 Substrate and ambient air temperatures are expected to fall outside MPI or paint manufacturer's prescribed limits.
    - .4 Relative humidity is above 85 % or when dew point is less than 3 degrees C variance between air/surface temperature.
    - .5 Rain or snow are forecast to occur before paint has thoroughly cured or when it is foggy, misty, raining or snowing at site.
  - .2 Perform no painting work when maximum moisture content of substrate exceeds:
    - .1 12% for concrete and masonry (clay and concrete brick/block).
    - .2 15% for wood.
    - .3 12% for plaster and gypsum board.
  - .3 Conduct moisture tests using a properly calibrated electronic Moisture Meter, except test concrete floors for moisture using a simple "cover patch test".
  - .4 Test concrete, masonry and plaster surfaces for alkalinity as required.
- .3 Surface and Environmental Conditions:
  - .1 Apply paint finish in areas where dust is no longer being generated by related construction operations or when wind or ventilation conditions are such that airborne particles will not affect quality of finished surface.
  - .2 Apply paint to adequately prepared surfaces and to surfaces within moisture limits noted herein.
  - .3 Apply paint when previous coat of paint is dry or adequately cured.
  - .4 Apply paint finishes when conditions forecast for entire period of application fall within manufacturer's recommendations.
  - .5 Do not apply paint when:
    - .1 Temperature is expected to drop below 10 degrees C before paint has thoroughly cured.
    - .2 Substrate and ambient air temperatures are expected to fall outside MPI or paint manufacturer's limits.
    - .3 Surface to be painted is wet, damp or frosted.
  - .6 Provide and maintain cover when paint must be applied in damp or cold weather. Heat substrates and surrounding air to comply with temperature and humidity conditions specified by manufacturer. Protect until paint is dry or until weather conditions are suitable.
  - .7 Schedule painting operations such that surfaces exposed to direct, intense sunlight are scheduled for completion during early morning.
  - .8 Remove paint from areas which have been exposed to freezing, excess humidity, rain, snow or condensation. Prepare surface again and repaint.

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS**

- .1 Paint materials listed in latest edition of MPI Approved Products List (APL) are acceptable for use on this project.
- .2 Paint materials for paint systems: to be products of single manufacturer.
- .3 Only qualified products with E2, E3 "Environmentally Friendly" ratings are acceptable for use on this project.
- .4 Paints, coatings, adhesives, solvents, cleaners, lubricants, and other fluids, to be as follows:
  - .1 Be water-based, water soluble and water clean-up.
  - .2 Be non-flammable and biodegradable.
  - .3 Be manufactured without compounds which contribute to ozone depletion in upper atmosphere.
  - .4 Be manufactured without compounds which contribute to smog in the lower atmosphere.
  - .5 Do not contain methylene chloride, chlorinated hydrocarbons, and toxic metal pigments.
- .5 Water-borne surface coatings must be manufactured and transported in a manner that steps of processes, including disposal of waste products arising therefrom, will meet requirements of applicable governmental acts, by-laws and regulations including, for facilities located in Canada, Fisheries Act and Canadian Environmental Protection Act (CEPA).
- .6 Water-borne surface coatings must not be formulated or manufactured with aromatic solvents, formaldehyde, halogenated solvents, mercury, lead, cadmium, hexavalent chromium or their compounds.
- .7 Water-borne surface coatings and recycled water-borne surface coatings must have flash point of 61.0 degrees C or greater.
- .8 Both water-borne surface coatings and recycled water-borne surface coatings must be made by a process that does not release:
  - .1 Matter in undiluted production plant effluent generating a 'Biochemical Oxygen Demand' (BOD) in excess of 15 mg/L to a natural watercourse or a sewage treatment facility lacking secondary treatment.
  - .2 Total Suspended Solids (TSS) in undiluted production plant effluent in excess of 15 mg/L to a natural watercourse or a sewage treatment facility lacking secondary treatment.
- .9 Water-borne paints and stains, recycled water-borne surface coatings and water borne varnishes must meet a minimum "Environmentally Friendly" E2 rating.
- .10 Recycled water-borne surface coatings must contain 50 % post-consumer material by volume.
- .11 Recycled water-borne surface coatings must not contain:
  - .1 Lead in excess of 600.0 ppm weight/weight total solids.
  - .2 Mercury in excess of 50.0ppm weight/weight total product.
  - .3 Cadmium in excess of 1.0ppm weight/weight total product.
  - .4 Hexavalent chromium in excess of 3.0 ppm weight/weight total product.
  - .5 Organochlorines or polychlorinated biphenyls (PCBS) in excess of 1.0 ppm weight/weight total product.

- .12 The following must be performed on each batch of consolidated post-consumer material before surface coating is reformulated and canned. These tests must be performed at a laboratory or facility which has been accredited by the Standards Council of Canada.
  - .1 Lead, cadmium and chromium are to be determined using ICP-AES (Inductively Coupled Plasma - Atomic Emission Spectroscopy) technique no. 6010 as defined in EPA SW-846.
  - .2 Mercury is to be determined by Cold Vapour Atomic Absorption Spectroscopy using Technique no. 7471 as defined in EPA SW-846.
  - .3 Organochlorines and PCBs are to be determined by Gas Chromatography using Technique no. 8081 as defined in EPA SW-846.

## **2.2 COLOURS**

- .1 Consultant will provide Colour Schedule after Contract award.
- .2 Colour schedule will be based upon selection of five (5) base colours. No more than five (5) colours will be selected for entire project and no more than three colours will be selected in each area.
- .3 Selection of colours will be from manufacturer's full range of colours.
- .4 Entrance canopy columns shall match RGB, R-225, G-100, B-30. Submit samples to Consultant for approval.
- .5 Second coat in three coat system to be tinted slightly lighter colour than top coat to show visible difference between coats.

## **2.3 MIXING AND TINTING**

- .1 Perform colour tinting operations prior to delivery of paint to site. On-site tinting of painting materials is allowed only with Consultant's written permission.
- .2 Mix paste, powder or catalyzed paint mixes in accordance with manufacturer's written instructions.
- .3 Add thinner to paint manufacturer's recommendations. Do not use kerosene or organic solvents to thin water-based paints.
- .4 Thin paint for spraying according in accordance with paint manufacturer's instructions. If directions are not on container, obtain instructions in writing from manufacturer and provide copy of instructions to Consultant.
- .5 Re-mix paint in containers prior to and during application to ensure break-up of lumps, complete dispersion of settled pigment, and colour and gloss uniformity.

## 2.4 GLOSS/SHEEN RATINGS

- .1 Paint gloss: defined as sheen rating of applied paint, in accordance with following values:

<u>Gloss Level-Category</u>	<u>Gloss @ 60 degrees</u>	<u>Sheen @ 85 degrees</u>
Gloss Level 1 – (Matte Finish)	Max. 5	Max. 10
Gloss Level 2 – (Velvet)	Max. 10	10 to 35
Gloss Level 3 – (Eggshell)	10 to 25	10 to 35
Gloss Level 4 – (Satin)	20 to 35	min. 35
Gloss Level 5 – (Semi-Gloss)	35 to 70	
Gloss Level 6 – (Traditional Gloss)	70 to 85	
Gloss Level 7 – (High Gloss)	More than 85	

- .2 Gloss level ratings of painted surfaces as specified and as noted on Finish Schedule.

## 2.5 EXTERIOR PAINTING SYSTEMS

- .1 Asphalt Surfaces: zone/traffic marking for drive and parking areas, etc.  
.1 EXT 2.1A - Latex zone/traffic marking finish.
- .2 Structural Steel and Metal Fabrications:  
.1 EXT 5.1G – Pigmented polyurethane finish lower epoxy zinc rich primer and high build epoxy.
- .3 Galvanized Metal: not chromate passivated  
.1 EXT 5.3B - Alkyd gloss level 6 finish.
- .4 Bituminous Coated Surfaces: cast iron pipe, concrete, etc.:  
.1 EXT 10.2A - Latex gloss level 6 finish.

## PART 3 - EXECUTION

### 3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.
- .2 Apply paint materials in accordance with paint manufacturer's written application instructions.

### 3.2 EXAMINATION

- .1 Exterior painting work: Notify Consultant in writing minimum of one (1) week prior to beginning work.
- .2 Exterior surfaces requiring painting: Prior to commencing with exterior painting Work, examine surfaces to be painted for defects and acceptance. Notify Consultant in writing of defects or problems, prior to commencing painting work, or after surface preparation if unseen substrate damage is discovered.
- .3 Commence with exterior painting Work only after preparation, repair or replacement of such unforeseen or noted defects are corrected.

### 3.3 PREPARATION

- .1 Perform preparation and operations for exterior painting in accordance with manufacturer's written instructions and MPI Maintenance Painting Manual except where specified otherwise.
- .2 Apply paint materials in accordance with paint manufacturer's written application instructions.
- .3 Clean and prepare exterior surfaces to be painted in accordance with manufacturer's written instructions and MPI Maintenance Repainting Manual requirements. Refer to the MPI Manual in regard to specific requirements and as follows:
  - .1 Remove dust, dirt, and surface debris by vacuuming, wiping with dry, clean cloths or compressed air.
  - .2 Wash surfaces with a biodegradable detergent and bleach where applicable and clean warm water using a stiff bristle brush to remove dirt, oil and other surface contaminants.
  - .3 Rinse scrubbed surfaces with clean water until foreign matter is flushed from surface.
  - .4 Allow surfaces to drain completely and allow to dry thoroughly. Allow sufficient drying time and test surfaces using electronic moisture meter before commencing work.
  - .5 Use water-based cleaners in place of organic solvents where surfaces will be repainted using water based paints.
  - .6 Many water-based paints cannot be removed with water once dried. Minimize use of kerosene or such organic solvents to clean up water-based paints.
- .4 Clean metal surfaces to be painted by removing rust, dirt, oil, grease and foreign substances in accordance with manufacturer's written instructions and MPI requirements. Remove such contaminants from surfaces, pockets and corners to be painted by brushing with clean brushes, blowing with clean dry compressed air, or brushing/vacuum cleaning as required.
- .5 Prevent contamination of cleaned surfaces by salts, acids, alkalis, other corrosive chemicals, grease, oil and solvents before priming and between applications of remaining coats. Touch-up, spot prime, and apply primer, paint, or pretreatment as soon as possible after cleaning before deterioration occurs.
- .6 Do not apply paint until prepared surfaces have been reviewed by Consultant.
- .7 Sand and dust between coats as required to provide adequate adhesion for next coat and to remove defects visible from a distance up to 1'-0".

### 3.4 EXISTING CONDITIONS

- .1 Investigate existing substrates for problems related to proper and complete preparation of surfaces to be painted. Report to Consultant damages, defects, unsatisfactory or unfavourable conditions before proceeding with work.
- .2 Conduct moisture testing of surfaces to be painted using a properly calibrated electronic moisture meter, except test concrete floors for moisture using a simple "cover patch test" and report findings to Consultant. Do not proceed with work until conditions fall within acceptable range as recommended by manufacturer.
- .3 Maximum moisture content as follows:
  - .1 Stucco: 12%.
  - .2 Concrete: 12%.
  - .3 Clay and Concrete Block/Brick: 12%.
  - .4 Wood: 15%.

### 3.5 PROTECTION

- .1 Protect existing building surfaces and adjacent structures from paint spatters, markings and other damage by suitable non-staining covers or masking. If damaged, clean and restore such surfaces as directed by Consultant.
- .2 Protect items that are permanently attached such as Fire Labels on doors and frames.
- .3 Protect factory finished products and equipment.
- .4 Protect passing pedestrians, building occupants and general public in and about building.
- .5 Remove light fixtures, surface hardware on doors, and other surface mounted equipment, fittings and fastenings prior to undertaking painting operations. Store items and re-install after painting is completed.
- .6 Move and cover exterior furniture and portable equipment as necessary to carry out painting operations. Replace as painting operations progress.
- .7 As painting operations progress, place "WET PAINT" signs in pedestrian and vehicle traffic areas to approval of Consultant.

### 3.6 APPLICATION

- .1 General:
  - .1 Finish all exposed to view unfinished materials and all previously painted surfaces.
  - .2 Finish paint all primed surfaces.
  - .3 Finish surfaces both above and below sight lines as specified for surrounding surfaces, including such surfaces as projecting ledges.
  - .4 Finish top, bottom, edges and cutouts of doors after fitting as specified for door surfaces.
  - .5 Do not paint baked enamel, chrome plated, stainless steel, aluminum or other surfaces finished with final finish in factory.
  - .6 Provide finish uniform in sheen, colour and texture, free from streaks, shiners and brush or roller marks or other defects.
  - .7 Paint entire plane of areas exhibiting incomplete or unsatisfactory coverage and of areas, which have been cut and patched. Patch paint will not be accepted.
  - .8 Advise Consultant when each applied paint coat may be inspected. Do not recoat until directed by Consultant in writing. Tint each coat slightly to differentiate between applied coats.
  - .9 Sand smooth enamel and varnish undercoats prior to recoating.
  - .10 Apply primer coat soon after surface preparation is completed to prevent contamination of substrate.
  - .11 Apply materials in accordance with manufacturer's directions and specifications. Do not use adulterants. Any reduction of coating's viscosity to only be permitted in accordance with manufacturer's directions.
  - .12 Finishes and number of coats specified hereinafter in Exterior Finishes Schedule are intended as minimum requirements guide only. Refer to manufacturer's recommendations for exact instructions for thickness of coating to obtain optimum coverage and appearance. Some materials and colours may require additional coats and deeper colours may require use of manufacturers' special tinted primers. Unless otherwise specified, provide 3 coats of finish minimum.

- .13 Obtain colour chart giving colour schemes and gloss value for various areas as directed by Consultant. Colour chart shall give final selection of colours and surface textures of all finishes, and whether finishes are transparent (natural) or opaque (paint).
  - .14 Use dipping, sheepskins or daubers when no other method is practical in places of difficult access and when specifically authorized by Consultant.
  - .15 Apply coats of paint as continuous film of uniform thickness. Repaint thin spots or bare areas before next coat of paint is applied.
  - .16 Allow surfaces to dry and properly cure after cleaning and between subsequent coats for minimum time period as recommended by manufacturer.
  - .17 Sand and dust between coats to remove visible defects.
- .2 Apply paint by brush, roller, air sprayer, airless sprayer. Method of application to be as approved by Consultant. Conform to manufacturer's application instructions unless specified otherwise.
- .1 Brush and Roller Application:
    - .1 Apply paint in a uniform layer using brush and/or roller of types suitable for application.
    - .2 Work paint into cracks, crevices and corners.
    - .3 Paint surfaces and corners not accessible to brush using spray, daubers and/or sheepskins. Paint surfaces and corners not accessible to roller using brush, daubers or sheepskins.
    - .4 Brush and/or roll out runs and sags, and over-lap marks. Rolled surfaces shall be free of roller tracking and heavy stipple unless approved by Consultant.
    - .5 Remove runs, sags and brush marks from finished work and repaint.
  - .2 Spray Application:
    - .1 Provide and maintain equipment that is suitable for intended purpose, capable of properly atomizing paint to be applied, and equipped with suitable pressure regulators and gauges.
    - .2 Keep paint ingredients properly mixed in containers during paint application either by continuous mechanical agitation or by intermittent agitation as frequently as necessary.
    - .3 Apply paint in a uniform layer, with overlapping at edges of spray pattern.
    - .4 Brush out immediately runs and sags.
    - .5 Use brushes to work paint into cracks, crevices and places which are not adequately painted by spray.
    - .6 Spray paint all doors and frames scheduled to be painted. Final coat may be brushed or rolled to accommodate finished adjacent surfaces.
    - .7 Spray paint overhead doors.

### **3.7 MECHANICAL / ELECTRICAL EQUIPMENT**

- .1 Unless otherwise specified, paint exterior exposed conduits, piping, hangers, duct work and other mechanical and electrical equipment with colour and finish to match adjacent surfaces, except as noted otherwise.
- .2 Touch up scratches and marks on factory painted finishes and equipment with paint as supplied by manufacturer of equipment.
- .3 Do not paint over nameplates.
- .4 Paint fire protection piping red.
- .5 Paint steel electrical light standards. Do not paint outdoor transformers and substation equipment.

### **3.8 FIELD QUALITY CONTROL**

- .1 Inspection:
  - .1 Field inspection of exterior painting operations to be carried out by Consultant.
  - .2 Advise Consultant when each surface and applied coating is ready for inspection. Do not proceed with subsequent coats until previous coat has been approved.
  - .3 Co-operate with inspection firm and provide access to areas of work.
- .2 Manufacturer's Field Services:
  - .1 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.
  - .2 Schedule site visits, to review Work and obtain written reports from manufacturer verifying compliance of Work at 25%, 65% and at completion of the Work, in handling, applying, finishing, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 – MANUFACTURE'S FIELD SERVICES.

### **3.9 CLEANING**

- .1 Proceed in accordance with Section 01 74 11 – Cleaning.
  - .1 Remove paint where spilled, splashed, splattered or sprayed as work progresses using means and materials that are not detrimental to affected surfaces.

### **3.10 RESTORATION**

- .1 Clean and re-install hardware items removed before undertaken painting operations.
- .2 Remove protective coverings and warning signs as soon as practical after operations cease.
- .3 Remove paint splashings on exposed surfaces that were not painted. Remove smears and spatter immediately as operations progress, using compatible solvent.
- .4 Protect freshly completed surfaces from paint droppings and dust to approval of Consultant. Avoid scuffing newly applied paint.
- .5 Restore areas used for storage, cleaning, mixing and handling of paint to clean condition as approved by Consultant.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 SUMMARY**

- .1 Section Includes:
  - .1 Material and installation of site applied paint finishes to new interior surfaces, including site painting of shop primed surfaces.
- .2 The Painting Contractor will produce a 'Properly painted surface.' A properly painted surface is defined as uniform in appearance, colour, texture, hiding and sheen. It is also free of foreign material, lumps, skins, runs, sags, holidays, misses, or insufficient coverage. It is also a surface free of loose, chipped, broken or bubbled paint, as well as drips, pin holes, spatters, spills or overspray whether or not caused by the Painting Contractor's workforce.
- .3 Preparation finish levels:
  - .1 Level 1 - Basic:
    - .1 This surface preparation level requires basic cleanliness of surfaces to ensure the adhesion of new finishes to the surfaces to which they are applied with less concern for the adhesion of existing paint coats and quality of appearance of the finished surfaces. Preparation shall include the removal of surface dust, dirt, obvious loose paint and other surface contaminants by washing, light power washing or pressure washing, hand cleaning, including the use of a duster brush or broom, and mildew treatment. This level of preparation should ensure that subsequently applied coats of paint will adhere to existing paint coats.
  - .2 Level 2 - Standard:
    - .1 This surface preparation level requires basic cleanliness of surface to ensure the adhesion of new finishes to the surfaces to which they are applied as well as the examination of existing coatings to assess their adhesion. With this level of surface preparation, good adhesion and longevity of finish is of primary concern and appearance is of secondary concern. This level of surface preparation includes that described in Level 1 plus other procedures necessary to create a sound surface for repainting including solvent cleaning, basic patching/filling, caulking, light sanding/abrading, and "feather edge" sanding.
  - .3 Level 3 - Superior:
    - .1 The level 3, superior, surface preparation level incorporates the requirements of Levels 1 and 2 with added emphasis on the quality of appearance of finish painted surfaces. This level of surface preparation includes filling, patching, taping cracks in drywall, and properly dealing with "nail pops," approximate matches to existing textures, and thorough sanding to minimize existing runs, sags, brush/roller marks, and the surface profile of cracked and peeling areas, and other existing surface defects. Under this level of preparation the general surface profile is retained but defects causing abrupt surface profile differences exceeding 1/16 inch or 62.5 mils will be corrected.
  - .4 Level 4: Supreme:
    - .1 The Level 4, supreme, surface preparation level incorporates the requirements of Levels 1, 2 and 3 with even more emphasis on the quality of appearance of finish painted surfaces. Under this level of surface preparation, all necessary preparation techniques will be employed to improve the quality of appearance except Restoration/Resurfacing. Thorough filling and sanding will be accomplished to eliminate defects causing abrupt surface profile differences exceeding 1/32 inch or 31 mils.

.5 Level 5 - Restoration/Resurfacing:

- .1 This degree of surface preparation is required when existing conditions indicate that the surfaces are severely deteriorated or there is substrate damage. Existing coatings may be completely or nearly completely removed. Abrasion, chemical removers or applied heat may be employed in order to remove a failed coating and/or to expose a failing substrate. Substrates may have to be completely replaced, repaired or resurfaced.

## 1.2 REFERENCES

- .1 Department of Justice Canada (Jus)
  - .1 Canadian Environmental Protection Act (CEPA), 1999, c. 33
- .2 Environmental Protection Agency (EPA)
  - .1 EPA Test Method for Measuring Total Volatile Organic Compound Content of Consumer Products, Method 24 - 1995, (for Surface Coatings).
- .3 Health Canada / Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).
- .4 Master Painters Institute (MPI)
  - .1 MPI Architectural Painting Specifications Manual, 2004.
- .5 National Fire Code of Canada - 1995
- .6 Society for Protective Coatings (SSPC)
  - .1 SSPC Painting Manual, Volume Two, 8th Edition, Systems and Specifications Manual.
- .7 Transport Canada (TC)
  - .1 Transportation of Dangerous Goods Act (TDGA), 1992, c. 34.

## 1.3 QUALITY ASSURANCE

- .1 Qualifications:
  - .1 Contractor: minimum of five (5) years proven satisfactory experience. Provide list of last three comparable jobs including, job name and location, specifying authority, and project manager.
  - .2 Journeymen: qualified journeymen who have "Tradesman Qualification Certificate of Proficiency" engaged in painting work.
  - .3 Apprentices: working under direct supervision of qualified trades person in accordance with trade regulations.
  - .4 Paint materials such as linseed oil, shellac, and turpentine to be highest quality product of an approved manufacturer and to be compatible with other coating materials as required.
  - .5 Retain purchase orders, invoices and documents to prove conformance when requested by Consultant.
- .2 Mock-Ups:
  - .1 Construct mock-ups in accordance with Section 01 45 00 – Quality Control.
    - .1 Provide full-sized mock-up in areas designated by Consultant Prepare and paint designated surface, area, room or item (in each colour scheme) to specified requirements, with specified paint or coating showing selected colours, gloss/sheen, textures. The sample is to include surface preparation, and the application of the primer, intermediate, finish coat and touch-up materials.

- .2 Mock-up area shall leave exposed a sampling of the approved substrate before and after any specified surface preparation for the system mock-up. In addition, there should be left a separate and individual sampling of each designated and subsequently applied coating and any intercoat surface preparation.
  - .3 Mock-up will be used:
    - .1 To judge workmanship, substrate preparation, operation of equipment and material application and workmanship to MPI Architectural Painting Specification Manual standards.
  - .4 Locate where directed.
  - .5 Allow 48 hours for inspection of mock-up before proceeding with work.
  - .6 Standard of Acceptance: mock-up and subsequent paint standards shall be examined without magnification at a distance of thirty-nine (39) inches or one (1) meter, under finished lighting conditions and from a normal viewing position.
  - .7 When accepted, mock-up will demonstrate minimum standard of quality required for this work. Approved mock-up may remain as part of finished work to Consultant approval Remove mock-up and dispose of materials when no longer required and when directed by Consultant.
- .3 Health and Safety:
- .1 Do construction occupational health and safety in accordance with Section 01 35 29 – Health and Safety Requirements.

#### **1.4 MANUFACTURER'S FIELD SERVICES**

- .1 Arrange for initial job start-up site attendance, periodic site attendance of paint manufacturer's technical representative during installation work, together with written report.
- .2 The Contractor must at all times enable and facilitate access to the work site by said representative.
- .3 Notify Consultant of date and time of inspection, a minimum of 48 hours prior to inspection. Provide one copy of manufacturer's report to the Consultant within 48 hours of inspection being carried out.

#### **1.5 SCHEDULING**

- .1 Submit work schedule for various stages of painting to Consultant for review. Submit schedule minimum of 48 hours in advance of proposed operations.
- .2 Obtain written authorization from Consultant for changes in work schedule.

#### **1.6 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submittals in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product Data:
  - .1 Submit product data and instructions for each paint and coating product to be used.
  - .2 Submit product data for the use and application of paint thinner.
  - .3 Submit two (2) copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 – Submittal Procedures. Indicate VOCs during application and curing.

- .3 Samples:
  - .1 Submit full range colour sample chips to indicate where colour availability is restricted.
  - .2 Submit duplicate 8" x 12" sample panels of each paint, stain, clear coating, special finish with specified paint or coating in colours, gloss/sheen and textures required to MPI Architectural Painting Specification Manual standards submitted on following substrate materials:
    - .1 1/8" plate steel for finishes over metal surfaces.
    - .2 1/2" birch plywood for finishes over wood surfaces.
    - .3 1/2" concrete block for finishes over concrete or concrete masonry surfaces.
    - .4 1/2" gypsum board for finishes over gypsum board and other smooth surfaces.
    - .5 3/8" maple for finishes over wood surfaces.
  - .3 Retain reviewed samples on-site to demonstrate acceptable standard of quality for appropriate on-site surface.
  - .4 Test reports: submit certified test reports for paint from approved independent testing laboratories, indicating compliance with specifications for specified performance characteristics and physical properties.
    - .1 Lead, cadmium and chromium: presence of and amounts.
    - .2 Mercury: presence of and amounts.
    - .3 Organochlorines and PCBs: presence of and amounts.
  - .5 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
  - .6 Manufacturer's Instructions:
    - .1 Submit manufacturer's installation and application instructions.
  - .7 Closeout Submittals: submit maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals as well as separately submitted package to the University Manager of Architectural Services which includes following:
    - .1 Product name, type and use.
    - .2 Manufacturer's product number.
    - .3 Colour numbers and name.
    - .4 Sheen
    - .5 Point of purchase
    - .6 Floor plan showing placement of all colours.
    - .7 MPI Environmentally Friendly classification system rating.

## **1.7 DELIVERY, STORAGE AND HANDLING**

- .1 Packing, Shipping, Handling and Unloading:
  - .1 Pack, ship, handle and unload materials in accordance with Section 01 61 00 - Common Product Requirements and manufacturer's written instructions.
- .2 Acceptance at Site:
  - .1 Identify products and materials with labels indicating:
    - .1 Manufacturer's name and address.
    - .2 Type of paint or coating.
    - .3 Compliance with applicable standard.
    - .4 Colour number in accordance with established colour schedule.

- .3 Remove damaged, opened and rejected materials from site.
- .4 Storage and Protection:
  - .1 Provide and maintain dry, temperature controlled, secure storage.
  - .2 Store materials and supplies away from heat generating devices.
  - .3 Store materials and equipment in well ventilated area with temperature range 7 degrees C to 30 degrees C.
- .5 Store temperature sensitive products above minimum temperature as recommended by manufacturer.
- .6 Keep areas used for storage, cleaning and preparation clean and orderly. After completion of operations, return areas to clean condition.
- .7 Remove paint materials from storage only in quantities required for same day use.
- .8 Fire Safety Requirements:
  - .1 Provide one 9 kg / 20 lbs. Type ABC dry chemical fire extinguisher adjacent to storage area.
  - .2 Store oily rags, waste products, empty containers and materials subject to spontaneous combustion in ULC approved, sealed containers and remove from site on a daily basis.
  - .3 Handle, store, use and dispose of flammable and combustible materials in accordance with National Fire Code of Canada requirements.

## 1.8 SITE CONDITIONS

- .1 Heating, Ventilation and Lighting:
  - .1 Ventilate enclosed spaces.
  - .2 Provide heating facilities to maintain ambient air and substrate temperatures above 10 degrees C for 24 hours before, during and after paint application until paint has cured sufficiently.
  - .3 Provide continuous ventilation for seven days after completion of application of paint.
  - .4 Provide temporary ventilating and heating equipment where permanent facilities are not available or supplemental ventilating and heating equipment if ventilation and heating from existing system is inadequate to meet minimum requirements.
  - .5 Provide minimum lighting level of 323 Lux on surfaces to be painted.
- .2 Temperature, Humidity and Substrate Moisture Content Levels:
  - .1 Unless pre-approved written approval by Consultant and product manufacturer, perform no painting when:
    - .1 Ambient air and substrate temperatures are below 10 degrees C.
    - .2 Substrate temperature is above 32 degrees C unless paint is specifically formulated for application at high temperatures.
    - .3 Substrate and ambient air temperatures are not expected to fall within MPI or paint manufacturer's prescribed limits.
    - .4 The relative humidity is under 85% or when the dew point is more than 3 degrees C variance between the air/surface temperature. Paint should not be applied if the dew point is less than 3 degrees C below the ambient or surface temperature. Use sling psychrometer to establish the relative humidity before beginning paint work.
    - .5 Rain or snow are forecast to occur before paint has thoroughly cured or when it is foggy, misty, raining or snowing at site.
    - .6 Ensure that conditions are within specified limits during drying or curing process, until newly applied coating can itself withstand 'normal' adverse environmental factors.

- .2 Perform painting work when maximum moisture content of the substrate is below:
  - .1 Allow new concrete and masonry to cure minimum of 28 days.
  - .2 15% for wood.
  - .3 12% for plaster and gypsum board.
- .3 Test for moisture using calibrated electronic Moisture Meter. Test concrete floors for moisture using "cover patch test".
- .4 Test concrete, masonry and plaster surfaces for alkalinity as required.
- .3 Surface and Environmental Conditions:
  - .1 Apply paint finish in areas where dust is no longer being generated by related construction operations or when wind or ventilation conditions are such that airborne particles will not affect quality of finished surface.
  - .2 Apply paint to adequately prepared surfaces and to surfaces within moisture limits.
  - .3 Apply paint when previous coat of paint is dry or adequately cured.
- .4 Additional interior application requirements:
  - .1 Apply paint finishes when temperature at location of installation can be satisfactorily maintained within manufacturer's recommendations.

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS**

- .1 Paint materials listed in the MPI Approved Products List (APL) are acceptable for use on this project.
- .2 Acceptable manufacturers:
  - .1 Sherwin Williams
  - .2 ICI
  - .3 Benjamin Moore
  - .4 General Point
- .3 Provide paint materials for paint systems from single manufacturer.
- .4 Conform to latest MPI requirements for interior painting work including preparation and priming.
- .5 Materials (primers, paints, coatings, varnishes, stains, lacquers, fillers, thinners, solvents, etc.) in accordance with MPI Architectural Painting Specification Manual "Approved Product" listing.
- .6 Linseed oil, shellac, and turpentine: highest quality product from approved manufacturer listed in MPI Architectural Painting Specification Manual, compatible with other coating materials as required.
- .7 Provide paint products meeting MPI "Environmentally Friendly" E2 or E3 ratings based on VOC (EPA Method 24) content levels.
- .8 Paints, coatings, adhesives, solvents, cleaners, lubricants, and other fluids:
  - .1 Water-based Water soluble Water clean-up.
  - .2 non-flammable biodegradable.
  - .3 Manufactured without compounds which contribute to ozone depletion in the upper atmosphere.
  - .4 Manufactured without compounds which contribute to smog in the lower atmosphere.
  - .5 Do not contain methylene chloride, chlorinated hydrocarbons, toxic metal pigments.

- .9 Formulate and manufacture water-borne surface coatings with no aromatic solvents, formaldehyde, halogenated solvents, mercury, lead, cadmium, hexavalent chromium or their compounds.
- .10 Flash point: 61.0 degrees C or greater for water-borne surface coatings and recycled water-borne surface coatings.
- .11 Ensure manufacture and process of both water-borne surface coatings and recycled water-borne surface coatings does not release:
  - .1 Matter in undiluted production plant effluent generating 'Biochemical Oxygen Demand' (BOD) in excess of 15 mg/L to natural watercourse or sewage treatment facility lacking secondary treatment.
  - .2 Total Suspended Solids (TSS) in undiluted production plant effluent in excess of 15 mg/L to natural watercourse or a sewage treatment facility lacking secondary treatment.
- .12 Water-borne paints and stains, recycled water-borne surface coatings and water borne varnishes to meet minimum "Environmentally Friendly" E2 rating.
- .13 Recycled water-borne surface coatings to contain 50 % post-consumer material by volume.
- .14 Recycled water-borne surface coatings must not contain:
  - .1 Lead in excess of 600.0 ppm weight/weight total solids.
  - .2 Mercury in excess of 50.0ppm weight/weight total product.
  - .3 Cadmium in excess of 1.0ppm weight/weight total product.
  - .4 Hexavalent chromium in excess of 3.0 ppm weight/weight total product.
  - .5 Organochlorines or polychlorinated biphenyls (PCBS) in excess of 1.0 ppm weight/weight total product.

## **2.2 COLOURS**

- .1 Consultant will provide Colour Schedule after Contract award.
- .2 Colour schedule will be based upon selection of six (6) base colours and four (4) accent colours. Not more than ten (10) colours will be selected for entire project and not more than four colours will be selected in each area.
- .3 Selection of colours from manufacturers full range of colours.
- .4 Where specific products are available in restricted range of colours, selection based on limited range.
- .5 Second coat in three coat system to be tinted slightly lighter colour than top coat to show visible difference between coats.

## **2.3 MIXING AND TINTING**

- .1 Perform colour tinting operations prior to delivery of paint to site. Obtain written approval from Consultant for tinting of painting materials.
- .2 Mix paste, powder or catalyzed paint mixes in accordance with manufacturer's written instructions.
- .3 Use and add thinner in accordance with paint manufacturer's recommendations. Do not use kerosene or similar organic solvents to thin water-based paints.
- .4 Thin paint for spraying in accordance with paint manufacturer's instructions. . If directions are not on container, obtain instructions in writing from manufacturer and provide copy of instructions to Consultant.

- .5 Re-mix paint in containers prior to and during application to ensure break-up of lumps, complete dispersion of settled pigment, and colour and gloss uniformity.

## 2.4 GLOSS/SHEEN RATINGS

- .1 Paint gloss is defined as sheen rating of applied paint, in accordance with following values:

Gloss Level-Category	Gloss @ 60 degrees	Sheen @ 85 degrees
Gloss Level 1 – (Matte Finish)	Max. 5	Max. 10
Gloss Level 2 – (Velvet)	Max. 10	10 to 35
Gloss Level 3 – (Eggshell)	10 to 25	10 to 35
Gloss Level 4 – (Satin)	20 to 35	min. 35
Gloss Level 5 – (Semi-Gloss)	35 to 70	
Gloss Level 6 – (Traditional Gloss)	70 to 85	
Gloss Level 7 – (High Gloss)	More than 85	

- .2 Gloss level ratings of painted surfaces as indicated and as noted on Finish Schedule.

## 2.5 INTERIOR PAINTING SYSTEMS

- .1 Concrete horizontal surfaces: Floors and stairs:
  - .1 INT 3.2C - Epoxy finish.
  - .2 INT 3.2F - Concrete floor sealer.
  - .3 INT 3.2G - Waterborne concrete floor sealer.
- .2 Masonry units: smooth and split face block and brick:
  - .1 INT 4.2G Epoxy (tile-like) finish for wet environments.
- .3 Structural steel and metal fabrications: columns, beams, joists:
  - .1 INT 5.1R - High performance architectural latex gloss level 5 finish.
- .4 Galvanized metal: doors, frames, railings, misc. steel, pipes, overhead decking, and ducts.
  - .1 INT 5.3M - High performance architectural latex gloss level 5 finish.
  - .2 (over self-priming epoxy) gloss level 6 finish.
  - .3
- .5 Plaster and gypsum board: gypsum wallboard, drywall, "sheet rock type material", and textured finishes:
  - .1 INT 9.2M - Institutional low odour/low VOC gloss level 3 finish.

## 2.6 SOURCE QUALITY CONTROL

- .1 Perform following tests on each batch of consolidated post-consumer material before surface coating is reformulated and canned. Testing by laboratory or facility which has been accredited by Standards Council of Canada.
  - .1 Lead, cadmium and chromium are to be determined using ICP-AES (Inductively Coupled Plasma - Atomic Emission Spectroscopy) technique no. 6010 as defined in EPA SW-846.
  - .2 Mercury is to be determined by Cold Vapour Atomic Absorption Spectroscopy using Technique no. 7471 as defined in EPA SW-846.
  - .3 Organochlorines and PCBs are to be determined by Gas Chromatography using Technique no. 8081 as defined in EPA SW-846.

### **PART 3 - EXECUTION**

#### **3.1 MANUFACTURER'S INSTRUCTIONS**

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and data sheet.
- .2 Apply paint materials in accordance with paint manufacturer's written application instructions.

#### **3.2 GENERAL**

- .1 Perform preparation and operations for interior painting in accordance with MPI Architectural Painting Specifications Manual except where specified otherwise.
- .2 Apply paint materials in accordance with paint manufacturer's written application instructions.
- .3 If sprayed applied, all walls and ceilings must be back-rolled on final coat.
- .4 Apply paint using brushes and rollers of high quality grade and as appropriate for the task.
- .5 Existing glossy painted surfaces shall be properly prepared by cleaning and deglossing.
- .6 Patch Painting will not be acceptable, total affected area shall be painted. Terminate painting only at corners or joints.
- .7 The paint contractor is responsible for protection of all adjacent surfaces. The contractor shall at all times protect those surfaces with approved materials.
- .8 Enamel and varnish undercoats are to be sanded smooth prior to the re-coating. Tops and bottoms of wood and metal doors are to be finished in the same manner as door facing.
- .9 New plaster and other masonry surfaces shall not be primed until it has been determined these substrates have dried sufficiently to safely accept paint. Unacceptable moisture content should be reported by appropriate authority.
- .10 Paints, stains, and coatings shall be specifically manufactured for the intended use.
- .11 The final coats to exhibit uniformity of colour and uniformity of sheen across the full surface area.
- .12 Ensure compatible paint products are being used on all surfaces.
- .13 All walls and ceilings, new or existing shall receive at least two finish coats of the specified paint.

#### **3.3 EXAMINATION**

- .1 Investigate existing substrates for problems related to proper and complete preparation of surfaces to be painted. Report to Consultant damages, defects, unsatisfactory or unfavourable conditions before proceeding with work.
- .2 Conduct moisture testing of surfaces to be painted using properly calibrated electronic moisture meter, except test concrete floors for moisture using simple "cover patch test". Do not proceed with work until conditions fall within acceptable range as recommended by manufacturer.

- .3 Maximum moisture content as follows:
  - .1 Stucco, plaster and gypsum board: 12%.
  - .2 Concrete: 12%.
  - .3 Wood: 15%.

### 3.4 PREPARATION

- .1 Protection:
  - .1 Protect existing building surfaces and adjacent structures from paint spatters, markings and other damage by suitable non-staining covers or masking. If damaged, clean and restore surfaces as directed by Consultant.
  - .2 Protect items that are permanently attached such as Fire Labels on doors and frames.
  - .3 Protect factory finished products and equipment.
  - .4 Protect passing pedestrians, building occupants and general public in and about the building.
- .2 Surface Preparation:
  - .1 Surface preparation Level 4 – Supreme.
  - .2 Remove electrical cover plates, light fixtures, surface hardware on doors, bath accessories and other surface mounted equipment, fittings and fastenings prior to undertaking painting operations. Identify and store items in secure location and re-installed after painting is completed.
  - .3 Move and cover furniture and portable equipment as necessary to carry out painting operations. Replace as painting operations progress.
  - .4 Place "WET PAINT" signs in occupied areas as painting operations progress. Signs to approval of Consultant.
- .3 Clean and prepare surfaces in accordance with MPI Architectural Painting Specification Manual requirements. Refer to MPI Manual in regard to specific requirements and as follows:
  - .1 Remove dust, dirt, and other surface debris by vacuuming, wiping with dry, clean cloths or compressed air.
  - .2 Wash surfaces with a biodegradable detergent and bleach where applicable and clean warm water using a stiff bristle brush to remove dirt, grease, oil and other surface contaminants.
  - .3 Rinse scrubbed surfaces with clean water until foreign matter is flushed from surface.
  - .4 Allow surfaces to drain completely and allow to dry thoroughly.
  - .5 Patch, repair, and smoothen minor substrate defects and deficiencies, e.g. machine, tool and sand paper marks, shallow gouges, pin holes, marks, and nibs.
  - .6 Remove all rust, scale, loose paint and other deleterious matters from existing surfaces which require re-painting. Thoroughly clean and prepare such surfaces to accept positive and permanent bond of new paint finish. If such preparation exposes bare surface, provide touch up primer.
  - .7 Where finish hardware has been installed, remove, store, and re-install finish hardware to accommodate painting. Do not clean hardware with solvent that will remove permanent lacquer finishes.
  - .8 Clean existing cementitious surfaces by pressure washing, indicate on drawings, with a TSP solution and pressure range of 1500 - 4000 PSI at 6 - 12". Rinse areas with clean water and allow to thoroughly dry. Provide for collection and disposal of water.
  - .9 Prepare surfaces for water-based painting, water-based cleaners should be used in place of organic solvents.
  - .10 Use trigger operated spray nozzles for water hoses.
  - .11 Many water-based paints cannot be removed with water once dried. Minimize use of mineral spirits or organic solvents to clean up water-based paints.

- .4 Prevent contamination of cleaned surfaces by salts, acids, alkalis, other corrosive chemicals, grease, oil and solvents before prime coat is applied and between applications of remaining coats. Apply primer, paint, or pretreatment as soon as possible after cleaning and before deterioration occurs.
- .5 Where possible, prime non-exposed surfaces of new wood surfaces before installation. Use same primers as specified for exposed surfaces.
  - .1 Apply vinyl sealer to manufacturer's written instructions to MPI #36 over knots, pitch, sap and resinous areas.
  - .2 Apply wood filler to nail holes and cracks.
  - .3 Tint filler to match stains for stained woodwork.
- .6 Sand and dust between coats as required to provide adequate adhesion for next coat and to remove defects visible from a distance up to 3'3".
- .7 Clean metal surfaces to be painted by removing rust, loose mill scale, welding slag, dirt, oil, grease and other foreign substances in accordance with MPI requirements. Remove traces of blast products from surfaces, pockets and corners to be painted by brushing with clean brushes, blowing with clean dry compressed air, or vacuum cleaning.
- .8 Touch up of shop primers with primer as specified.
- .9 Do not apply paint until surfaces are properly prepared in accordance with manufacture's written recommendations.

### 3.5 APPLICATION

- .1 General:
  - .1 Finish all exposed to view unfinished materials and all previously painted surfaces in area of new Work and as scheduled.
  - .2 Finish paint all primed surfaces.
  - .3 Do not paint baked enamel, chrome plated, stainless steel, aluminum or other surfaces finished with final finish in factory.
  - .4 Provide finish uniform in sheen, colour and texture, free from streaks, shiners and brush or roller marks or other defects.
  - .5 Paint entire plane of areas exhibiting incomplete or unsatisfactory coverage and of areas, which have been cut and patched. Patch paint will not be accepted.
  - .6 Sand smooth enamel and varnish undercoats prior to recoating.
  - .7 Apply primer coat soon after surface preparation is completed to prevent contamination of substrate.
  - .8 Use dipping, sheepskins or daubers only when no other method is practical in places of difficult access.
  - .9 Apply coats of paint continuous film of uniform thickness.
    - .1 Repaint thin spots or bare areas before next coat of paint is applied.
  - .10 Allow surfaces to dry and properly cure after cleaning and between subsequent coats for minimum time period as recommended by manufacturer.
  - .11 Sand and dust between coats to remove visible defects.
  - .12 Finish surfaces both above and below sight lines as specified for surrounding surfaces, including such surfaces as tops of interior cupboards and cabinets and projecting window stool ledges.
  - .13 Finish closets and alcoves as specified for adjoining rooms.
  - .14 Finish top, bottom, edges and cutouts of doors after fitting as specified for door surfaces.

- .2 Apply paint by brush, roller, air sprayer, airless sprayer. Method of application to be as approved by Consultant. Conform to manufacturer's application instructions unless specified otherwise.
  - .1 Brush and Roller Application:
    - .1 Apply paint in uniform layer using brush and/or roller type suitable for application.
    - .2 Work paint into cracks, crevices and corners.
    - .3 Paint surfaces and corners not accessible to brush using spray, daubers and/or sheepskins. Paint surfaces and corners not accessible to roller using brush, daubers or sheepskins.
    - .4 Brush and/or roll out runs and sags, and over-lap marks. Rolled surfaces free of roller tracking and heavy stipple.
    - .5 Remove runs, sags and brush marks from finished work and repaint.
  - .2 Spray application:
    - .1 Provide and maintain equipment that is suitable for intended purpose, capable of atomizing paint to be applied, and equipped with suitable pressure regulators and gauges.
    - .2 Keep paint ingredients properly mixed in containers during paint application either by continuous mechanical agitation or by intermittent agitation as frequently as necessary.
    - .3 Apply paint in uniform layer, with overlapping at edges of spray pattern. Back roll first coat application.
    - .4 Brush out immediately all runs and sags.
    - .5 Use brushes and rollers to work paint into cracks, crevices and places which are not adequately painted by spray.
    - .6 Spray paint all doors and frames scheduled to be painted. Final coat may be brushed or rolled to accommodate finished adjacent surfaces.
    - .7 Spray paint overhead doors. Doors to be spray painted in a controlled environment (automotive paint booth).
- .3 Caulking:
  - .1 The application of painter's caulk shall be assumed within the scope of work:
    - .1 Joints between wood or wood composite materials, trim, baseboard, molding, and casements. These joints include and are limited to wood to wood or wood composite substrates, and wood to gypsum drywall, plaster or similar wall surfaces. These joints shall only be between field painted surfaces.
  - .2 The application of painter's caulk shall be assumed not within the scope of work:
    - .1 Surface defects, cracks, joints, voids or holes greater than 1/8 inch (3.18mm) wide, deep or across in wood, masonry, gypsum drywall, plaster or any other substrate.

### **3.6 MECHANICAL/ELECTRICAL EQUIPMENT**

- .1 Paint finished area exposed conduits, piping, hangers, ductwork and other mechanical and electrical equipment with colour and finish to match adjacent surfaces, except as indicated.
- .2 Boiler room, mechanical and electrical rooms: paint exposed conduits, piping, hangers, ductwork and other mechanical and electrical equipment.
- .3 Other unfinished areas: leave exposed conduits, piping, hangers, ductwork and other mechanical and electrical equipment in original finish and touch up scratches and marks.
- .4 Touch up scratches and marks on factory painted finishes and equipment with paint as supplied by manufacturer of equipment.

- .5 Do not paint over nameplates.
- .6 Keep sprinkler heads free of paint.
- .7 Paint inside of ductwork where visible behind grilles, registers and diffusers with primer and one coat of matt black paint.
- .8 Paint fire protection piping red.
- .9 Paint disconnect switches for fire alarm system and exit light systems in red enamel.
- .10 Paint natural gas piping yellow.
- .11 Paint both sides and edges of backboards for telephone and electrical equipment before installation. Leave equipment in original finish except for touch-up as required, and paint conduits, mounting accessories and other unfinished items.
- .12 Do not paint interior transformers and substation equipment.

### **3.7 SITE TOLERANCES**

- .1 Walls: no defects visible from a distance of 3'-0" at 90 degrees to surface.
- .2 Ceilings: no defects visible from floor at 45 degrees to surface when viewed using final lighting source.
- .3 Final coat to exhibit uniformity of colour and uniformity of sheen across full surface area.

### **3.8 FIELD QUALITY CONTROL**

- .1 Interior painting and decorating work shall be inspected by a Paint Inspection Agency (inspector) acceptable to the specifying authority and local Painting Contractor's Association. Painting contractor shall notify Paint Inspection Agency a minimum of one week prior to commencement of work and provide a copy of project painting specification, plans and elevation drawings (including pertinent details) as well as a Finish Schedule.
- .2 Interior surfaces requiring painting shall be inspected by Paint Inspection Agency who shall, Prior to commencing with interior painting Work, examine surfaces to be painted for defects and acceptance. Notify Consultant and General Contractor in writing of defects or problems, prior to commencing painting work, or after prime coat shows defects in substrate.
- .3 Commence with interior painting Work only after preparation, repair or replacement of such noted defects are corrected.
- .4 Where "special" painting, coating or decorating system applications (i.e. elastomeric coatings) or non-MPI listed products or systems are to be used, paint or coating manufacturer shall provide as part of this work, certification of surfaces and conditions for specific paint or coating system application as well as on site supervision, inspection and approval of their paint or coating system application as required at no additional cost to Consultant.
- .5 Manufacturer's Field Services: Schedule site visits, to review Work and obtain written reports from manufacturer verifying compliance of Work at 25%, 65% and at completion of the Work, in handling, applying, finishing, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 – MANUFACTURE'S FIELD SERVICES.

- .6 Standard of Acceptance:
  - .1 Walls: no defects visible from a distance of 3'-0" at 90 degrees to surface.
  - .2 Ceilings: no defects visible from floor at 45 degrees to surface when viewed using final lighting source.
  - .3 Final coat to exhibit uniformity of colour and uniformity of sheen across full surface area.
- .7 Field inspection of painting operations to be carried out by independent inspection firm as designated by Consultant.
- .8 Advise Consultant when each applied paint coat may be inspected. Do not recoat until directed by Consultant in writing. Tint each coat slightly to differentiate between applied coats.
- .9 Cooperate with inspection firm manufacturer's representative and provide access to areas of work.
- .10 Retain purchase orders, invoices and other documents to prove conformance with noted MPI requirements when requested by Consultant.

### **3.9 CLEANING**

- .1 Proceed in accordance with Section 01 74 11 - Cleaning.
  - .1 Remove paint where spilled, splashed, splattered or sprayed as work progresses using means and materials that are not detrimental to affected surfaces.

### **3.10 RESTORATION**

- .1 Clean and re-install hardware items removed before undertaken painting operations.
- .2 Remove protective coverings and warning signs as soon as practical after operations cease.
- .3 Remove paint splashings on exposed surfaces that were not painted. Remove smears and spatter immediately as operations progress, using compatible solvent.
- .4 Protect freshly completed surfaces from paint droppings and dust to approval of Consultant. Avoid scuffing newly applied paint.
- .5 Restore areas used for storage, cleaning, mixing and handling of paint to clean condition as approved by Consultant.

### **3.11 CLEANING**

- .1 Proceed in accordance with Section 01 74 11 – Cleaning.
  - .1 Remove paint where spilled, splashed, splattered or sprayed as work progresses using means and materials that are not detrimental to affected surfaces.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 REFERENCES**

- .1 Aluminum Association (AA):
  - .1 DAF 45-03 (R2009), Designation System for Aluminum Finishes.
- .2 American National Standards Institute (ANSI):
  - .1 ANSI A135.4-2004, Hardboard Standard.
  - .2 ANSI A208.1-2009, Particleboard.
  - .3 ANSI A208.2-2009, Medium Density Fiberboard for Interior Use.
- .3 ASTM International:
  - .1 ASTM A 653/A 653M-15, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
  - .2 ASTM A 924/A 924M-14, Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
- .4 CSA International:
  - .1 CSA O121-08 (R2013), Douglas Fir Plywood.
  - .2 CSA O151-09 (R2014), Canadian Softwood Plywood.
  - .3 CAN/CSA-Z809-08, Sustainable Forest Management.

### **1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for whiteboards and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Installation Drawings:
  - .1 Submit installation drawings.
  - .2 Indicate location, type, size, panel arrangement, backing, hardware, anchor or mounting details, frame or trim and accessories.
- .4 Samples:
  - .1 Submit duplicate 300 x 300 mm / 12" x 12" sample of whiteboard and 300 mm long sample of each type trim.
- .5 Closeout Submittals:
  - .1 Provide operation and maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
  - .2 Affix maintenance instruction labels to whiteboards.

### **1.3 QUALITY ASSURANCE**

- .1 Test Reports: certified test reports showing compliance with specified performance characteristics and physical properties.

- .2 Manufacturer/Source: Obtain each type of glass product from a single primary glass manufacturer and a single manufacturer/fabricator for each glass product type.
- .3 Installer Qualifications: Experienced Installer with minimum of 5 successful completed projects of similar materials and scope, approved by glass product manufacturer/fabricator.
- .4 Certificates: product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

#### **1.4 WARRANTY**

- .1 Provide a 5 year limited Warranty on Manufacturer's standard form, signed by manufacturer, agreeing to provide replacement glass for units that display delamination exceeding those allowed by ASTM C 1172
- .2 Warranty for Laminated Glass: Manufacturer/fabricator's standard form, signed by manufacturer/fabricator, agreeing to replace laminated-glass units that display edge separation, delamination, and blemishes exceeding those allowed by ASTM C 1172, within five years of date of manufacture.

#### **1.5 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials off ground indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect whiteboards from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.

### **PART 2 - PRODUCTS**

#### **2.1 MATERIALS**

- .1 Laminating adhesive: to manufacturer's standard.
- .2 Joint reinforcement: concealed mechanical jointing system to provide straight, rigid, continuously supported, tight butt, flush joints at surface.
- .3 Anchor clips, brackets and fasteners: concealed type recommended by whiteboard manufacturer selected by Consultant for fixed mounting.
- .4 Facings:
  - .1 to CAN/CGSB-12.9, 5/16" thick magnetic laminated glass complete with opacifier coating, colour as later selected by Consultant from manufacturer's complete colour range.
    - .1 Acceptable product: 'Opaci-Coat 300' by Industrial Control Development Inc., or approved alternate.

## **2.2 COMPONENTS**

- .1 Extruded aluminum: aluminum Association alloy AA 6063-T5. Minimum 1.5 mm / 1/16" thick.

## **2.3 TRIM AND ACCESSORIES**

- .1 Fixed magnetic whiteboards:
  - .1 Material: 1.5 mm / 1/16" minimum wall thickness, extruded aluminum clear anodized sections AA6063-T5, satin finish.
  - .2 Perimeter trim: anodized aluminum perimeter trim and transitions between the whiteboards and tile.
  - .3 Marker rail below each board:
    - .1 65 mm / 2 1/2" deep x full width of board removable aluminum magnetic accessory tray smooth angle cut ends, finish to match trim, or approved alternate.
  - .4 Top and bottom rails: anodized aluminum mounting rails as recommended by the manufacturer.

## **2.4 FABRICATION**

- .1 Fabricate whiteboard panels to sizes indicated.
- .2 Factory prepare whiteboards, consisting of facing sheet, with core and backing sheet with adhesive in accordance with manufacturer's recommendations.
- .3 Make finished panels flat and rigid and fit with joint reinforcement.
- .4 Fit joints between abutting whiteboard panels with joint reinforcement except where covering trim is required.
- .5 Factory fit assemblies too large for shipment to site in one piece, disassemble for delivery and make ready for reassembly on site.

## **2.5 MANUFACTURER**

- .1 Acceptable Product: 5/16" 'GlasPro-GL Magnetic Glass' by Glass Pro, or approved alternate.

## **PART 3 - EXECUTION**

### **3.1 MANUFACTURER'S INSTRUCTIONS**

- .1 Compliance: comply with manufacturer's written data, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.

### 3.2 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for whiteboard installation in accordance with manufacturer's written instructions.
  - .1 Visually inspect substrate.
  - .2 Inform Consultant of unacceptable conditions immediately upon discovery.
  - .3 Proceed with installation only after unacceptable conditions have been remedied.

### 3.3 INSTALLATION

- .1 Install whiteboards where indicated in accordance with manufacturer's instructions, parallel to floor with uniform vertical surface, plumb and level, to provide rigid, secure writing surface.
- .2 Install trim and framing around whiteboard panels.
  - .1 Make mitres and joints to hair-line fit, free of rough edges.
  - .2 Use concealed brackets to reinforce and hold joints tight and flush.
  - .3 No exposed fasteners permitted.
  - .4 Overlap trim 6 mm onto panels.
- .3 Mechanical attachment:
  - .1 To concrete or solid masonry use lag screw and expansion bolts or screws and fibre plugs as appropriate for stresses involved.
  - .2 To hollow masonry use toggle bolts or equivalent.
  - .3 To wood or sheet metal use screws. Secure into framing members in stud walls.

### 3.4 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 – Cleaning.
  - .1 Leave Work area clean at end of each day.
  - .2 Perform cleaning after installation to remove construction and accumulated environmental dirt.
  - .3 Clean surfaces after installation using manufacturer's recommended cleaning procedures.
  - .4 Clean aluminum with damp rag and approved non-abrasive cleaner.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 – Cleaning.

### 3.5 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by whiteboard installation.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 REFERENCES**

- .1 ASTM International:
  - .1 ASTM A 167-99 (2009), Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
  - .2 ASTM B 456-11, Standard Specification for Electrodeposited Coatings of Copper plus Nickel Plus Chromium and Nickel Plus Chromium.
  - .3 ASTM A 653/A 653M-15, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
  - .4 ASTM A 924/A 924M-14, Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
- .2 Canadian General Standards Board (CGSB):
  - .1 CAN/CGSB-1.81-M90, Air Drying and Baking Alkyd Primer for Vehicles and Equipment.
  - .2 CAN/CGSB-1.88-92, Gloss Alkyd Enamel, Air Drying and Baking.
  - .3 CGSB 31-GP-107MA-90, Non-inhibited Phosphoric Acid Base Metal Conditioner and Rust Remover.
- .3 Canadian Standards Association (CSA International):
  - .1 CAN/CSA-B651.2-07 (R2012), Accessible Design for the Built Environment.
  - .2 CAN/CSA-G164-M92 (R2003), Hot Dip Galvanizing of Irregularly Shaped Articles.
  - .3 CSA Z316.6-14, Evaluation of single-use and reusable medical sharps containers for biohazardous and cytotoxic waste.

### **1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product Data:
  - .1 Provide manufacturer's printed product literature and data sheets and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
  - .1 Indicate size and description of components, base material, surface finish inside and out, hardware and locks, attachment devices, description of rough-in-frame, building-in details of anchors for grab bars.
- .4 Samples:
  - .1 Submit samples if requested by Consultant.
  - .2 Samples will be returned for inclusion into work, if requested.

### **1.3 CLOSEOUT SUBMITTALS**

- .1 Provide maintenance data for toilet and bath accessories for incorporation into manual specified in Section 01 78 00 – Closeout Submittals.

## **1.4 MAINTENANCE MATERIAL SUBMITTALS**

- .1 Tools:
  - .1 Provide special tools required for assembly, disassembly or removal for toilet and bath accessories in accordance with requirements specified in Section 01 78 00 – Closeout Submittals.
  - .2 Deliver special tools to Owner.

## **1.5 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 – Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials off ground, indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect toilet and bathroom accessories from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS**

- .1 Sheet steel: to ASTM A 653/A 653M with ZF001 designation zinc coating.
- .2 Stainless steel sheet metal: to ASTM A 167, Type 304, with satin finish.
- .3 Stainless steel tubing: to AISI No. 4, commercial grade, seamless welded, 1.2mm18 gauge wall thickness, satin luster finish.
- .4 Fasteners: concealed screws and bolts hot dip galvanized, exposed fasteners to match face of unit. Expansion shields fibre, lead or rubber as recommended by accessory manufacturer for component and its intended use.

### **2.2 MANUFACTURER**

- .1 Products specified are manufactured by Frost unless otherwise indicated. Should an alternate product to Frost be specified, provide only the specified product or an approved alternate.
- .2 Equivalent products by Bobrick or Watrous will be acceptable to Frost products unless otherwise indicated.
- .3 Supply only those products listed or approved alternates in accordance with Section 00 21 13 – Instructions to Bidders.
- .4 Provide all accessories with concealed fasteners and concealed tamperproof screws.

## 2.3 COMPONENTS

- .1 The following toilet and bath accessories are to be supplied by the Owner, and installed by the Contractor:
  - .1 Toilet Tissue Dispenser (TTD1): '1093W' by iView
  - .2 Soap/Sanitizer Dispenser (SD): STOKO Spray Dispenser or '9325 Foam-eeze' by Impact Products
  - .3 Towel Dispenser (TD): '1091W' by iView
  - .4 Sanitary Napkin Disposal (SND): 'Automatic Feminine Hygiene Disposal Service' by Citron Hygiene
  - .5 Biohazard Sharps Disposal (BSD): Frost 878.
- .2 The following toilet and bath accessories are to be supplied and installed by the Contractor:
  - .1 Adult Change Station (ACS):
    - .1 Size: 810 mm wide x 1830 mm
    - .2 Operation: folding electrically height adjustability between 500 mm and 850 mm above the finished floor
    - .3 Fastening: wall mounted as per manufacturers instructions
    - .4 Capacity: designed to carry a minimum load of 1.33kN
    - .5 Accessories: roll guard
    - .6 Acceptable Product: 'Nursing Bench 1000' by Pressalit Care.
  - .2 Toilet tissue dispenser with shelf (TTD2): double roll type 12-1/2" long x 1-1/2" high x 4" deep, surface mounted, chrome plated steel frame, capacity of 500 double ply roll, roll under spring tension for controlled delivery.
    - .1 Acceptable product (double roll): 'B-2740' by Bobrick or approved alternate
  - .3 Surface mounted waste receptacle (WR): 304 stainless steel, surface mounted, waste receptacle, open top loading, approximately 24-1/4" high x 15-1/4" wide x 11-1/2" deep:
    - .1 Acceptable product: "Code 400-14C" by Frost.
  - .4 Grab bars: 1 1/4" diameter 18 ga. wall tubing of stainless steel, 3 1/4" diameter wall flanges, exposed concealed screw attachment, flanges welded to tubular bar, provided with steel back plates and all accessories. Knurl bar at area of hand grip. Grab bar material and anchorage to withstand downward pull of 2.2 kN.
    - .1 Acceptable product: 'Code 1000 series', by Frost.
      - .1 GB2: L-shaped, 760 x 760 mm / 30" x 30" long.
        - .1 Acceptable material: 'Code 1003 30" x 30"' by Frost.
      - .2 GB1: 24" long straight bar.
        - .1 Acceptable material: 'Code 1001-24' by Frost.
    - .5 Robe hook (RH): stainless steel , single robe hook,
      - .1 Acceptable product: "Code 1138S" by Frost.
    - .6 Fixed Mirror: refer to Section 08 80 50 – Glazing.
    - .7 Shelf: heavy duty, 22 ga. stainless steel brushed finish with rounded corners, size as indicated.
      - .1 Acceptable product: '950-4' by Frost
    - .8 Toilet Backrest (BR): 1 1/4" tubing stainless steel finish, solid plastic laminate backrest.
      - .1 Acceptable product:
        - .1 'Code 1028' by Frost.

- .9 Infant Change Table: Wall Surface Mounted (ICT - WSM): high density polyethylene, 912 mm / 36" long x 517 mm / 20" deep (in down position) x 565 mm / 22¼" high, with deep concave flip down table with 100 mm / 4" depth in up position, 115 kg. (250 lbs.) load capacity, oversized hinge with safety stop system, child protection strap, diaper bag hooks and tamper proof hardware.
  - .1 Acceptable product: 'Code 1125' by Frost.
- .10 Mop and Broom Holder: formed channel, 20 ga., Type 304 No. 4 brushed finish, size indicated.
  - .1 Acceptable material:
    - .1 (MBH 2): 915 mm / 36" long with 4 holders. 'Code 1114', by Frost.

## 2.4 FABRICATION

- .1 Weld and grind joints of fabricated components flush and smooth. Use mechanical fasteners only where approved.
- .2 Wherever possible form exposed surfaces from one sheet of stock, free of joints.
- .3 Brake form sheet metal work with 1/16" radius bends.
- .4 Form surfaces flat without distortion. Maintain flat surfaces without scratches or dents.
- .5 Back paint components where contact is made with building finishes to prevent electrolysis.
- .6 Hot dip galvanize concealed ferrous metal anchors and fastening devices to CAN/CSA-G164.
- .7 Shop assemble components and package complete with anchors and fittings.
- .8 Deliver inserts and rough-in frames to job site at appropriate time for building-in. Provide templates, details and instructions for building in anchors and inserts.
- .9 Provide steel anchor plates and components for installation on studding and building framing.

## 2.5 FINISHES

- .1 Chrome and nickel plating: to ASTM B 456, satin polished finish.
- .2 Baked enamel: condition metal by applying one coat of metal conditioner to CGSB 31-GP-107Ma, apply one coat Type 2 primer to CAN/CGSB-1.81 and bake, apply two coats Type 2 enamel to CAN/CGSB-1.88 and bake to hard, durable finish. Sand between final coats. Colour as later selected from standard colour range by Consultant.
- .3 Manufacturer's or brand names on face of units not acceptable.

## **PART 3 - EXECUTION**

### 3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrates and surfaces to receive toilet and bathroom accessories previously installed under other Sections or Contracts are acceptable for product installation in accordance with manufacturer's instructions prior to toilet and bathroom accessories installation.

- .2 Inform Consultant of unacceptable conditions immediately upon discovery.
- .3 Proceed with installation only after unacceptable conditions have been remedied.

### **3.2 INSTALLATION**

- .1 Install and secure accessories rigidly in place as follows:
  - .1 Stud walls: install steel back-plate to stud prior to plaster or drywall finish. Provide plate with threaded studs or plugs.
  - .2 Hollow masonry units, existing plaster or drywall: use toggle bolts drilled into cell or wall cavity.
  - .3 Solid masonry, marble, stone or concrete: use bolt with lead expansion sleeve set into drilled hole.
  - .4 Toilet and shower compartments: use male to female through bolts.
- .2 Install grab bars on built-in anchors provided by bar manufacturer.
- .3 Install adult and infant change stations in accordance with load and support requirements of the Ontario Building Code and recommendations from the manufacturer.
- .4 Use concealed tamper proof screws/bolts for fasteners.
- .5 Fill units with necessary supplies shortly before final acceptance of building.

### **3.3 ADJUSTING**

- .1 Adjust toilet and bathroom accessories components and systems for correct function and operation in accordance with manufacturer's written instructions.
- .2 Lubricate moving parts to operate smoothly and fit accurately.

### **3.4 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 – Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 – Cleaning.

### **3.5 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by toilet and bathroom accessories installation.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 REFERENCES**

- .1 Aluminum Association (AA)
  - .1 AA DAF 45-03(R2009), Designation System for Aluminum Finishes.
- .2 ASTM International
  - .1 ASTM A 167-99(2009), Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
  - .2 ASTM B 456-11, Standard Specification for Electrodeposited Coatings of Copper Plus Nickel Plus Chromium and Nickel Plus Chromium.
  - .3 ASTM A 653/A 653M-15, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
  - .4 ASTM A 924/A 924M-14, Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
- .3 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-1.81-M90, Air Drying and Baking Alkyd Primer for Vehicles and Equipment.
  - .2 CAN/CGSB-1.88-92, Gloss Alkyd Enamel, Air Drying and Baking.
  - .3 CGSB 31-GP-107MA-90, Non-inhibited Phosphoric Acid Base Metal Conditioner and Rust Remover.
- .4 CSA International
  - .1 CAN/CSA-B651.2-0 7(R2012), Accessible Design for the Built Environment.
  - .2 CAN/CSA-G164-M92 (R2003), Hot Dip Galvanizing of Irregularly Shaped Articles.

### **1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product Data:
  - .1 Provide manufacturer's printed product literature and data sheets and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
  - .1 Indicate size and description of components, base material, surface finish inside and out, hardware and locks, attachment devices, description of rough-in-frame, building-in details.
- .4 Samples:
  - .1 Submit samples if requested by Consultant.
  - .2 Samples will be returned for inclusion into work.

### **1.3 CLOSEOUT SUBMITTALS**

- .1 Provide maintenance data for miscellaneous specialties for incorporation into manual specified in Section 01 78 00 – Closeout Submittals.

## **1.4 MAINTENANCE MATERIAL SUBMITTALS**

- .1 Tools:
  - .1 Provide special tools required for assembly, disassembly or removal for miscellaneous specialties in accordance with requirements specified in Section 01 78 00 – Closeout Submittals.
  - .2 Deliver special tools to Owner.

## **1.5 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 – Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials off ground indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect miscellaneous specialties from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.

## **PART 2 – PRODUCTS**

### **2.1 TACTILE WARNING SURFACE**

- .1 Stainless steel tactile indicator domes: shall be drilled and set into existing terrazzo landings.
  - .1 Size: 23 mm diameter truncated dome
  - .2 Conformance: CSA B651-12,
  - .3 Finish: Stainless Steel
  - .4 Acceptable product: UAS-SS2218' by Urban access Solutions or approved alternate.

### **2.2 WALL PROTECTION**

- .1 Corner guards: provide 4" x 4" x 40" stainless steel corner guards at all exposed corners.
  - .1 Acceptable products:
    - .1 Corner Guard: 'Code 1117' by Frost, or approved alternate.
- .2 Chair rails: provide 4" high chair rail, lengths and locations as indicated, colour to later select by consultant from manufacturers full range of colours.
  - .1 Acceptable products:
    - .1 Chair rail: 'SCR-40N' as manufactured by Construction specialties, or approved alternate.

### **2.3 NON-SLIP STAIR NOSING**

- .1 Non-slip Stair Nosing: mineral coated high-friction slip resistant tape, 76 mm / 3" wide tread width suitable for installation on exiting stair treads.
  - .1 Acceptable product: "Safety-Walk Slip Resistant General Purpose Treads", by 3M or approved alternate.

## **2.4 MAILBOXES AND DROP BOX**

- .1 Recessed Secure Mail Drop:
  - .1 Acceptable product: 'Model 1700' by Canadian Mailbox Company.
  - .2 Options:
    - .1 Rear collection box complete with high security Medeco lock.
  - .3 Depth: Custom depth to fit flush mounted within a 152mm metal stud assembly.
  - .4 Height: custom height as indicated to suit application.
  - .5 Finish: brushed stainless steel.
- .2 Mailboxes
  - .1 Acceptable product: 'Model 1301' by Canadian Mailbox Company.
  - .2 Access: Front loading
  - .3 Mailbox Size: 3" x 12-7/8" size 'C'
  - .4 Quantity: 30 compartment – 3 wide x 10 high
  - .5 Finish: clear anodized.
  - .6 Options:
    - .1 Mail slot in each door 1/2" (12.7mm) High x 10" (254mm) Wide

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- .1 Verification of Conditions: verify that conditions of substrates and surfaces to receive miscellaneous specialties previously installed under other Sections or Contracts are acceptable for product installation in accordance with manufacturer's instructions prior to miscellaneous specialties installation.
- .2 Inform Consultant of unacceptable conditions immediately upon discovery.
- .3 Proceed with installation only after unacceptable conditions have been remedied.

### **3.2 INSTALLATION**

- .1 Install and secure miscellaneous specialties rigidly in place where required in accordance with manufacturer's instructions.
- .2 Use concealed fasteners where possible.
- .3 Install miscellaneous specialties where indicated.
- .4 Install and secure miscellaneous specialties rigidly in place, level and true to manufacturers written recommendations using concealed fasteners.

### **3.3 WALL PROTECTION**

- .1 Preparation:
  - .1 Surface preparation: Prior to installation, clean substrate to remove dirt, debris and loose particles. Perform additional preparation procedures as required by manufacturer's instructions.

- .2 Installation:
  - .1 Take all necessary steps to prevent damage to material during installation as required in manufacturer's installation instructions.
  - .2 Install the work of this section in strict accordance with the manufacturer's recommendations using approved adhesive.
  - .3 Lay out centre line of wall protection both ways, to provide balanced sheets at room perimeter with sheet size not less than 50% of standard widths. Report all discrepancies immediately upon discovery to Consultant prior to commencing with work.
  - .4 Temperature at the time of installation must be between 18 and 24°C with relative humidity not exceeding 80%. Maintained temperature and relative humidity for at least 48 hours following installation to allow for proper adhesive set up.
  - .5 Do not expose wall covering to direct sunlight during or after installation to prevent surface temperature to rise which may result in air bubbles and delamination.
- .3 Cleaning:
  - .1 Immediately upon completion of installation, clean wall covering and accessories in accordance with manufacturer's recommended cleaning method.

### **3.4 NON-SLIP STAIR NOSING**

- .1 Install non-slip stair nosings on each stair tread in accordance with manufacturer's written instructions.

### **3.5 ADJUSTING**

- .1 Adjust miscellaneous specialty components and systems for correct function and operation in accordance with manufacturer's written instructions.
- .2 Lubricate moving parts to operate smoothly and fit accurately.

### **3.6 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 – Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 – Cleaning.

### **3.7 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by miscellaneous specialties installation.
- .3 Protect installed materials to prevent damage by other trades. Use materials that may be easily removed without leaving residue or permanent stains.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 REFERENCES**

- .1 Canadian General Standards Board (CGSB):
  - .1 CAN/CGSB-44.40-01, Steel Clothing Locker.

### **1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit submittals in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product Data:
  - .1 Provide manufacturer's printed product literature and data sheets for metal lockers and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
  - .1 Indicate on drawings: type and class of locker, thicknesses of metal, fabricating and assembly methods, assembled banks of lockers, tops, rods, hooks, shelves, bases, trim, numbering, filler panels, end/back panels, doors, handles, locking method, ventilation method, finishes.
- .4 Samples:
  - .1 Submit duplicate 2" x 2" samples of colour and finish on actual base metal.
  - .2 Samples will be returned for inclusion into work.

### **1.3 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 – Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements:
  - .1 Deliver materials to site in original factory packaging, labelled with manufacturer's name 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 metal lockers from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURED UNITS**

- .1 Lockers: to CAN/CGSB-44.40.
  - .1 Double Tier: Class 2 - A bank of two or more lockers, freestanding tier: Class 2 - A bank of two or more lockers, freestanding.
  - .2 Size: 305 mm / 12" wide x 455 mm / 18" deep x 1830 mm / 72" high.
  - .3 Steel thickness No. 14 MSG No. 20 MSG backs and sides.

- .4 Assembly: welded.
- .5 Top: 16 ga. sloped.
- .6 Base: pre-manufactured 16 ga.
- .7 Inside accessories (each compartment): one shelf and three hooks. Place shelf to provide 1" air space between shelf and back of locker for ventilation. Place shelf 12" from top..
- .8 Doors: flush, one-piece double-wall envelope construction, steel thickness 20 ga. inner panel, 16 ga. outer panel, bonded to honeycomb core, enclosed on all edges.
- .9 Accessories:
  - .1 Rubber bumpers riveted to door to act as door stop
  - .2 Clear anodized number plate on each locker, number as later directed by Consultant.
- .10 Door handle: recessed handle stainless steel with brushed No 304 finish.
- .11 Door Hinge: continuous piano hinge welded to frame and riveted to door.
- .12 Filler panels / false fronts: 16 ga. thick, place where required, colour to match door.
- .13 End Panels: where ends of lockers are exposed, provide 16 ga. end panels attached with concealed fasteners.
- .14 Colour as later selected by Consultant from manufacturer's standard colour range, not more than two (2) colours.
- .15 Acceptable products:
  - .1 'Emperor' by Hadrian, or approved alternate.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- .1 Verification of Conditions: verify conditions of substrates and surfaces to receive metal lockers previously installed under other Sections or Contracts are acceptable for product installation in accordance with manufacturer's instructions prior to metal locker installation.
- .2 Inform Consultant of unacceptable conditions immediately upon discovery.
- .3 Proceed with installation only after unacceptable conditions have been remedied.

#### **3.2 INSTALLATION**

- .1 Assemble and install lockers in accordance with manufacturer's written instructions.
- .2 Securely fasten lockers to grounds and nailing strips.
- .3 Install wall trim around recessed locker banks.
- .4 Install filler panels (false fronts) where indicated and where obstructions occur.
- .5 Install finished end panels to exposed ends of locker banks.
- .6 Install locker numbers.

### **3.3 ADJUSTING**

- .1 Adjust metal lockers for correct function and operation in accordance with manufacturer's written instructions.
- .2 Lubricate moving parts to operate smoothly and fit accurately.

### **3.4 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 – Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 – Cleaning.

### **3.5 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by metal locker installation.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 SECTION INCLUDES**

- .1 Manually operated sunscreen roller shades (also referred to as roller blinds).
- .2 Manually operated double-roller sunscreen and room-darkening shades (also referred to as roller blinds).
- .3 Manually operated acoustic sound dampening shades (also referred to as acoustic blinds).

### **1.2 REFERENCES**

- .1 ASTM International
  - .1 ASTM D 1784-11, Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
  - .2 ASTM G 21-15 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.

### **1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit submittals in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's printed product literature and data sheets for roller blinds and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2 Fire-Performance Characteristics:
    - .1 Provide shade material tested in accordance with NFPA 701 - Vertical-Burn Test, rated "PASS".
- .3 Shop Drawings:
  - .1 Indicate on drawings dimensions in relation to window jambs, operator details, head and sill anchorage details, hardware and accessories details.
- .4 Samples:
  - .1 Submit one representative working sample of each type roller blind.
  - .2 Submit duplicate samples of manufacturer's standard colours for selection by Consultant.
  - .3 After approval samples will be returned for incorporation into Work.
- .5 Maintenance Data:
  - .1 Submit methods for maintaining roller shades, precautions regarding cleaning materials and methods, instructions for operating hardware and controls.

### **1.4 QUALITY ASSURANCE**

- .1 Obtain roller shades through one source from a single manufacturer with a minimum of 20 years experience in manufacturing products comparable to those specified in this section.

- .2 Installer qualifications: Installer trained and certified by the manufacturer with a minimum of ten years experience in installing products comparable to those specified in this section.
- .3 Fire-Test-Response Characteristics: Passes NFPA 701-99 small and large-scale vertical burn. Materials tested shall be identical to products proposed for use.
- .4 Anti-Microbial Characteristics: 'No Growth' per ASTM G 21 results for fungi ATCC9642, ATCC 9644, ATCC9645.
- .5 Mock-Up: Provide a mock-up of one assembly of each type of blind for evaluation of mounting, appearance and accessories.
  - .1 Locate mock-up in window designated by Consultant.
  - .2 Do not proceed with remaining work until mock-up is approved in writing by Consultant.
- .6 Acoustic Testing:
  - .1 Refer to Section 09 21 16 Gypsum Board Assemblies.

## **1.5 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 – Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials off ground indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect roller blinds from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.

## **1.6 WARRANTY**

- .1 Provide roller shade/acoustic shade hardware, chain and shade cloth with manufacturer's standard non-depreciating twenty-five year limited warranty.
- .2 Roller Shade/Acoustic Shade Installation: One year from date of Substantial Completion.

## **PART 2 - PRODUCTS**

### **2.1 DESIGN CRITERIA**

- .1 Design roller/acoustic blinds to following requirements:
  - .1 Allow wear susceptible parts to be replaceable by either user or manufacturer.
  - .2 Guarantee of at least five-years of available replacement parts following discontinue of products manufacture.
  - .3 Include instructions for replacing or repairing worn parts, including inventory numbers for parts and procedures for ordering replacement parts.
  - .4 Allow for refurbishing or return of used vertical louvre blinds.

- .5 Permit effective disassembly of components in for recycling of materials.
- .6 Include stamps on major plastic components indicating composition code to facilitate recycling efforts.
- .2 Roller/Acoustic Shade Type:
  - .1 Shade Type 1: Manual operating, chain drive, sunscreen roller shades in all exterior windows of rooms and spaces shown on the Drawings.
  - .2 Shade Type 2: Manual operating interior, chain drive "double" solar and room darkening blackout roller shades, operating independently of each other, and related mounting systems and accessories.
  - .3 Shade Type 3: Manual operating interior, cord drive, acoustic honeycomb shades on both sides of all one-way mirror locations.

## 2.2 MANUFACTURER

- .1 Roller Blinds Type 1 and 2 specified are manufactured by Sun Project Model. Equivalent products by the following manufacturer's will be acceptable:
  - .1 MechoShade Systems, Inc.
  - .2 Solarfective Products Limited.
- .2 Acoustic Blinds: 'Duette FR Honeycomb Shades' by Hunter Douglas or approved alternate.

## 2.3 MATERIALS AND FABRICATION – ROLLER SHADES TYPE 1 AND TYPE 2

- .1 Shade Cloth Roller:
  - .1 Visually Transparent Single-Fabric Shadecloth: single thickness non-raveling 0.030-inch thick vinyl fabric, woven from 0.018-inch diameter extruded vinyl yarn comprising of 21 percent polyester and 79 percent reinforced vinyl.
    - .1 Dense Linear Weave: 3 percent open, dense linear-weave pattern.
    - .2 Colour: As later selected by Consultant from manufacturer's complete colour range.
  - .2 Vinyl Room Darkening Shadecloth (Single-Fabric): blackout material, washable and colorfast laminated and embossed vinyl coated fabric, 0.012 inches thick blackout material, 0.81 lbs. per square yard, with a minimum of 62 threads per square inch.
    - .1 Colour: As later selected by Consultant from manufacturer's complete colour range.
- .2 Shade Band:
  - .1 Shade Bands: Construction of shade band includes fabric, hem weight, hem-pocket, shade roller tube, and attachment of shade band to roller tube. Sewn hems and open hem pockets will not be accepted.
    - .1 Hem Pockets and Hem Weights: Provide fabric hem pocket and ends with RF-welded seams and concealed hem weights. Size continuous hem weights to suit shade band inside sealed hem pocket. Construct hem pocket and hem weights similar for all shades within one room.
  - .2 Shade band and Shade Roller Attachment:
    - .1 Size extruded aluminum shade roller tube of a diameter and wall thickness required to support shade fabric without excessive deflection. Minimum roller tube diameter:
      - .1 Manual shades: 1.55".
    - .2 Provide positive mechanical engagement with drive / brake mechanism.

- .3 Provide positive mechanical attachment of removable / replaceable shade band to roller tube with "snap-on" snap-off" spline mounting, without removing shade roller from shade brackets.
    - .4 Use of adhesives, adhesive tapes, staples, and/or rivets to mounting spline will not be accepted.
- .3 Shade Fabrication:
  - .1 Fabricate units to completely fill existing openings from head to sill and jamb-to-jamb, unless specifically indicated otherwise.
  - .2 Fabricate unguided shadecloth with heat-sealed trimmed edges to:
    - .1 Hang flat without buckling or distortion.
    - .2 Hang straight without curling or raveling.
    - .3 Roll true and straight without shifting sideways more than 1/8 " in either direction per 8' of shade height due to warp distortion or weave design. Fabricate hem with:
    - .4 Bottom hem weights:
      - .1 Concealed hemtube.
      - .2 Exposed hemtube.
      - .3 Exposed blackout hembar with light seal.
      - .4 Exposed blackout hembar with polybond seal.
  - .3 Provide battens in standard shades from stainless steel or tempered steel as required to assure proper tracking and uniform rolling of the shadebands with width-to-height (W:H) ratios to manufacturer's recommendations.
  - .4 Railroaded shadebands: provide seams in railroaded multi-width shadebands with seam alignment to Consultant approval. Furnish battens in place of plain seams when the width, height, or weight of the shade exceeds manufacturer's standards.
  - .5 Provide battens for railroaded shades when width-to-height (W:H) ratios to meet or exceed manufacturer's to assure proper tracking and roll of shadebands.
  - .6 Blackout shadebands:
    - .1 Horizontally mounted, roll-formed stainless steel or tempered-steel battens not more than 3' on centre, extending fully into side channels.
    - .2 Conceal battens with integrally-coloured fabric to match inside and outside colours of shadeband, in accordance with manufacturer's written recommendations.
    - .3 Batten pockets:
      - .1 Self-colored fabric front and back as required to eliminate any see through.
      - .2 RF welded into the shadecloth.
      - .3 Maximum 1 1/2" high, totally opaque.
- .4 Components:
  - .1 Access and Material Requirements:
    - .1 Shade hardware to permit:
      - .1 Removal of shade roller tube from brackets without removing hardware and supports.
      - .2 Removal and re-mounting of the shade bands without removal of shade tube, drive or operating support brackets.
    - .2 Plastic components of shade hardware: Use only Delrin engineered plastics by DuPont, or approved alternate.
  - .2 Manual Operated Chain Drive Hardware and Brackets to provide:
    - .1 Universal, adjustable regular and offset drive capacity.
    - .2 Provide removable fascias complete with concealed fastening.

- .3 Provide single chain for smooth operation of multiple shade bands to manufacturer's design criteria.
- .4 Provide positive mechanical engagement of drive mechanism to shade roller tube. Friction fit connectors will not be accepted.
- .5 Provide shade hardware constructed of minimum 1/8" minimum thick plated steel as required to support 150% of the full weight of each shade.
- .6 Drive Bracket / Brake Assembly to provide:
  - .1 Fully integrated drive bracket with all accessories, including, but not limited to fascia, room darkening side / sill channels, centre supports and connectors for multi-banded shades.
  - .2 Rotating drive sprocket and brake assembly supported on a welded 3/8" minimum steel pin.
  - .3 Over-running clutch design brake during the raising and lowering of a shade and capable of withstanding a pull force of 50 lbs. in the stopped position.
  - .4 Permanently lubricated assembly for smooth operation in raising and lowering of shades.
  - .5 Fully independent of shade tube assembly and capable of removal and reinstallation without effecting roller shade limit adjustments.
  - .6 Acceptable product: 'Moduline' by Altex Sunproject.
- .3 Drive Chain: #10 qualified stainless steel chain rated to 90 lb. minimum breaking strength.
- .5 Accessories:
  - .1 Fascia (for Shade Type 1 and 2):
    - .1 Continuous removable extruded aluminum fascia of slim line design that attaches to shade mounting brackets without the use of adhesives, magnetic strips, or exposed fasteners.
    - .2 Fascia capable of one-piece installation across two or more shade bands.
    - .3 Fascia to fully conceal brackets, shade roller and fabric on tube.
    - .4 Provide bracket / fascia end caps to conceal exposed roller shade and brackets.
  - .2 Room Darkening Side and / or Sill Channels (for Shade Type 2):
    - .1 Extruded aluminum with polybond edge seals and mounting brackets complete with concealed fastening and channels capable of accepting one-piece exposed blackout hembar with vinyl seal for side light and sill light control.
    - .2 Colour: Selected from manufacturer's standard colours.
      - .1 Colour: As later selected by Consultant from manufacturer's complete colour range.

## **2.4 MATERIALS AND FABRICATION – ACOUSTIC SHADES TYPE 3**

- .1 Shade Cloth:
  - .1 Opaque honeycomb construction to NFPA 701. Colour as later selected by consultant from manufacturers complete colour range.
- .2 Spools:
  - .1 0.9 mm polyester cord on steel v-shaft and spools. Length to suit application.
  - .2 Spools spaced not more than 150 mm from end of slats and 550 mm on centre.
- .3 Headrails:
  - .1 One piece steel channel with rolled edges, formed to provide sufficient strength to support blind without sagging, twisting or distorting; internally fitted with hardware, pulleys, and bearings for operation; same depth as width of slats.
  - .2 Metal minimum 0.65 mm thick.

- .4 Bottom rails:
  - .1 Polyvinylchloride full-width section.
  - .2 0.65 mm thick.
  - .3 Colour to match slats.
- .5 Bottom rail end caps:
  - .1 Soft moulded plastic fitted snugly over ends of rails.
  - .2 Colour to match slats.
- .6 Clutch and gearbox: designed to permit ease of operation with minimum wear to cord.
- .7 Valance: width as required to conceal headrail, same colour as slats.
- .8 Cord locks: designed to provide smooth operation with feature to prevent accidental dropping of blinds.
- .9 Installation brackets: end and centre type complete with safety locking caps to secure headrail and valance.
- .10 Lift cords: continuous loop complete with universal chord tensioner, minimum tensile strength 689 kPa.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- .1 Verification of Conditions: verify conditions of substrates and surfaces to receive roller blinds previously installed under other Sections or Contracts are acceptable for product installation in accordance with manufacturer's instructions prior to roller blinds installation.
  - .1 Visually inspect substrate.
  - .2 Inform Consultant of unacceptable conditions immediately upon discovery.
  - .3 Proceed with installation only after unacceptable conditions have been remedied.

#### **3.2 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.

#### **3.3 INSTALLATION**

- .1 Install roller shades level, plumb, square, and true according to manufacturer's written instructions, and located so shade band is not closer than 2" to interior face of glass. Allow proper clearances for window operation hardware.
- .2 Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.

- .3 Engage Installer to train Owner's maintenance personnel to adjust, operate and maintain roller shade systems.
- .4 Include centre brackets where necessary to prevent deflection of headrail.
- .5 Adjust to provide for smooth operation without binding.
- .6 Use non corrosive metal fasteners for installation, concealed in final assembly.

### **3.4 ADJUSTING**

- .1 Adjust roller blinds components for correct function and operation in accordance with manufacturer's written instructions.
- .2 Lubricate moving parts to operate smoothly and fit accurately.

### **3.5 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 – Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 – Cleaning.
- .3 Clean roller shade surfaces after installation, according to manufacturer's written instructions.

### **3.6 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Touch-up, repair or replace damaged products before Substantial Completion.
- .3 Repair damage to adjacent materials caused by roller blinds installation.

### **3.7 SCHEDULE**

- .1 Shade Type 1 – All exterior windows unless otherwise noted.
- .2 Shade Type 2 – At exterior windows in the following rooms: Large Group Room 129, Large Group Room 233, Lounge 217, Viewing Rooms 214, and Viewing Room 228A.
- .3 Shade Type 3 – Both sides at all interior one-way mirror locations.

END OF SECTION

University of Guelph Building #046

Guelph, Ontario

Vertical Transportation  
specification  
elevators

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## **Section 14 21 23 MRL Passenger Elevator** 1

### **PART ONE - GENERAL** 1

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## PART ONE - GENERAL

### 1.1 Summary

.1 Conform with requirements of Division 01, General Requirements, as it applies to the work of this Section.

.2 Provide labour, materials, products, equipment and services necessary for the following work at University of Guelph Building #046, Guelph, Ontario:

.1 Supply and installation of one machine-room-less traction passenger elevator as specified in Section 14 21 23.

### 1.2 Maintenance: warranty period

.1 Elevator maintenance shall commence upon Substantial Completion and shall be carried out in accordance with University of Guelph's Maintenance Agreement document, which is to be provided with the Bid and Contract Documents, for a period of twelve (12) months. Include all labour, materials, equipment, and services that are necessary to fulfill the requirements of preventive elevator maintenance in accordance with the requirements of ASME A17.1-2010/CSA B44-10 Safety Code for Elevators inclusive of Article 8.6.1.2, CSA B44.2-10, and the University of Guelph's maintenance requirements as provided in Section 14100, Maintenance Agreement.

.2 Make good any defect not resulting from vandalism or misuse, for a period of one year from the Date of Substantial Performance, or at any time during the maintenance contract. Warranty shall cover for both the labour and material associated with the replacement of such part(s).

.3 Costs for this maintenance to be included in the project costs.

### 1.3 Owner's General Terms and Conditions

.1 Abide by the Owner's General Terms and Conditions, including the University of Guelph Design Standard RD-02 Elevator.

.2 Where there is a conflict between the Owner's General Terms and Conditions and these specifications the Owner's Terms and Conditions take precedence.

1.4 Definitions of terms

- .1 The term "Owner", as used herein, refers to University of Guelph.
- .2 The term "Inspecting Authorities", as used herein, refers to authorized agents of governments and of insurance groups that are charged with the responsibility of carrying out periodic inspections and tests on vertical transportation equipment.
- .3 The term "Consultant", as used herein, means KJA Consultants Inc. or such other entity selected by the Owner to fulfill the role of Consultant.
- .4 The term "provide", as used herein, means to supply and install new equipment.
- .5 The term "arrange", as used herein, means to provide the required features.
- .6 The term "unit", as used herein, means any Elevator, Escalator, Dumbwaiter, Moving Walk, Material Lift or similar device mentioned in this Specification.
- .7 The term "Code", as used herein, refers to the CAN/CSA-B44-10 Safety Code for Elevators and Escalators with updates and including Nonmandatory Appendices (which are deemed mandatory herein).
- .8 The terms in the Specifications that are not otherwise defined shall have the definitions as given in the Code.

1.5 Singular and plural

- .1 In all cases singular and plural shall be interchangeable and shall be applied as required to meet the sense and intent of the Specifications.
- .2 Where the singular is employed it shall be interpreted as necessary, unless otherwise indicated, to apply to all equipment and devices required to produce a complete installation.

1.6 Pre-inspection check list

- .1 Upon completion review each page of the specifications and initial each page at the bottom left to indicate that the work has been completed in compliance with the Specifications.
- .2 Submit this initialled copy of the Specifications to the Consultant prior to requesting an inspection by the Consultant.

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| <u>1.7</u> <u>Inspection and acceptance</u>       | <p>.1        When completed, carry out an inspection, witnessed by the Consultant, to see that the work is in compliance with the Specifications.</p> <p>.2        Furnish a team of competent personnel, for one working day per unit, to assist in making these inspections.</p> <p>.3        If the results of these inspections do not meet the requirements of the Specifications, make the appropriate corrections, and provide, as set out above, for another inspection.</p> <p>.4        Give sufficient advance notice in writing so that the Consultant can arrange for his representative to witness these inspections.</p> |
| <u>1.8</u> <u>Materials validity check</u>        | <p>.1        Perform a general materials validity check of components and fastenings that under failure might create a dangerous situation, including, but not limited to, sheave bolts, welds, car slings, gears, worm shafts, sheave shafts, brakes, safeties, guide rails, car platform and any other retained component.</p>  |
| <u>1.9</u> <u>Acknowledgments</u>                 | <p>.1        The proposer acknowledges that the proposer has found no discrepancies nor any ambiguities in the specifications.</p>  |
| <u>1.10</u> <u>Submission of proposal</u>         | <p>.1        Submission of a proposal will be considered presumptive evidence that the proposer is conversant with local facilities and conditions, requirements of the Contract Documents and of pertinent provincial and local codes, state of labour and material markets, and in the proposal has made due allowance for all contingencies.</p>   |
| <u>1.11</u> <u>Inability to complete contract</u> | <p>.1        Should there be a reasonable doubt that the work can be completed within the scheduled time because of labour disputes or any other cause, the Owner reserves the right, at the Owner's option, to cancel the contract.</p> <p>.2        In the event this option is exercised, the payments for the work shall be made on a pro rata basis for materials and labour supplied to the time of cancellation and such material and work performed shall become the property of the Owner.</p> <p>.3        Prior to exercising this option, the Owner shall give two weeks notice in writing of intention to cancel.</p>      |

1.12    Materials and  
workmanship

- .1        Provide all new materials and equipment.
- .2        Install equipment in a neat, accurate, workmanlike manner.

1.13    Warranty of work

- .1        Warrant that the materials, performance and workmanship are in accordance with the industry standard in every respect.
- .2        Make good defects not due to improper use which may develop within one year from the date of Substantial Performance of the project.
- .3        Warrant that the equipment performs to the standards set out herein.
- .4        Neither the final payment nor any provision of the Contract Documents diminishes the responsibility for negligence or faulty materials or workmanship within the extent and period provided by law.
- .5        Upon written notice remedy defects and pay expenses for damage to others resulting from defects.

1.14    Assignments

- .1        Do not assign nor sublet the contract without the written consent of the Owner.
- .2        Do not assign any payment due or to become due as a result of this contract without the written consent of the Owner.

1.15    Certificates of inspection

- .1        Obtain and pay for certificates of approval and all other necessary permits and inspections.
- .2        Prior to Substantial Performance, arrange for and pay for a safety inspection of the equipment by a government authority or, if that is not available, by a recognized independent private professional inspection organization.
- .3        As a minimum, ensure that this inspection includes:
  - .1        Full load overspeed car safety tests if car safeties are provided;
  - .2        Empty car overspeed counterweight safety tests if counterweight safeties are provided;
  - .3        Pressure tests for hydraulic elevators;
  - .4        Full load full speed car buffer tests if oil buffers are provided;

- .5 Empty car full speed counterweight buffer tests if counterweight oil buffers are provided;
- .6 Full load full speed down direction brake tests if a traction machine is provided;
- .7 Electrical safety circuit check;
- .8 Door pressure tests;
- .9 Tests of any other safety devices.

.4 Submit, prior to Substantial Performance inspection, the approved safety inspection report.

.5 Should more than one inspection for a licence or approval be required due to deficient work by others give sufficient advance notice of such deficient work to allow the Work to be completed prior to the time of the subsequent inspection.

.6 If sufficient advance notice of such deficient work has not been given, assume the cost of the additional inspections.

#### 1.16 Changes in Work

.1 The Owner, without invalidating the contract, may order extra work or make changes by altering, adding to, or deducting from the Work, the contract sum being adjusted as agreed.

.2 Execute all such work under the conditions of the original contract except that any claim for extension of time caused thereby shall be adjusted at the time of ordering such change.

.3 The Consultant shall have authority to make minor changes in the Work, not involving extra cost and not inconsistent with the purpose of the contract.

.4 Otherwise do no extra work nor make any change unless in pursuance of written order from the Owner.

#### 1.17 Equipment moving

.1 Provide floor protection and bracing so that equipment moving causes no damage to the building.

1.18 Claims for extra cost

.1 Give any claims for extra cost due to instructions or otherwise, to the Owner in writing within a reasonable time after the instructions and in any event before proceeding with the work.

.2 No such claim shall be valid unless so made and authorized in writing by the Owner.

1.19 Operating environment

.1 Provide material and equipment to function normally within the requirements of the specifications when the ambient temperature is between 3.5 and 36.0 degrees Celsius (38 and 97 degrees Fahrenheit).

.2 Provide material and equipment to function normally and within the requirements of the specifications when the ambient relative humidity is between 25% and 100%.

.3 Provide material and equipment to function normally and within the requirements of the specifications when the supply voltage is within minus 15% and plus 10% of the nominal voltage and the frequency is within 5% of the nominal frequency.

1.20 Acceleration of the Work

.1 If the Work falls behind the schedule, take action as necessary to meet the schedule, including, but not limited to, extra personnel and overtime work.

.2 Pay any costs associated with this action unless the delay is caused by acts of government, riot, civil commotion, war, malicious mischief, act of God or any cause beyond the control of the contractor.

1.21 Overtime provisions

.1 Include overtime labour for work necessary to complete the job, such as emergency power testing, fire alarm testing, wiring of hall stations into dispatchers, tasks requiring two or more elevators in a group to be out of service and work that will cause a major disruption of service to the building.

1.22 Overtime premium

.1 In the event that the Owner, for whatever reason, pays for overtime worked to complete the work as set out in the Specifications, the Owner will pay the added cost of the overtime plus twenty-one percent for all miscellaneous charges such as overhead, inefficiency, et cetera.

.2 The added cost shall be the difference between the actual overtime cost and actual straight time cost.

.3 The actual cost shall be that amount that the Contractor is required to pay to the Contractor's employees on the job site together with any amounts that the Contractor is required to pay on behalf of the employees in

contributions to various fringe benefits.

.4 Obtain from the Owner prior written authorization for overtime to be worked and chargeable, as described above, to the Owner, this authorization to be for specific amounts and for specific times.

.5 Submit time sheets for such overtime worked for approval to the Owner or the designated representative of the Owner within 48 hours of the time that such overtime is worked.

.6 If the procedures as set out above are not followed, assume the costs of the time worked.

### 1.23 Completion schedule

.1 Submit with the proposal, a detailed schedule including specific dates for equipment delivery times, start of site work, completion of each unit and resolution of all noted deficiencies.

.2 During the construction period give the following information to the Consultant:

.1 Revisions, if necessary, to the completion schedule;

.2 A progress report every month showing the progress being made and the percentage of the job completed;

.3 Two weeks advance notice for inspection by the Consultant.

.3 Schedule a job site meeting every two weeks during the construction period.

### 1.24 Drawing and sample submittals

.1 Drawing and sample submittals are required for exposed finishes and fixtures.

.2 Submit for review samples of metals, glass, paint colours, plastic laminates and finishes, of 200 mm (8") by 300 mm (12") approximate size, properly identified as to project, location and material.

.3 Submit for review, as a minimum, the following:

.1 General arrangements;

.2 Details of areas where the work joins the work of other trades;

.3 Machine room layouts showing the location of the

equipment;

.4 Hoistway layouts showing the location of the equipment, car platform dimensions, cab interior dimensions and net inside cab area;

.5 Hoistway sections showing overhead, pit equipment, car and frame and entrances;

.6 Cab details including the cab shell, platform, interior panels, ceiling, entrance, lighting and finishes;

.7 Details of control panels such as central control consoles or fire control panels showing the layout and detailing the design of switches and indicator lights;

.8 Details of intercom system station types detailing the controls;

.9 Details of any display devices complete with examples of proposed displays, symbols and layout;

.10 Fixture brochures.

.4 Show on the general arrangement or separately, details of frames, doors, sills and supports, lanterns and gongs, including views showing the relationship of hall stations, lanterns and entrances.

.5 Provide as built information at job completion prior to Substantial Performance.

.6 Reviews do not include the checking of measurements and do not imply approval of variations from the specifications.

#### 1.25 Defective work and non-performance

.1 The Owner reserves the right to correct any defective work and to charge the cost to the contractor.

.2 Should the contractor fail to execute any of the Work set out in the contract the Owner reserves the right to do the Work and to charge the cost to the contractor.

.3 The Owner reserves the right to withhold payment in the event of non-performance or to pay only for that portion of the Work that has been executed.

.4 The Owner will give reasonable notice in writing prior to taking such action unless the defective work or non-performance prejudice the safety of

people or the installation.

#### 1.26 Electrical diagrams

- .1 Supply wiring diagrams and data as required for the execution of the Work including schematics for speed control, dispatching system, interfaces, printed circuit boards.
- .2 Incorporate, as part of the schematic diagrams, a reference index ('road map') giving the location of electrical components and wiring interconnections for relay coils, relay contacts, field equipment, integrated circuits and other such devices, so that the position on the schematics of any of these items can be readily determined.
- .3 Supply, prior to the Substantial Performance inspection, three prints and one reproducible of the wiring and schematic diagrams revised to show changes that have been made.
- .4 Supply, prior to the Substantial Performance inspection, a set of plastic coated schematics mounted on a rack in the machine room so arranged that each sheet is readily accessible for trouble-shooting purposes, revised to show changes that have been made.
- .5 Supply, prior to the Substantial Performance inspection, a PDF copy of the wiring and schematic diagrams revised to show changes that have been made.
- .6 If changes are subsequently made to the wiring or control, supply an additional two sets of marked-up prints, a marked-up set of plastic coated schematics mounted on a rack in the machine room and an additional PDF copy of marked-up prints of the schematics and field wiring diagrams showing the changes.

#### 1.27 Test data form: traction

- .1 After completion of the Work, and prior to the inspection by the Consultant, submit a test data form certifying that the unit is complete and ready for inspection.
- .2 Arrange that this form be signed by the person responsible for the performance of the Work.
- .3 Include a check list of the items in the specifications as well as other performance data such as door times, operating times, brake-to-brake times, starting, running, stopping currents and voltages, slowdown and limit switch settings, governor settings, and, in general, settings of any adjustable devices.
- .4 List on this form safety devices, together with their settings and indicate whether they have been checked and adjusted.

.5 Submit a soft copy of the data form in PDF (Acrobat Reader) format.

1.28 Patents

.1 Hold and save the Owner and its officers, agents, servants and employees harmless from liability due to patent or copyright infringement arising from the use of, in the performance of the work or in the completed installation, any invention, process, article, or appliance.

1.29 Liability insurance

.1 Provide, during the period this contract is in force, premises liability, including public liability insurance and property damage insurance in the amount of \$5,000,000 inclusive, to be covered against any claims for damage to property or for personal injury, including death, which may arise from operation under this contract, whether such operation is by yourself or by any sub-contractor or anyone directly or indirectly employed by you.

.2 Upon completion of the contract, have in force a completed operations and products liability insurance, in the amount of \$5,000,000 inclusive, to be covered against any claims for damages to property or for personal injury, including death, which may arise after the premises liability is terminated.

.3 Maintain the insurance in force for a minimum period of two years after completion of the contract.

.4 List the Owner as an additional insured.

.5 The certificates shall state that the insurance will not become ineffective without sufficient written notice to the Owner.

.6 Submit certificates of such insurance with the Owner before work is begun.

1.30 Equipment insurance

.1 The Owner's insurance policy covers equipment actually in place in the building and accepted by the Owner.

.2 All other material and equipment is not included in the Owner's policy and such material and equipment is stored at the Contractor's own risk.

1.31 Failure to perform

.1 If the contractor shall neglect to prosecute the work properly or fail to perform any provision of the contract, the Owner after ten days written notice to the contractor may, without prejudice to any other remedy the Owner may have, make good such deficiencies and may deduct the cost therefrom from payment due to the contractor.

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### 1.32 Fixture type

- .1 Provide, unless otherwise indicated in the Specifications or Drawings, all signal fixtures, such as push buttons, position indicators, et cetera, of the vandal resistant type.
- .2 Provide Dupar US91 Optic C3 with BB push buttons with the following characteristics:
  - .1 Mirror chrome for surround finish.
  - .2 Mirrored steel on outer portion of button with stainless steel in the middle.
  - .3 Dual illumination whereby button and Braille are partially illuminated white when not pressed with the halo around the button turning red once pressed and the Braille having full white intensity when the button has been pressed.
  - .4 Braille to the left of each push button in black anodized aluminum. Braille tactile to be recessed and studded on the car station.
- .3 Provide push buttons with a positive stop on the back of the button to prevent excessive force from transferring to the contact.
- .4 Provide, unless otherwise indicated in the Specifications or Drawings, signal fixtures in an illumination colour selected by the Owner.
- .5 Submit illustrations of those types available and provide at least one physical button sample of the type selected by the Owner for final approval.

### 1.33 Key switches

- .1 Where key switches are specified supply switches and keys compatible with the vertical transportation equipment portfolio of the Owner, where possible, unless otherwise noted herein.
- .2 Provide to the Owner, five copies of each key-switch key type defined in the Code as being Security Group 2, 3 and 4.
- .3 Provide keys with engraved labels and group the keys by Security Group and key type.

### 1.34 Finishes: stainless steel

- .1 Provide, unless otherwise indicated in the Specifications or Drawings, Rimex stainless steel 12LG number 2B finish for visible natural metal finishes.
- .2 Arrange, unless otherwise indicated in the Specifications or Drawings, that the brush or grain direction of finishes of visible natural

metals be in the direction of the longer surface dimension.

1.35    Maintenance manual

- .1        Supply to the Owner prior to the Substantial Performance inspection, a maintenance manual in PDF format.
- .2        Incorporate in the manual a description of the controller user interface, fault and error codes, troubleshooting and diagnostic procedures, methods of use and the adjustment of programmable parameters together with their settings at the time of final adjustment.

1.36    Operation manual: elevator

- .1        Supply to the Owner prior to the Substantial Performance inspection, a manual describing in detail the operation of the equipment including special features, dispatching sequences, and such items as intercom systems and security systems.
- .2        Set out in step by step form the operation for special features such as Firefighters' Emergency Operation, Independent service and Emergency Power service.
- .3        Supply, as part of the manual, as built diagrams and drawings of operating panels (e.g. car panels, central control consoles) with descriptions of the function of switches and indicators.
- .4        Supply one copy of the manual in PDF format on digital media acceptable to the Owner.

1.37    Technical seminar

- .1        At the time of Substantial Performance, arrange with the Owner to provide a seminar for the Owner's staff.
- .2        Include in the seminar a complete review of the documentation, operation of the equipment and demonstration of any special features.

1.38    Trade marks

- .1        Do not apply trade marks visible to the general public on any piece of equipment.

1.39    Parts

- .1        Supply parts on request for a period of fifteen years subsequent to Substantial Performance of the project, at then prevailing prices.
- .2        Where purchased components are used, ensure that the original manufacturer's name and component designation are clearly marked on the part or in the parts catalogue.

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| <u>1.40</u> <u>Dimensions</u>                        | .1        Provide equipment to suit the existing hoistway, pit and overhead dimensions.  |
| <u>1.41</u> <u>Measurements</u>                      | .1        In the execution of the work, verify all dimensions with the actual conditions in order to do a perfect job.   |
| <u>1.42</u> <u>Unit inspection by the Consultant</u> | .1        Advise the Consultant in writing two weeks prior to the completion of a unit so as to arrange an inspection by the Consultant at a mutually convenient time.<br><br>.2        Assist the Consultant in the performance of this inspection to verify that performance figures, workmanship and equipment furnished are in compliance with the Specifications.<br><br>.3        Provide the necessary test weights to carry out full load tests and a team of competent persons to assist the Consultant in making the necessary tests and inspections.  |
| <u>1.43</u> <u>System log error codes</u>            | .1        Provide to the Owner a PDF document listing system error codes complete with a full English description of the meaning of each code.<br><br>.2        Incorporate as part of the document a description of the procedure for accessing and resetting the codes and demonstrate this procedure to the Consultant.   |
| <u>1.44</u> <u>Special tools and access codes</u>    | .1        If any special tools (i.e. tools that are not readily purchased from a hardware supplier) are used to maintain or adjust the equipment or are required for any aspect of the work on the equipment, list these tools with details on the proposal form and provide such tools to the Owner prior to Substantial Performance.<br><br>.2        If any access codes are used to maintain or adjust the equipment or are required for any aspect of the work on the equipment (including the reading and resetting of error codes and logs) list these access codes with details on the proposal form and provide such access codes to the Owner prior to Substantial Performance.<br><br>.3        Do not change the access codes without the written consent of the Owner and, when changed, provide to the Owner the new access codes. |

1.45 Generic maintenance

- .1 Arrange that the equipment can be maintained and adjusted by any competent elevator company without the use of proprietary tools, information or equipment or, if such tools, information or equipment are required, provide them (these shall become the property of the Owner).
- .2 Provide a customer tool or such similar device if necessary to carry out full load overspeed safety tests or other similar tests (for temporarily bypassing the appropriate circuits).
- .3 Offer to the Owner updates to the system software, from time to time as may be required to keep it current.
- .4 Offer these updates to the Owner at standard market prices such as those charged to United States government agencies.
- .5 Do not incorporate any running time, cycle counters or trip counters that would cause the equipment to shut down or alter its operation in any way.

1.46 Operation by persons with physical disabilities

- .1 Ensure that controls and fixtures comply with Appendix E of the Code.

1.47 Codes and ordinances

- .1 Supply equipment and do work in accordance with building codes, by-laws, regulations and requirements of the local, provincial and federal authorities in effect at the time of the execution of the work.
- .2 Supply equipment and do work in accordance with the Code, and any other code which may govern the requirements of the installation.
- .3 Provide labour and material, whether or not specifically mentioned in this specification, that may be necessary to provide an installation conforming to the applicable codes and regulations.
- .4 Comply with the requirements of the Occupational Health and Safety Act and Workplace Hazardous Materials Information System (WHMIS) regarding employee safety, use, handling, storage and disposal of hazardous materials.
- .5 Prior to submission of the proposal and throughout the duration of work, give prompt notification in writing of any regulations or requirements known to be in process which might affect the acceptability of the work.
- .6 If changes in codes or regulations result in extra costs, those taking effect subsequent to the date of proposal submission shall be treated as an extra to the contract.

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- 1.48 Subcontractors
- .1 Bind subcontractors to all applicable portions of the Specifications.
  - .2 The contractor shall be responsible for all actions and all work performed by its subcontractors to the same extent as the contractor is itself responsible under the Specifications.
- 1.49 Preliminary information
- .1 Submit, within 30 working days after awarding of contract, the information and details, including reactions, power requirements, ventilation requirements, cutouts, access requirements, light and outlet locations, quantity, location and size of external wires required to inter-connect the equipment, and all other information required to complete the work to be performed by others in conjunction with the installation of the equipment.
- 1.50 Information with proposal
- .1 Provide the following information, where relevant, with the proposal:
    - .1 The model and manufacturer of such items as solid state drives, fixtures, control systems, door operators and other purchased material (with the exception of miscellaneous minor items);
    - .2 The current rating of the solid state drives;
    - .3 The KVA rating of the transformers feeding the solid state drives;
    - .4 Certification from an independent testing laboratory detailing the line pollution generated by the solid state drives;
    - .5 Certification from an independent testing laboratory detailing the extent to which the control systems are protected against external electromagnetic radiation;
    - .6 Brochures, descriptions and manuals (where applicable) for the major items;
    - .7 Renderings or samples of the fixtures and exposed materials;
    - .8 Detailed completion schedule for the work;
    - .9 A copy of your health and safety policy as issued to your employees;
    - .10 Mechanic and team regular and overtime hourly rates.

1.51 Withdrawal or rejection of proposals

- .1 The Owner reserves the right to reject any or all proposals or to waive any conditions.
- .2 Proposals may not be withdrawn until sixty days after the scheduled date for the receipt of the proposals.

1.52 Organization chart

- .1 Provide to the Owner an organization chart from the local supervisory level up.
- .2 Provide to the Owner the names, positions and experience of the field and supervisory personnel associated with this project.
- .3 During the course of the work when organization changes are made, provide the Owner with updated information.

1.53 Regular hours of work

- .1 Regular hours of work are from 07:00 to 17:00 Monday to Friday, excluding holidays.
- .2 Carry out noisy work, work creating excessive odours or work that creates a disturbance to the building tenants outside of regular hours or at such other times as selected by the Owner and include in your submission the costs for such overtime work.

1.54 Progress payments

- .1 Progress payments will be based on the percentage of the work complete as determined by the Consultant.
- .2 A 10% holdback will apply to payments, this holdback to be released within one year of completion of all the work described in these specifications.

1.55 Request for payment

- .1 Submit monthly applications for payment for work done at the end of each month together with the necessary data, information, waivers and affidavits.

1.56 Payment withheld

- .1 Approval for payment may be withheld to such extent as may be necessary on account of:
  - .1 Defective work not remedied;
  - .2 Claims filed or reasonable evidence indicating probable filing of claims;
  - .3 Failure of contractor to make payments properly to

sub-contractors or for material and labour;

.4 Failure to work to schedule;

.5 A reasonable doubt that the contract can be completed for the balance then unpaid;

.6 Damage to the building or another contractor.

.2 When the above grounds are removed, payment will be made for amount withheld.

1.57 Liens and affidavits

.1 The final payment and any part of the retained percentage shall not become due until a complete release of liens arising out of this contract or receipts in full in lieu thereof have been delivered to the Owner.

.2 Furnish an affidavit to the Owner that the release or receipts include labour and materials for which a lien could be filed.

.3 If any lien remains unsatisfied after all payments are made, refund to the Owner monies that the Owner may be compelled to pay in discharging such a lien, including costs and reasonable legal fees.

1.58 Labour laws

.1 Comply with applicable provisions of federal, provincial and local labour laws and with applicable union regulations.

1.59 Personnel

.1 Supervise your personnel so that they present a neat appearance and their movement in the building is within the requirements of their work.

.2 Provide uniforms and photo identification for personnel.

.3 The Owner reserves the right to reject or refuse access to personnel or contractors at its sole discretion.

.4 Assign and maintain a dedicated service representative to the work, this representative to be responsible for liaison with the Owner and the Consultant.

.5 Assign and maintain a dedicated service supervisor to the work, this supervisor to be responsible for technical communications with the Owner and the Consultant.

1.60 Protection of the Work and property

- .1 Maintain protection of the Work and protect the Owner's property from injury or loss arising out of the execution of this contract.
- .2 Make good any injury or loss caused by your agents or employees.
- .3 Take all necessary precautions to ensure that the Work is done in a manner that does not endanger any person.

1.61 Work site protection

- .1 Provide, maintain and, after the work is complete, remove protective hoarding around the work site.
- .2 Arrange the protective hoarding so as to prevent public access to the work site.

1.62 Hoistway protection

- .1 Provide, maintain and, after the Work is complete, remove any partitions required in the hoistway.
- .2 Provide, maintain and, after the Work is complete, remove protective hoarding required at openings into the hoistway.
- .3 Submit the design and finish of the protective hoarding for review.

1.63 Removal of rubbish

- .1 Remove rubbish, keep the building and premises clean during the progress of the work, and leave the premises at completion in perfect condition as far as the work under the specifications is concerned.

1.64 Taxes

- .1 Include applicable local, provincial and federal taxes or assessments in effect at the time of the signing of the contract.
- .2 Show on the proposal form the amount of each tax included.
- .3 The Contractor is liable for the above mentioned taxes or assessments whether or not specifically mentioned in his proposal or in the final contract document.
- .4 In the event new taxes or assessments, to become due on completion of the contract, are imposed after the signing of the contract these are to be paid, in addition to the original contract amount, by the Owner to the Contractor, who in turn is to pay them to the proper authorities.
- .5 In the event taxes or assessments in effect at the signing of the contract should be revoked before consummation of the contract rebate to the Owner the amount of such taxes and assessments included in the original

contract.

1.65 Environmental considerations

- .1 Where practicable recycle material replaced in the course of the work.
- .2 Provide a list of materials to be removed from site and their proposed recycling or disposal location for approval prior to commencing work.
- .3 Where practicable provide new materials manufactured by methods that do not adversely affect the environment by, for example, generating residual deposits of heavy elements and greenhouse gases.
- .4 Use materials on site, such as low VOC (Volatile Organic Compound) adhesives and paint, that will not negatively affect the in-building environment.
- .5 Use only adhesives that comply with the requirements of SCAQMD Rule #1168.

1.66 Coordination with other trades

- .1 Where the work joins another trade, provide drawings showing the actual dimensions and the method of joining the work to the work of the other trade and information such as anchors, templates and details for cast-ins.

1.67 Work by other trades

- .1 In the event that work by other trades is required and work by others as set out herein is in conflict with or inadequate for your equipment or design, so state on the proposal form with all necessary details.
- .2 If no exceptions are noted on the proposal form, pay the costs of all modifications necessary to suit your equipment and design.

1.68 Work under division 02 (Site Preparation)

- .1 A lockable storage space during the installation period.

1.69 Work under division 03 (Concrete)

- .1 Properly framed hoistways with a variation from nominal well dimensions of not more than +25 mm (1").

.2 A structure designed for the following reactions (including a provision for impact) generated by each device:

Reactions at:	car buffer		counterweight buffer		overhead	
	kN	lb	kN	lb	kN	lb
Elevator	161	36,300	135	30,300	172	38,600

.3 Supports for the sill support angles, flush with the inside hoistway wall, a minimum of 150 mm (6") in depth, capable of sustaining a minimum unit load equivalent to the capacity of the elevator.

.4 Pockets, as required, to permit fastening of rail brackets to building structure. Pockets to be filled after brackets installed.

.5 Suitable pits.

.6 Fire-resistant control room with a concrete floor and access door.

.7 Gross openings for hoistway entrances exceeding the clear door dimensions by 250 mm (10") on each side and above.

1.70 Work under division 04  
(Masonry)

.1 Grouting under hoistway sills.

1.71 Work under division 05  
(Metals)

.1 Supports for the guide-rails at each floor and in the overhead.

.2 For hoistway walls not made of concrete, intermediate supports for the guide-rails where guide-rail reinforcement cannot be installed by the elevator contractor and where floor heights exceed 4300 mm (14' 0").

.3 A hoisting beam at the top of the hoistway parallel to the hoistway doors and located in the middle of the hoistway plan, and capable of sustaining a 34 kN (7500 lb) load.

.4 Pit access ladders as shown on the Drawings.

1.72 Work under division 07  
(Thermal and Moisture Protection)

.1 Means to limit the presence of water, gases and odours in the pit.

.2 Waterproofing of the pit.

1.73    Work under division 08  
(Doors and Windows)

- .1        For the elevator control room, a full height self-locking and self-closing access door.
- .2        If required, pit access doors as shown on the drawings, being self-locking and self-closing (required where any single or common pit has a depth of more than 3000 mm (10')).

1.74    Work under division 09  
(Finishes)

- .1        Initial painting of the control room floors.
- .2        Sealing of the control room ceilings and walls to reduce dust.
- .3        Painting of the hoistway entrances, if required.
- .4        Elevator cab tile flooring.
- .5        Cutting and patching of machine room walls and floors as needed.
- .6        Cutting and patching of walls and floors around elevator entrances as needed.
- .7        Cutting and patching of walls around elevator hall fixtures back boxes and conduits as needed.

1.75    Work under Division 15  
(Mechanical)

- .1        A pit drain with connection to the building drainage system, drains to have a capacity of 11.3 m<sup>3</sup>/h (3,000 gal/h) per elevator having a positive means to prevent water, gases and odours from entering the hoistway.
- .2        A cover for the floor drains secured to and level with the pit floor.
- .3        Any sprinkler systems employing water if installed in the machine rooms, control rooms or hoistway to be arranged to operate at a higher temperature (approximately 20% higher) than the fire alarm sensors.
- .4        If required by the applicable regulations, means to limit the presence of smoke in the hoistway of the designated firefighters' elevator.
- .5        Heating and cooling in order to maintain continuously (i.e. 24 hours a day) a temperature of greater than 13 degrees Celsius and less than 29 degrees Celsius based on the heat generated by the elevator equipment as follows:

Heat generated:	control room		hoistway	
	kW	BTU/h	kW	BTU/h
Elevator	0.7	2,500	0.2	750

1.76 Work under division 16  
(Electrical)

.1 A grounded power supply sufficient to start and run each elevator at rated speed and capacity, and including the following:

.1 A disconnect means located in view of the elevator controller near the access to the control room.

.2 A disconnect means located in view of the elevator equipment at the top of the hoistway.

.3 The power supply should be capable of absorbing the regenerated power from the system.

.4 Wiring between the disconnect and the elevator power input point (elevator transformer or controller).

.5 Protection of the feeder cables.

.2 A power supply capable of supplying for each unit the following starting and running currents in amperes (based on a 600 V power supply):

Full load up currents	Power supply (V)	Starting current (amps)	Running current (amps)
Elevator	600	35	12

.3 In the elevator control room, an auxiliary disconnect contact with wiring to the controller for the traction elevator emergency power device, to indicate if the disconnect is on or off.

.4 In the elevator control room, one 15 A 120 V, single phase circuit breaker for each elevator, located adjacent to the lock side of the machine or control room door, to power cab ventilation and lighting equipment.

.5 In the elevator control room, one 15 A 120 V, single phase circuit breaker for each elevator, located adjacent to the lock side of the machine or control room door, to power the cab interior duplex GFCI receptacle and auxiliary equipment (e.g. camera).

.6 In the elevator control room, LED lights (with guards) controlled by a switch located adjacent to the lock side of the space access door, located at approximately 2500 mm (8') from floor level as required to give a minimum illumination of 200 lx at floor level and within the controller.

.7 In the elevator control room, duplex GFCI receptacles mounted on the wall and spaced at approximately 5000 mm (16') intervals.

.8 In the pit, duplex GFCI receptacles mounted on the wall, spaced at approximately 5000 mm (16') intervals and located clear of elevator

equipment.

.9 In the elevator pit, LED protected lights, controlled by a light switch located adjacent to the pit entrance, located clear of elevator equipment to give a minimum illumination of 160 lux at pit level, the lowest lamps to be within 500 mm (20") of the pit floor. The power for the lighting circuit to be derived from the emergency power supply if available.

.10 In the elevator overhead, LED lights (with guards), located in front of and behind the machine and associated equipment as required to give a minimum illumination of 200 lux on the equipment. The light switch to be located in the hoistway at the point of entry. The power for the lighting circuit to be derived from the emergency power supply if available.

.11 In the elevator overhead, duplex GFCI receptacles mounted on the wall and spaced at approximately 5000 mm (16') intervals.

.12 Smoke detectors and heat detectors on the recall floor.

.13 Smoke detectors and heat detectors on the alternate recall floor.

.14 Smoke detectors and heat detectors on all other floors.

.15 Smoke detectors and heat detectors at the top of the hoistway.

.16 Smoke detectors and heat detectors in the pit.

.17 Smoke detectors and heat detectors in the machine space.

.18 Smoke detectors and heat detectors in the control space.

.19 A connection from the smoke detectors and heat detectors on the recall floor to the elevator controller.

.20 A connection from the smoke detectors and heat detectors on the alternate recall floor to the elevator controller.

.21 A connection from the smoke detectors and heat detectors on all other floors to the elevator controller.

.22 A connection from the smoke detectors and heat detectors at the top of the hoistway to the elevator controller.

.23 A connection from the smoke detectors and heat detectors in the pit to the elevator controller.

.24 A connection from the smoke detectors and heat detectors in the

machine space to the elevator controller.

.25 A connection from the smoke detectors and heat detectors in the control space to the elevator controller.

.26 An active telephone line to the control room.

.27 Conduit between the elevator hoistway, control room and any remote equipment locations, terminated outside the hoistway at the basement level (or other level designated by the Owner) at a junction box (junction box to be provided by the elevator contractor).

.28 Pulling of wire between the elevator hoistway, control room and any other remote equipment locations.

.29 Electric power during erection, for illumination, operations of tools and hoist, starting, testing and adjusting.

\*\*\*\*\*END OF SECTION\*\*\*\*\*

**Section 14 21 23 MRL Passenger Elevator****PART ONE - GENERAL****1.1 General requirements**

- .1 Conform to Section 14 20 00.
- .2 Provide equipment to suit the control room (room D231), pit, hoistway, and overhead dimensions shown on the architectural drawings.
- .3 Provide labour, materials, products, equipment and services necessary for the supply and installation of one machine-room-less traction passenger elevator.
- .4 Provide products by Delta Elevator Co. Ltd. or approved equivalent.

**1.2 Data**

Building #046		
number of units	1	
designation	TBD	
application	passenger	
rated speed (m/s, fpm)	0.76	150
capacity (kg, lb)	1590	3500
motor power (kW, HP)	7.7	10
operation	simplex	
machine type	machine-room-less traction	
machine location	within hoistway	
drive type	solid state regenerative	
emergency brake	provide	
car governor	provide	
counterweight governor	none	
roping ratio	2:1	
control system	microprocessor	
control location	room D231	
front entrances	1, 2	
rear entrances	none	
door type	single speed side opening	
hoistway door fire resistance	1.5 hours	
lobby sill material	aluminum	
cab sill material	aluminum	
entrance width (mm, “)	1070	42
entrance height (mm, “)	2130	84
entrance markings	provide	

cab width (mm, “)	2030	80
cab depth (mm, “)	1600	63
cab height (mm, “)	2440	96
car door restrictor	provide	
door safety retainers	provide	
entrance protection	infrared multi-beam	
door operator	GAL MOVFE	
interlocks	provide	
main car station	provide, applied	
auxiliary car station	none	
verbal annunciation	provide	
car position indicator	digital	
cab emergency lighting	provide	
cab communication	hands-free telephone	
in-cab news monitor	none	
car call security	provisions	
hall call security	none	
hall stations (typical)	single riser	
hall stations (main floor)	single riser	
hoistway access switches	provide	
cab ventilation	2-speed fan	
cab finishes	provide	
hall door finish (typical)	Rimex stainless steel 12LG	
hall door finish (main floor)	Rimex stainless steel 12LG	
car door finish	Rimex stainless steel 12LG	
hall lanterns	provide	
in-car lanterns	none	
hall position indicator	dot matrix at floor 1	
lobby panel	none	
CACF panel	none	
central control monitor	none	
car top inspection station	provide	
load weighing device	none	
car guiding	provide	
counterweight guiding	provide	
guide rails	provide	
compensation	none	
emergency recall	automatic	
firefighter's operation	provide	
emergency power	battery rescue device	
car top railing	provide	

operating time	13.0 seconds
acceleration rate	0.8 m/s/s

## PART TWO - PRODUCTS

### 1.3 Prone stretcher requirement

- .1 Arrange the elevator to meet the requirement for accommodating and providing adequate access for a patient stretcher 2010 mm (79") long by 610 mm (24") wide in the prone position.

### 1.4 Speed

- .1 Arrange the elevators to run under any condition of loading, except the case of overload, within 1.5 percent of the rated speed.

### 1.5 Machine: MRL (Machine-Room-Less)

- .1 Provide a machine of the single-wrap traction type including an AC motor, electromechanical brake, sheave shaft and traction sheave properly aligned.
- .2 Mount the machine in the hoistway.
- .3 Provide a machine with a proven record, over a period of at least seven years, of satisfactory operation on other installations of the same speed, capacity and counterweighting.
- .4 Provide equipment which will deliver its rated output continuously with a temperature rise not to exceed 50 degrees C (122 degrees F).
- .5 Provide, as a minimum, Class B insulation.
- .6 Submit with the proposal the horsepower and torque ratings of the elevator motor.
- .7 Provide a traction sheave to suit the suspension means.
- .8 Provide a brake actuated switch to indicate to the control system the state of the brake: that is, lifted or applied.
- .9 Design and adjust the machine so that, when running at full speed, it vibrates no more than 0.025 mm (0.001") as measured at the motor end.
- .10 Arrange that the sound level in the hoistway at the machine location is not more than 60 dB during an elevator operating cycle, including brake lift and brake application.

.11 Provide sound and vibration isolation pads or springs arranged so that there is no solid contact between the machine and the building structure.

1.6 Solid state motor drive:  
regenerative

.1 Provide a regenerative solid state drive to control the speed of the elevator.

.2 Provide circuits to cause the elevator to regenerate power, under negative load conditions, to the building power supply with a minimum 0.95 power factor.

.3 Provide a drive system to meet the EN12015 standards and the recommended guidelines of IEEE-519 for generated harmonics and power factor measured at the disconnect switch.

.4 Provide pre-torquing.

.5 Arrange that the system in responding to a unit step function does not overshoot by more than 21 percent.

.6 Arrange that the error signal does not, in normal operation, exceed 2.5 percent.

.7 Provide means to shut down the unit in the event that the error signal exceeds 5.0 percent.

.8 Provide means to limit the increase in noise level during acceleration to less than 12 decibels (A scale) as measured in the centre of the machine room.

.9 Provide electronic feedback circuits to limit the current through the motor and the solid state power devices.

.10 Arrange that under low voltage conditions the unit does not exceed the current limits.

.11 Provide safety circuits to prevent runaway in the event of closed loop feedback circuit failure.

.12 Arrange these circuits so that:

.1 With a partial or complete loss of the feedback signal the elevator will come to a stop before the governor jaws are tripped;

.2 If the elevator is in the levelling zone with the door interlock circuit open, the elevator will come to a stop prior to leaving the levelling zone.

.13 Test these circuits by opening the feedback circuit while the elevator is running at contract speed no load up and while the elevator is levelling into

the floor no load up.

.14 Provide means for dissipating the heat generated by solid state devices.

.15 Provide safety circuits to shut down the unit in the event of overheating.

.16 Design the equipment so that power loss or power fade (brownout) does not cause fuses to blow.

.17 Provide means to protect the solid state power devices against surge currents.

.18 Provide filters and circuits to reduce the line pollution so that the distortion generated by the solid state power device is within the following limits as measured at the disconnect switch:

.1 The 5th harmonic voltage does not exceed 6 percent;

.2 The 5th harmonic current does not exceed 20 percent;

.3 The total harmonic voltage does not exceed 10 percent;

.4 The total harmonic current does not exceed 25 percent;

.5 Line voltage notching of duration greater than 1 millisecond is less than three per cent of the peak sine wave voltage measured from zero reference;

.6 The notch depth is less than 10 per cent;

.7 The notch duration is less than 2 milliseconds.

.19 Provide filters and circuits to reduce the electromagnetic noise level at any frequency with the elevator running, to not more than 0.1 db above the ambient electromagnetic noise level (with the elevator stopped), as measured in the centre of the machine room using a calibrated radio frequency receiver designed in accordance with CSA Standard C108.1.1 together with a calibrated rod or loop antenna.

.20 Provide filters and circuits to reduce the electromagnetic noise level at 10 KHz with the elevator running, to not more than 0.01 db above the ambient electromagnetic noise level (with the elevator stopped), as measured in the centre of the machine room using a calibrated radio frequency receiver designed in accordance with CSA Standard C108.1.1 together with a calibrated rod or loop antenna.

.21 Arrange the equipment so that any vibration generated is not transmitted directly to the building structure.

1.7     Speed control:  
regenerative

.1 Provide a closed loop negative feedback control system.

.2 Include in the system the following features:

.1 A pattern generator to give a velocity input signal modified by position with constant peak acceleration and constant peak change of acceleration;

.2 A digital or analog tachometer generator to provide a velocity feedback signal;

.3 A digital transducer to provide a position feedback signal;

.4 A current transformer to provide a current feedback signal.

.3 Provide the following safety devices:

.1 Means to stop the elevator in the event the error exceeds five percent of the signal;

.2 Means to stop the elevator in the event the acceleration exceeds the normal acceleration by more than fifteen percent;

.3 A circuit to cut off power in the event of excessive power module switching time;

.4 Means to cut off power in the event of overheating of the solid state components;

.5 A circuit to initiate a slowdown and stop at the next floor in the event of a disagreement between the position as derived from the digital transducer and the position as derived from the integration of the velocity feedback signal.

.4 Arrange the response of the system so that the elapsed time between the detection of a fault and the cut off of power does not exceed 100 milliseconds.

.5 Provide protective devices so arranged that any one fault will not cause risk of injury to the passengers.

.6 Arrange that, if a fault occurs such that a subsequent fault could cause an unsafe condition, the fault will be detected and the elevator shut down.

.7 Provide invertors and associated controls arranged to return to the electrical supply system the power produced by the machine under negative loads.

.8 Arrange the control system so that the power factor is not less than 96%.

## 1.8 Position transducer

.1 Provide a position transducer device to transmit to the control system the position of the elevator.

.2 Arrange that the device transmit a minimum of 10 counts per 25 mm (1") of travel.

.3 Provide a device having an overall precision within  $\pm 2.5$  mm ( $\pm 0.1$ ").

.4 Arrange the elevator controls so that the output from this device is read at least every 5 ms.

.5 Transmit the signal from this device either in serial format using a standard protocol (e.g, CAN) or in parallel format using low impedance (less than 10 kilohms) inputs.

.6 If the transducer is a relative (pulse counter) type rather than an absolute encoder type:

.1 Provide gray encoding so as to indicate the direction of movement of the car and to offset 'false' counts caused by vibration;

.2 In the event of a counter error reset the position with an accuracy within  $\pm 2.5$  mm ( $\pm 0.1$ ") by returning the car at low speed to a fixed point in the hoistway.

## 1.9 Emergency machine dual brake

.1 Provide an emergency braking device to prevent uncontrolled movement of the elevator.

.2 Provide a device separate from and independent of the normal elevator stopping devices.

.3 Provide a device combined with and integrated with the normal operating machine brake.

.4 Arrange that the braking device applies if:

.1 The elevator overspeeds;

.2 The elevator moves away from the floor with the doors open.

- .5 Restrict the deceleration effected by the emergency braking device to between 25% and 75% of gravity.
- .6 Arrange the device to restrict the distance the elevator is allowed to move away from the floor with the doors open to less than 400 mm (16").
- .7 Arrange the device so that it is actuated at a sufficient distance from the buffer — relative to the speed of the elevator — so as to prevent the counterweight striking the buffer at a velocity in excess of the rated velocity of the buffer.
- .8 Provide a manually reset electrical switch arranged to disconnect power to the elevator motor and brake when the emergency braking device is actuated.
- .9 Provide a device capable of being applied for test purposes without damage to the device or to the other elevator equipment.
- .10 Arrange the device so that it can be reset and the elevator put back into service only from the elevator machine room.
- .11 Arrange that the device and its component parts are readily accessible for maintenance.
- .12 After correctly adjusting the device, seal it with a numbered seal so as to prevent un-authorized re-adjustment.

#### 1.10 Brake spring

- .1 After the brake spring is adjusted for correct operation and prior to the performance of safety tests and checks by the inspecting authorities, provide means to positively define the length of the brake spring and minimize the possibility of future incorrect adjustment using one of the following methods:
  - .1 Measure the length of the brake spring and mark this length on a tag permanently affixed to the machine;
  - .2 Measure the number of exposed threads on the brake spring rod and mark this number on a tag permanently affixed to the machine.
- .2 Record the details of the brake setting on the test data sheet.

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- |  |   |
|--|---|
| <u>1.11</u> <u>Governor: automatic reset</u> | <ul style="list-style-type: none"><li>.1        Provide an automatic reset governor located so that it can be maintained from the top of the elevator car and tested without special access arrangements.</li><li>.2        Arrange that the governor, once tripped, will be reset when the car is moved up off the car safeties.</li></ul>   |
| <u>1.12</u> <u>Elevator suspension means</u> | <ul style="list-style-type: none"><li>.1        Provide elevator suspension means such that the addition of 50 per cent of the rated load to the car cab will cause no more than a 0.04 per cent elongation in the suspension means.</li><li>.2        Where multiple suspension elements are used in parallel to share a load, ensure that the elements are all from one manufacturing run.</li><li>.3        Provide sufficient removable counterweight buffer blocking to allow adjustment for suspension means stretch without requiring shortening of the suspension means.</li><li>.4        Where the suspension means is such that measurements of wear cannot be readily made, provide a method to indicate wear of the suspension means such as a marking stripe that will be exposed when replacement is required.</li></ul>   |
| <u>1.13</u> <u>Controller</u>                | <ul style="list-style-type: none"><li>.1        Provide a micro-processor based controller designed to give the required operation as herein specified.</li><li>.2        Mount panels securely on substantial, self supporting steel frames designed for floor or wall mounting.</li><li>.3        Provide completely enclosed controllers with covers.</li><li>.4        Do not mount equipment on the covers.</li><li>.5        Where relays are used, provide those having a design electrical life and mechanical life equivalent to thirty years operation in the given application, with their contacts designed for maximum conductivity and wiping action.</li><li>.6        Provide electronic time delay devices which employ stable capacitors or crystals as the time base.</li><li>.7        Install wiring on the controller, whether control or field wiring, in a neat workmanlike order and make connections to studs and terminals by means of solder or solderless lugs, or similar connecting devices.</li><li>.8        Mark relays, contactors, fuses, printed circuit boards and other components clearly and permanently with designations as shown on the</li></ul> |

schematics.

.9 Mount the designations for plug in components on the controller adjacent to the component; do not mount the designation on the plug in component.

.10 Provide a written guarantee from the control manufacturer that over the life of the installation software and firmware updates will be provided at no charge to the Owner.

#### 1.14 Computing devices

.1 Where computing devices are used, such as micro-processors or mini-computers, along with associated devices, design to the following requirements:

.1 Isolate the inputs from external devices (such as push-buttons) and isolate the outputs to external devices (such as indicators) by means of relays or optical devices;

.2 Provide the control program on read-only-memory with spare capacity to allow for future programming modifications and extensions;

.3 Provide crystal regulation of frequency;

.4 Provide for separate regulated power supplies to serve each micro-processor system.

#### 1.15 Power interruption restart

.1 Provide means so that the elevator system will restart automatically in the event of power interruption.

.2 Where volatile memories are provided for position and other data necessary to the continuing operation of the elevators, provide means of preserving this data on power failure or fading ('brownout') for a minimum of four hours and means of automatic recovery upon restoration of normal power.

#### 1.16 Control circuits grounding

.1 Arrange the control circuits so that one side of the control power supply for external circuits is grounded to facilitate testing and trouble shooting.

.2 An external circuit is defined as one wired outside micro-processors or solid-state devices, as for example, buttons, relays, lights, limits, locks and such similar devices.

.3 Arrange that accidental grounding in the control system will not

defeat the safety circuits.

#### 1.17 Solid-state hardware

- .1 Mount solid-state devices, except for high power silicon controlled rectifiers, on removable printed circuit boards.
- .2 Gold plate the contact points of edge connectors.
- .3 Use G10 glass epoxy with minimum equivalent 57 gram (2 ounce) copper.
- .4 Coat the circuits with tin-lead.
- .5 Provide a solder resist screen.
- .6 Provide plated through holes for double sided boards.
- .7 Make all connections to the printed circuits on the printed circuit boards by means of properly dimensioned pads.
- .8 Do not provide "patched" connections.
- .9 Design solid-state devices for a high level of noise immunity.
- .10 Incorporate electrical noise suppression devices in the power supplies and the inputs and outputs associated with the solid-state circuits.
- .11 Provide filters and circuits to limit the generated electromagnetic noise level at any frequency to not more than 0.1 db above the ambient electromagnetic noise level, as measured in the centre of the machine room using a calibrated radio frequency receiver designed in accordance with CSA Standard C108.1.1 together with a calibrated rod or loop antenna.
- .12 Provide filters and circuits to limit the generated electromagnetic noise level at 10 KHz to not more than 0.01 db above the ambient electromagnetic noise level, as measured in the centre of the machine room using a calibrated radio frequency receiver designed in accordance with CSA Standard C108.1.1 together with a calibrated rod or loop antenna.

#### 1.18 Auxiliary slowdown devices

- .1 Provide auxiliary slowdown devices compatible with the solid state speed control and so arranged that, if the normal slowdown devices fail to operate correctly, the elevator will be brought to a controlled stop at the terminal landing with an acceleration not exceeding 0.3 g.
- .2 Arrange the control circuits so that, if the auxiliary slowdown devices were required to act to stop the elevator, the elevator parks at the

terminal landing until the system is checked by a maintenance technician.

1.19    Entrances

- .1        Provide entrances consisting of frames, jambs, sills, sill support angles and brackets, struts, headers, fascias, toe guards, and sight guards and doors of approved design and size complete with guides and bumpers and all other items necessary to provide a completed installation.
- .2        Construct the doors of sheet steel a minimum of 1.3 mm (18 gauge) thick.

1.20    Entrance installation

- .1        Assume undivided responsibility for the entire installation of the entrances.
- .2        Handle, store, protect, install the entrances and associated equipment.
- .3        Set door frames in perfect alignment with the elevator car platform.
- .4        Fasten frames and headers to structural supports.
- .5        Set frames and sills in place prior to building walls.
- .6        Install frames within 1 mm (0.04") of plumb and sills within 2 mm (0.08") of level over the entrance width.
- .7        Fasten frames securely at the sill and header.
- .8        Fasten sills securely to the building structure by means of a support angle or substantial brackets.
- .9        Install struts, fascias, toe guards and other associated equipment required to complete the installation of the entrances.

1.21    Entrances: door hardware

- .1        Supply hoistway door hardware consisting of door hangers and tracks, interlocks, door closers, relating mechanism, operating linkages, gibbs, and all other hardware necessary for the installation and operation of the hoistway doors.
- .2        Supply, for each sliding panel, sheave type, two point suspension hangers.
- .3        Supply sheaves not less than 75 mm (3") in diameter with ball bearings, properly sealed to retain grease lubrication, and mounted on stands arranged for direct attachment to the panels.
- .4        Equip hangers with adjustable ball bearing rollers to take the

up-thrust of the doors.

.5 Arrange the tracks and sheaves so that there is no metal to metal contact, and so that the doors operate properly without any regular lubrication.

.6 Design all door hardware for a minimum of noise.

1.22 Door type: single speed  
side opening

.1 Provide car and hoistway doors of the single-speed side opening, horizontal sliding type.

1.23 Entrance: fire rating

.1 Provide entrances bearing a 1.5 hours fire rating approved by authorities having jurisdiction.

.2 Provide a closure, including interlock mechanism and associated wiring, capable of operating for a period of at least one hour when the assembly is subjected to the standard fire exposure tests.

1.24 Lobby and car sills:  
aluminum

.1 Provide aluminum sills.

1.25 Floor marking: hoistway

.1 Identify each landing by means of markings on the inside of the hoistway.

.2 Place these markings so that people in a stalled elevator will be able to readily see the floor marking upon opening the car doors.

.3 Use a stencil to ensure that the floor markings are neat and uniform in appearance.

.4 Provide numerals and letters approximately 100 mm (4") high and of a clearly contrasting colour to the colour of the doors and fascias.

1.26 Entrance floor markings

.1 Provide, on each hall entrance jamb, raised tactile and braille metallic markings to designate the floor.

.2 Provide markings as selected by the Owner.

.3 Provide samples for review.

1.27    Main floor elevator markings

- .1        Provide at the main floor, for each elevator designated as a Firefighter's Elevator, a suitable symbol such as a Firefighter's Hat.
- .2        Provide at the main floor for each elevator a numeral indicating the number of the elevator.
- .3        Provide markings as selected by the Owner.
- .4        Provide samples for review.

1.28    Fascias

- .1        Provide fascias to meet, as a minimum, the requirements of the Code.
- .2        Unless a car door interlock is provided and the strength of the car door meets the applicable requirements of the Code:
  - .1        Provide fascias from the header of one entrance to the sill of the entrance above for the complete travel of the elevator including any express zone;
  - .2        Provide fascias extending below the sill of the lowest landing and above the header of the highest landing.
- .3        Provide fascia plates extending on each side at least 75 mm (3") beyond the clear openings.
- .4        Provide fascia plates of sheet steel of minimum 1.5 mm (16 gauge) thickness.
- .5        Reinforce fascia plates properly.
- .6        Provide all necessary supports required to secure fascia plates in place.

1.29    Car frame

- .1        Provide a car frame of steel channels and angles securely welded, bolted or riveted and substantially reinforced and braced so as to relieve the car enclosure of all strains.

1.30    Car platform

- .1        Provide a car platform of sufficient size to accommodate the cab and to give the required inside net area assuming typical 50 mm (2") wall thickness and 180 mm (7") for doors, sill and return.
- .2        Provide a car platform with a structural steel frame filled with wood, aluminum or steel flooring having a depression to receive the finished floor.
- .3        Mount the car platform on isolating pads to prevent the transmission

of noise and vibration from the car frame to the car platform.

.4 Install the equipment in such a way that there is no direct metal connection between the car platform or the car cab and the car frame except metallic flex, where required, run in such a way as to provide vibration isolation.

### 1.31 Cab installation

.1 Assume undivided responsibility for the entire installation of the cab.

.2 Handle, store, protect and install the cab and all associated equipment.

.3 Install the elevator cab on the platform plumb and in alignment with the hoistway entrances.

.4 Sound isolate the cab from the car frame.

.5 Provide additional material and labour as required for handling, storing and installing the cab so as to provide a complete job.

### 1.32 Car door equipment

.1 Provide car door header, hangers and tracks, door closers, door electrical contacts, master door operators, and all incidental devices necessary for the correct operation of the doors.

.2 Provide, for each sliding car door panel, sheave type, two point suspension hangers.

.3 Provide sheaves not less than 80 mm (3.25") in diameter with ball bearings, properly sealed to retain grease lubrication, and mounted on stands directly attached to the panels.

.4 Equip hangers with adjustable ball bearing rollers to take the up-thrust of the doors.

.5 Arrange the tracks and sheaves so that there is no metal to metal contact, and so that the doors operate properly without any regular lubrication.

.6 Design all door equipment and associated components for a minimum of noise.

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- .3 Position the receivers and emitters at least 25 mm (1") back from the leading edge of the door.
- .4 Provide logic control to ensure that each receiver receives light from every emitter.
- .5 Arrange that if the system fails to provide protection over the active area of the door opening, the elevator will park at the current floor with its doors open and the lights off, or the system will go over to nudging operation.
- .6 Provide a signal on the unit or in the machine room to indicate that a failure has occurred.
- .7 Should a door protective device be operated continuously for more than 20 seconds after the elapse of the normal door open time, cause the doors to go over to nudging operation.
- .8 Arrange the nudging operation as follows:
  - .1 Cause the doors to close slowly under reduced power;
  - .2 Operate a buzzer in the car panel as a warning to the person obstructing the door;
  - .3 Cause the 20 seconds to be reduced to 6 seconds until a normal door cycle is performed.
- .9 Supply a device, reliable and consistent in operation, not affected by dust or temperature changes, and having inherent long term reliability with minimum maintenance.

#### 1.38 Door operator

- .1 Provide a heavy duty door operator to open and close the car and hoistway doors simultaneously.
- .2 Mount the operator on the cab above the car doors.
- .3 Provide either:
  - .1 An alternating current motor, either standard or linear induction type, with associated variable voltage and variable frequency solid state drive to control the speed and torque of the door operator, or;
  - .2 A direct current motor with associated solid state drive to control the speed and torque of the door operator.
- .4 Provide as a minimum a 375 W (0.5 HP) motor.

- .5 Provide dual drive arms for centre-opening doors.
- .6 Provide GAL MOVFE or approved equivalent.
- .7 Provide a solid state door operator control incorporating negative feedback circuits for position, acceleration, velocity and torque.
- .8 Provide event logging with non-volatile memory so as to retain the event log under power-off conditions.
- .9 Provide fully automatic installation algorithm profiles that self-adjust the motion profile for the relevant parameters.
- .10 Provide an output from the door control for a pre-start command to the elevator speed control system.
- .11 Provide optical isolation for input and output signals.
- .12 Provide signal line short circuit protection.
- .13 Provide a serial input to the door control to allow adjustment of speed, acceleration, torque and pre-start point using a notebook computer or keypad.
- .14 Provide the keypad or software for a standard notebook computer.
- .15 Arrange that the settings for the door operator can be uploaded to the keypad or notebook computer and then downloaded to another identical operator.
- .16 Provide an average door closing speed of 300 mm (12") per second, respecting the parameters for door force and door inertia as set out in the elevator code.
- .17 Provide an average door opening speed of 700 mm (28") per second.
- .18 Provide, either in the door operator control or in the main elevator control, means to automatically recycle the doors in the event that they stall during the opening or closing operations.
- .19 Design the door operator and associated components for a minimum of noise.

1.39    Hoistway entrance lunar  
key access

- .1        Provide lunar key access for each hoistway entrance.

1.40    Car station

- .1        Provide one car station on the right side of the cab (viewed from within the elevator cab facing the doors).
- .2        Provide in the station the devices required for normal automatic operation, including the following:
- .1        Floor push buttons;
- .2        Door open button;
- .3        Door close button.
- .3        Number the car call buttons to correspond to the floor served.
- .4        Provide in conjunction with the car buttons a call registered light for each button to be lighted when the button is pressed and extinguished when the car stops at the selected floor.
- .5        Provide, only when required by the prevailing codes, a stop switch, arranged to stop the elevator and to duplicate the functions of the alarm button.
- .6        Provide a locked service cabinet, located below the main car station, containing those devices, other than those used for normal automatic operation, required for the various control features, including the following:
- .1        Light switch;
- .2        Fan switch;
- .3        GFI duplex receptacle for maintenance purposes (Run the wires for this receptacle separately from the wires for the other car light and ventilation equipment and connect it to a separate breaker in the machine room);
- .4        Emergency lighting test switch.
- .7        Engrave the car station with markings and signage such as car capacity, elevator number and other markings required by the prevailing codes and local regulations.
- .8        Hinge the car station faceplate so that it can be swung open to allow access for servicing of the inner components of the car station.
- .9        Provide a hinge capable of supporting without distortion a test weight of minimum 11 kg resting on the panel non-hinged edge with the panel

swung open.

1.41 Car position annunciator

- .1 Provide automatic verbal announcement to announce the floors and to provide floor passing tones.
- .2 Provide a unit to meet the requirements of the Code.
- .3 Provide a key switch in the service cabinet to allow the option of having floor passing tones or verbal announcements or neither one.
- .4 Provide means in the service cabinet to adjust the volume over a range from 55 and 70 decibels.
- .5 Use a female voice for the announcements.

1.42 Car position indicator:  
digital readout

- .1 Provide a digital car position indicator mounted in each car operating panel.
- .2 Arrange the indicator to display a number or symbol at least 50 mm (2") high.
- .3 Indicate the position of the car at all times, corresponding to the landing through which the car is passing or at which it is stopped.
- .4 Provide a segmented display using light emitting diodes with a minimum of 16 segments per character.
- .5 Arrange the circuits so as to provide continuous indication of car position.
- .6 Overlapping dual indication, when the elevator is between floors, is acceptable.

1.43 Emergency lighting

- .1 Provide a back-up battery power system for alarm bell operation and emergency cab lighting.
- .2 Provide a lighting level of at least 11 lux of illumination at the car operating panels for a minimum period of four hours, using at least two lamps of equal rating.
- .3 Cause the lamps to be immediately energized in the event of a power failure or electrical fault de-energizing the normal elevator lighting circuit.
- .4 Provide for the automatic disconnection of the lamps and the automatic recharging of the lighting unit when normal power is restored to

the elevator lighting circuit.

.5 Provide a rechargeable battery of the hermetically sealed type, or of a type which provides a reserve of electrolyte, capable of operating unattended and requiring no addition of water or electrolyte for a period of not less than ten years, with provision for visual checking of the electrolyte level without opening the battery or removing caps or fittings.

.6 Arrange the battery charging to operate automatically upon restoration of normal power to the unit, to remain in operation until the battery is fully recharged and to maintain the battery at full rated capacity at all times when the unit is not in operation.

.7 Provide a pilot lamp to indicate that the normal power supply to the unit and battery charging is in operation.

.8 Arrange that the unit can be conveniently tested and operated manually.

.9 Install the unit as part of the car so that it is not readily removed.

.10 Do not provide portable equipment.

.11 Install the lamp fixture above the car station.

.12 Provide an emergency lighting test switch in the car service cabinet or behind the car swing return.

#### 1.44 Signal lights

.1 Provide LED position indicators and call registered lights having a minimum contrast ratio of 8:1 throughout a life expectancy greater than 100,000 hours.

.2 The contrast ratio is to be determined by subtracting the brightness of the indicator background from the brightness of the marking and then dividing the result by the brightness of the background.

.3 Arrange that the variation in intensity and contrast ratio between position indicators does not exceed 5 percent.

.4 Arrange that the variation in intensity and contrast ratio between call registered lights does not exceed 5 percent.

.5 All measurements are to be made in ambient lighting conditions meeting Code requirements.

1.45 Cab fan and light 'Green Control'

- .1 Provide a device in the cab to remove power from the cab lights and fan when there is no one in the elevator.
- .2 Arrange that the cab lights and fan are turned off in five minutes when:
  - .1 No movement in the cab is sensed;
  - .2 The elevator is level at a floor;
  - .3 The elevator doors are closed;
  - .4 The elevator has not been selected to answer a call;
  - .5 The elevator is on automatic operation;
  - .6 The elevator safety circuit (including interlocks) is intact.
- .3 Should any of the above conditions no longer obtain or when telephone communication is initiated, turn the car lights and fan on.
- .4 Use a triaxial accelerometer to detect movement.
- .5 Provide a Henning "Light Watcher" device or approved equivalent.

1.46 Telephone: hands-free operation

- .1 Provide a hands-free telephone with automatic dialer capable of initiating and receiving calls.
- .2 Integrate the telephone into the car station.
- .3 Provide a push button to initiate the telephone connection.
- .4 Arrange that the telephone connection can be initiated by an external call.
- .5 Provide an indicator light to confirm that communication has been established.
- .6 Pierce the car station for the push button and indicator light with the indicator light mounted flush with the panel.
- .7 Provide a speaker/microphone for communication.
- .8 Pierce the car station in front of the speaker with multiple holes 3 mm (1/8") in diameter to allow passage of sound to and from the speaker.

- .9 Identify the telephone and the button with a raised symbol and Braille.
- .10 Provide wiring for the telephone from the cab to the machine room.
- .11 Provide a communication station in the machine room.
- .12 Connect the wiring on the car to a terminal block mounted in or adjacent to the telephone box.
- .13 Terminate the wiring in the machine room at a separate enclosed external terminal block mounted on the controller.
- .14 Provide the terminal block and its enclosure and locate it so that personnel other than elevator mechanics can easily run their conduit and wiring to these terminals without interfering with or touching the elevator wiring or controls.
- .15 Where more than one controller is in a common machine room bring wiring to one common terminal block.
- .16 Clearly mark the terminal block.
- .17 Provide wiring of the twin conductor shielded type with grounded shields.
- .18 Provide equipment and wiring compatible with and acceptable to the telephone company providing service to the project.
- .19 Provide material and labour as necessary so as to ensure that the communication system meets the requirements of the Code.

#### 1.47 Security system

- .1 Provide for the future installation of an elevator card reader security system.
- .2 Provide accessible space, mounting supports and wiring for a security antenna and a security controller in the cab main front return panel.
- .3 Provide a free space 100 mm (4") in height, 175 mm (7") in width and 75 mm (3") in depth centred behind the car panel insert for the security antenna installation.
- .4 Provide, within 250 mm (10") of the security antenna, a free space 200 mm (8") in height, 200 mm (8") in width and 75 mm (3") in depth, for the security controller installation.
- .5 Provide in front of the security antenna a translucent polycarbonate cover.

- .6 Provide an elevator security interface box in the machine room mounted on the side of an elevator controller.
- .7 Provide wiring from the car station card reader to the security interface box using standard connectors.
- .8 Interface with the security system using serial data transfer.
- .9 Provide a signal, unique for each car call, to the security system when a car call "request" (which could either be by means of a button or touch screen) is entered and enter the car call when a return signal is received from the security system validating the request.
- .10 Arrange that the elevator system functions without restriction by the security system when Firefighters' Emergency Operation or independent service is operative.
- .11 Until such time as the security system is installed, arrange that the elevator system functions without restriction by the security system.
- .12 Provide any incidental elevator material and elevator work necessary to obtain a complete functioning elevator security system.
- .13 Submit for review, interface box drawings, location drawings and electrical schematics.

1.48 Hall push button stations:  
single riser

- .1 Provide a single riser of hall push button stations.
- .2 Provide one station for each floor.
- .3 Provide at the intermediate floors, for each station, up and down push buttons located one above the other and call registered lights.
- .4 Provide at the upper terminal and lower terminal, for each station, a single button and call registered light.
- .5 Illuminate the call registered light only when there is an elevator in service to respond to the call.
- .6 Secure the hall push button stations to the wall using countersunk spanner head fasteners or approved equivalent.

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- 1.49    Hoistway access switch
- .1        Provide hoistway access switches in accordance with the Code.
  - .2        Locate the switches in the entrance frame or in the sight guard in an inconspicuous place.
- 1.50    Cab ventilation
- .1        Provide an exhaust fan capable of developing 30 pascals (0.1" H<sub>2</sub>O) static pressure differential with a minimum capacity of 165 litres per second (350 cfm).
  - .2        Provide a two speed motor for the fan with the speed control located in the car operating panel.
  - .3        Arrange that the increase in noise level caused by the fan, measured in the car with the fan running at maximum speed, does not exceed 3 decibels.
- 1.51    Cab: standard finishes
- .1        Provide a cab including the following items:
    - .1        A reinforced metal cab shell allowing the use of the elevator without interior finishes;
    - .2        A ceiling finished in white baked enamel;
    - .3        Returns, transom, car door jamb, lintel and door finished in Rimex stainless steel 12LG;
    - .4        Aluminum car sill;
    - .5        A 3 mm (1/8") thick aluminum plate over a wooden sub-floor;
    - .6        For non-access walls above the handrail, 19 mm (3/4") thick plywood panels covered with plastic laminate chosen by the Owner among the standard products from Formica and Armstrong, with stainless steel reveals and binders;
    - .7        For non-access walls below the handrail, 19 mm (3/4") thick plywood panels covered with Rimex stainless steel 12LG, with stainless steel reveals and binders;
    - .8        A solid suspended ceiling made of #4 brushed stainless steel, with four equally spaced ceiling panels;
    - .9        One LED light fixture with a stainless steel trim in each suspended ceiling panel;
    - .10       A recess for tile flooring by others to be installed flush with
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the car sill;

.11 For non-access walls, tubular stainless steel handrails of an exterior diameter of 38 mm (1.5") with their ends returned into the wall, securely fastened with 40 mm between the handrail and the wall and installed at a height of 812 mm as measured from the top of the handrail to the finished floor;

.12 On the back wall, a 6.3mm x 76mm flat bar bumper rail, installed at a height of 229mm as measured from the top of the bumper rail to the finished floor;

.13 Aluminum hooks for protective pads.

.2 Provide vandal-resistant finishes.

.3 Supply any other material and labour necessary to provide a completed, installed cab including mounting strips, stay plates, base and sound-deadening material.

.4 Provide cut-outs to accommodate the elevator equipment.

.5 Submit for review shop drawings showing the finishes and design.

1.52 Entrance finish: Rimex  
stainless steel 12LG

.1 Provide Rimex stainless steel 12LG entrances at all floors finished so that spot welds or other surface defects will not show under reflected light.

1.53 Protective pads

.1 Provide protective pads covering all exposed wall surface, attached to inconspicuous pad hooks at the top of the cab and reaching to within 100 mm (4") of the car floor.

.2 Provide pads to fit over the front return and transom areas with a cutout for the car station and locking service cabinet.

.3 Provide pads with diamond pattern stitching.

1.54 Hall lanterns and gongs

.1 Provide hall lanterns complete with electronic gongs at each entrance to indicate the future direction of the elevator.

.2 Provide a single light for the fixture at the upper terminal.

.3 Provide a single light for the fixture at the lower terminal.

.4 Provide separate up and down lights for the fixture at the

intermediate landing.

.5 Arrange the lanterns so that as soon as a car has reached a predetermined distance from the floor, and is going to stop at the floor, the corresponding hall lantern illuminates and the gong operates.

.6 Arrange the controls so that the hall lantern provides a minimum five second advance notice of the arrival of a car.

.7 Maintain the hall lantern illuminated until the car has stopped and the door open time has elapsed.

.8 Do not illuminate the hall lantern on a door re-open unless the re-open is caused by a reversal of direction of travel of the car.

.9 Arrange the operation of the lanterns and gongs to comply with requirements for the handicapped.

.10 Sound the tone once to indicate the up direction and twice to indicate the down direction.

.11 Provide LEDs for illumination.

.12 Design the fixture so that the lamps may be readily changed.

.13 Do not mount any equipment to the covers; arrange that the covers can be removed completely without disturbing the electric wiring.

.14 Locate the centre-line of the fixture a minimum of 1830 mm (72") above the floor.

.15 Provide lanterns of minimum 60 mm (2.4") size in the smallest direction.

.16 Provide means to adjust the gong volume in a range from 55 and 70 decibels.

#### 1.55 Hall position indicator and lantern

.1 Provide a combined digital position indicator and hall lantern mounted above the main floor entrance.

.2 Arrange the indicator to display a number or symbol at least 50 mm (2") high.

.3 Indicate the position of the car at all times, corresponding to the

landing through which the car is passing or at which it is stopped.

.4 Provide a dot matrix display using light emitting diodes.

.5 Arrange the circuits so as to provide continuous indication of car position.

.6 Overlapping dual indication, when the elevator is between floors, is acceptable.

.7 Provide lanterns complete with electronic gongs to indicate the future direction of the elevator.

.8 Do not mount any equipment to the covers; arrange that the covers can be removed completely without disturbing the electric wiring.

.9 Provide lanterns of minimum 50 mm (2") size in the smallest direction.

.10 Provide means to adjust the gong volume in a range from 55 and 70 decibels.

#### 1.56 Car inspection devices

.1 Provide, on the top of the car, a fixed lamp receptacle, with switch, outfitted with wire clamp guards, and a GFI duplex receptacle with safety ground connection.

.2 Provide, on the top of the car, an inspection station consisting of an emergency stop button, up, down and common inspection running buttons, on-off switch for the door operator and other devices necessary for top-of-car inspection operation.

#### 1.57 Sliding guides

.1 Equip the car and counterweight with spring-loaded sliding guides mounted at both the top and the bottom of the car and counterweight frame.

.2 Provide guide shoes of the self-aligning, self lubricating, swivel type with metal body and removable non-metallic liners to ensure smooth and quiet operation.

#### 1.58 Guide rails

.1 Provide standard section guide rails with tongued and grooved joints.

.2 Provide guide rails of structural strength and rigidity sufficient to limit the horizontal deflection of the guide at any point to less than 0.6 mm (0.025") under normal conditions of operation.

- .3 Use substantial machined finished plates to form the rail joints.
- .4 Erect guide rails with a variation of not more than 1.6 mm (0.06") over any 6 m (20') section and with a maximum variation of not more than 0.8 mm (0.03") in 25 mm (1").
- .5 Install guide rails in a strong and substantial manner using brackets affixed to the building structure.
- .6 Clamp the guides to the bracket with clips.
- .7 Arrange each clip so as to resist a vertical force of less than 4500 N (1000 pounds) and so as to allow the rail to slide if the vertical force exceeds 9000 N (2000 pounds).
- .8 Arrange the clips to prevent any horizontal movement of the rail.
- .9 Extend rails to within less than 300 mm (12") and more than 150 mm (6") of the underside of the overhead slab.
- .10 Use all standard length rails unless shorter lengths are required to avoid bracket locations or to complete the rail run at the top of the hoistway.
- .11 Install and locate the rails so that joints do not interfere with the supporting brackets and clamps.

1.59    Traction elevator  
emergency power device

- .1 Provide a device to automatically move the elevator to a floor in the event of power failure.
- .2 Arrange that when normal power fails, sufficient power is provided by the device to lift the brake, cause the elevator to move to a floor, open the doors and then remove the elevator from service until normal power is restored.
- .3 Provide batteries complete with charging system to power the unit.
- .4 Provide batteries having a minimum life expectancy of ten years.

1.60    Car top guard

- .1 For the safety of the technicians working on the top of the car, provide a car top guard consisting of the following.
- .2 Provide car top guard to meet, as a minimum, the requirements of the Code.
- .3 Provide a continuous guard around the sides and rear of the car top.
- .4 Provide a solid kickplate at the bottom of the guard rail extending from the car top to a height of 150 mm to prevent objects on the car top from

falling over the side of the car.

.5 Bolt the car top guard components together so that, if necessary, the guard can be temporarily removed.

.6 Finish the guard with two coats of rust inhibiting primer and one finished coat of enamel.

.7 So as to preserve the cab isolation affix the car top guard either to the cab top or to the car sling and frame but not to both.

.8 If the car top guard is affixed to the car sling provide, where necessary, supports to the cab using vibration isolated mountings so arranged as to preserve the cab isolation.

.9 If the car top guard is affixed to the cab provide, where necessary, supports to the car sling and uprights using vibration isolated mountings so arranged as to preserve the cab isolation.

.10 Ensure that the installation of the car top guard does not reduce the overhead clearances to less than allowed by Code.

#### 1.61 Counterweight

.1 Provide a counterweight to counterbalance the elevator for smooth and economical operation.

.2 Contain the weights in a structural steel frame.

.3 Make the counterweight equal to the weight of the complete elevator car plus between 40 percent and 50 percent of the rated load.

.4 Provide counterweight guards where required by Code.

#### 1.62 Counterweight balance

.1 Statically balance the counterweight so that, at the centre of the travel, with the top guiding means removed, the counterweight hangs in the centre of the rails.

.2 Arrange the equipment so that there is, in this position, with the guiding means properly adjusted, no pressure upon the guides.

.3 Adjust the guiding means so that the pressure upon any guide at any point in the travel does not exceed 110 Newtons (25 pounds).

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| <u>1.63</u> <u>Car balance</u>                  | <p>.1        Statically balance the car so that, at the centre of the travel, with the top guiding means removed, the car hangs in the centre of the rails.</p> <p>.2        Arrange the equipment so that there is, in this position, with the guiding means properly adjusted, no force upon the guides.</p> <p>.3        Make this test with empty car and car doors closed.</p> <p>.4        Locate and adjust devices such as the compensating devices, travelling cable hangers and cab balancing weights so that the force upon any guide at any point in the travel does not exceed 110 Newtons (25 pounds) with empty car and car doors closed.</p> |
| <u>1.64</u> <u>Sheaves and supporting beams</u> | <p>.1        Provide sheaves, together with supporting beams or channels, necessary to obtain proper lead of the ropes to car and counterweight, accurately machined and grooved for the diameter of the ropes used.</p> <p>.2        Design and arrange the sheaves so that they can be readily serviced or removed.</p> <p>.3        Provide sound and vibration isolation pads or springs arranged so that there is no solid contact between the sheaves and the building structure.</p>  |
| <u>1.65</u> <u>Pit equipment</u>                | <p>.1        Provide buffer extensions, support beams, work platform with ladder as necessary to accommodate the pit depth.</p>  |
| <u>1.66</u> <u>Limit switch dowelling</u>       | <p>.1        After the final limit switches are adjusted and prior to the performance of safety tests and checks by the inspecting authorities, fasten, by throughbolting or dowelling, the final limit switches and final limit switch brackets so as to minimize the possibility of future incorrect adjustment.</p>   |
| <u>1.67</u> <u>Painting</u>                     | <p>.1        Ensure that machine room and hoistway equipment, except for machined surfaces and non-rusting surfaces, is protected with two coats of a rust inhibiting primer of a neutral colour, each coat of 25 micron minimum thickness.</p>  |
| <u>1.68</u> <u>External connections</u>         | <p>.1        Provide a junction box on the external wall of the hoistway at a point to be designated later for connections for such items as telephones, CCTV, lobby panels, monitor systems, to external locations such as the CACF Room.</p> <p>.2        Locate this box as instructed and provide clearly marked terminal</p>  |

blocks for the wiring connections.

.3 Supply the required wiring for the connections from this box to the external locations (provision of external conduit and pulling of wiring by others).

#### 1.69 Travelling cable

.1 Provide travelling cables with flame-retarding and moisture-resisting outer covers and stranded conductors.

.2 Supply cables approved for elevator use.

.3 Provide in the travelling cables:

.1 14 AWG (1.5 square mm) conductors for constant current-carrying circuits;

.2 Minimum of eight 18 AWG (0.75 square mm) conductors for signal circuits;

.3 20 AWG (0.5 square mm) shielded pair conductors with shielding for telecommunications circuits and data circuits;

.4 two RG-6U coaxial cables and one pair 18 gauge stranded conductor cable within an overall braided shield for closed-circuit television.

.4 Provide ten percent additional minimum spare signal and current-carrying wires in each cable.

.5 Terminate cables using terminal blocks or suitable connectors having identifying numbers to facilitate replacement and service.

.6 Suspend light weight cables using a wire mesh sleeve to relieve strain in the individual conductors and heavier cables using a steel supporting strand if the suspended weight exceeds 35 kg (seventy-five pounds).

#### 1.70 Electric wiring

.1 Provide wiring required to interconnect the equipment.

.2 Provide copper wire.

.3 Provide insulated wiring having a flame retarding and moisture resisting outer cover.

.4 Where flexible conduit is used, supply it in aluminium.

.5 Provide travelling cable to connect car operating panels and other car

operating devices to the controller in the machine room.

.6 Where shielded wire is specified, provide wire of not less than 0.52 mm<sup>2</sup> area (20 gauge) having individually shielded pairs with 100% shielding.

.7 Provide colour or number coded wires in multiwire cables.

.8 Provide waterproof terminal labels.

.9 Provide stranded field wire except for the individual wires in multiwire cables which may be either stranded or solid.

### PART THREE - EXECUTION

#### 1.71 Operation: simplex collective

.1 Provide a micro-processor based simplex control for the elevator.

#### 1.72 Operation: call initiation

.1 Control the elevator automatically by buttons in the car, marked to correspond with the respective landings served, and by the call buttons at the landing stations.

.2 Register a call by momentary pressure of a button.

#### 1.73 Operation: call response

.1 Store all hall and car calls in the control memory until answered.

.2 Cancel a call when it is answered by a car.

.3 Stop a running car at the first landing for which a car call is registered.

.4 Stop a running car for a hall call registered for the same direction as the car is travelling, subject to higher priority assignments and to load in the car.

#### 1.74 Operation: high & low call return

.1 Cause the car to proceed to the calls until it has come to the limit of calls placed in the direction in which it is travelling, and having done this, subject to the assignment of the dispatch system, to reverse direction.

.2 Do not stop the car, except in the case of high and low return, for hall

calls in the opposite direction to the direction of the car.

1.75    Operation: coincident calls

.1        Assign a hall call to an elevator with a car call at the same floor if the elevator is travelling in the same direction as the hall call.

1.76    Operation: fault recovery

.1        Provide a recovery circuit arranged to take the elevator at low speed to the next floor in the event of an overspeed condition, overload trip, or other similar fault condition.

.2        Do not implement the recovery circuit if the movement of the car would endanger the passengers in the car.

.3        Provide a circuit separate from the normal speed control circuits, with power derived through separate controls and limited in power by resistance or fixed devices to an appropriate low level.

.4        Do not use, in this circuit, any solid state or other device which could fail in a mode that would allow an increase in applied power.

.5        Upon arrival of the car level at the next floor, cause the doors to open and remain open, and turn off the car lights.

.6        Leave the elevator in this state until the fault is corrected and the car restored to service.

1.77    Operation: direction reversal

.1        Cause a car without registered car calls, arriving at a floor where both up and down hall calls are registered, to initially respond to the hall call in the direction that the car was travelling.

.2        If, subsequent to the stop at this landing, there are no car or hall calls registered such as to require immediate travel in the same direction as before stopping at that landing, cause the car to close its doors, immediately reopen them and respond to the hall call in the opposite direction.

1.78    Operation: independent service

.1        Provide independent service.

.2        On independent service:

.1        Remove the car from the automatic supervisory control system;

.2        Arrange the circuits so that the car does not respond to hall

calls;

- .3 Render the hall lanterns (if provided) inoperative;
- .4 Cause the car to park with its doors open;
- .5 Arrange the controls so that the car responds to any car calls registered if a button is held until the doors are closed and the interlocks made-up;
- .6 Cause the doors to reopen if the button is released at any time up to the point at which the elevator starts to move;
- .7 Render inoperative the normal door protective devices;
- .8 Arrange the controls so that the attendant can select direction of travel;
- .9 Cancel all registered car calls when the direction reverses or a car call is answered.
- .10 Arrange the independent service operation so that it does not override security features or security systems.

1.79    Operation: door protective device

- .1 Arrange the door protective device so that, should it detect a person or any object in its path, at any point during the door closing operation, it will cause the doors to return to the open position.
- .2 Adjust both the detection device and the door operation so that an object or person in the way of the door will cause the doors to reverse without the door panel of either hall or car doors actually striking the object or person.

1.80    Operation: car call anti-nuisance feature

- .1 Arrange the control circuits to cancel all car calls when an unreasonable number of car calls has been registered relative to the number of passengers in the car.
- .2 Prevent nuisance car calls by:
  - .1 Not allowing car calls to be registered below the current position of an up travelling car;
  - .2 Not allowing car calls to be registered above the current position of a down travelling car;

.3 Or, by cancelling car calls when the car reverses direction.

1.81 System clock

- .1 Where operations or functions are subject to clock control or require clock input, provide a solid state clock.
- .2 Provide, in the machine room or at the central control console, means to indicate the current clock time.
- .3 Provide, in the machine room or at the central control console, means to readily reset the clock time.
- .4 Provide crystal regulation of frequency and voltage control adequate to maintain the time within an accuracy of plus or minus five seconds per month.
- .5 Provide software to automatically adjust the time for changes from standard to daylight saving time and from daylight saving time to standard time.
- .6 Provide battery back-up to maintain for a period of at least 24 hours accurate clock time in the event of power loss.

1.82 Door protective device  
by-pass (nudging)

- .1 Should a door protective device be operated continuously for more than 20 seconds after the elapse of the normal door open time, cause the doors to close slowly under reduced power and operate a buzzer in the car panel as a warning to the person obstructing the door.
- .2 Cause the 20 seconds to be reduced to 6 seconds until a normal door cycle is performed.

1.83 Door open pause time

- .1 Arrange the circuits so that when the car is stopped in response to a hall call the doors remain open a predetermined length [approximately 3 seconds for an elevator whose entrances are within 3 metres (10') of the hall push button and approximately 4 seconds for an elevator whose entrances are further than 3 metres (10') from the hall push button].
- .2 Arrange that this predetermined length of time is reduced to approximately 0.7 seconds if a person moves through the entrance (as indicated by the actuation of the door protective device).
- .3 Unless otherwise specified (e.g. to allow for advance hall lantern warning), arrange the circuits so that when the car is stopped in response to a car registered call the doors remain open a predetermined length of time (approximately 1 second).
- .4 Make the times separately adjustable over a range from 0.25 seconds

to 15 seconds.

.5 Arrange the circuits so that the door open pause time is cancelled if a car call button is pressed or the door close button is pressed.

1.84 Car call registration tones

.1 Provide an audible tone, arranged to sound when a car call is registered, having an adjustable volume level of between 55 and 70 decibels, as measured from within the elevator cab.

1.85 Noise level: door operation

.1 Arrange the equipment so that the noise level, as measured within the cab, does not exceed 60 decibels at any time during a full door open, door close and door reversal cycle.

.2 Initiate the door reversal by triggering the door protective device.

.3 Measure the noise level using an ANSI type 2 sound level meter on the "A" scale with an "F" response.

1.86 Noise level: cab

.1 Arrange that, with the elevator travelling from one end of the hoistway to the other, the noise level as measured within the elevator cab does not vary by more than 3 decibels.

.2 Measure this noise level with an ANSI type 2 sound level meter on the "A" scale with an "F" response.

1.87 Cab fan: operation

.1 Arrange that there is no discernible vibration in the car with the fan operating.

.2 Arrange that the noise level developed by the fan, measured in the car with the fan running, does not exceed 55 db.

1.88 Noise level: machine room

.1 Design the equipment so that the noise level with the elevator running, as measured by a meter positioned in the centre of the machine room, does not exceed 80 decibels.

.2 Measure this noise level using an ANSI type 2 sound level meter on the "A" scale with an "S" response.

1.89    Car ride

.1        Arrange that the horizontal acceleration front to rear or side to side measured in the car with the elevator travelling, with a load of less than 10 per cent of capacity, from top to bottom and bottom to top does not exceed 150 mm per second per second (0.5 fpsps) measured between two consecutive points of opposite value.

.2        Arrange that the vertical acceleration measured in the car with the elevator travelling, with a load of less than 10 per cent of capacity, from top to bottom and bottom to top at contract speed, does not exceed 100 mm per second per second (0.3 fpsps) measured between two consecutive points of opposite value.

1.90    Levelling

.1        Cause the car to stop automatically at floor level, without overshoot, regardless of load or direction of travel so that the car sill is level, within 6 mm (1/4"), with respect to the hoistway sill.

.2        When the elevator cab is stopped at a floor, correct for over travel or under travel or movement of the cab away from the floor, by returning the car imperceptibly to floor level.

1.91    Transmitted vibration

.1        Arrange that the dose value of the transmitted vibration generated by the machine and associated sheaves in the frequency range from 0 to 100 Hz is less than 0.2 in any single axis and that the average of the dose values of the three axes is less than 0.15.

.2        Measure the vibration over a period of ten seconds in both directions of travel at contract speed with empty car.

.3        Record the vibration using an accelerometer transducer mounted on the machine beam adjacent to the machine.

.4        Process the accelerometer output through a low pass digital or analogue filter to delete frequencies above 100 Hz.

.5        Record the accelerations from 0 Hz to a minimum 200 Hz in the vertical axis and the two horizontal axes.

.6        Calculate the vibration dose value by integrating the fourth power of the acceleration in m/s/s over the ten second period, dividing by the number of samples, and taking the fourth root of the result.

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**1.92 Speed control**

- .1 Design and adjust the equipment so that the average acceleration over the period of constant acceleration is 0.8 metres per second per second (2.6 f/s/s) plus or minus 10%.
- .2 Design and adjust the equipment so that the average change in acceleration (jerk) is 1.8 metres per second per second per second (6.0 f/s/s/s) plus or minus 10%.
- .3 Design and adjust the equipment so that the rated speed is maintained with an accuracy of 1.5 percent.

**1.93 Operating time**

- .1 Adjust the equipment so that the elapsed time to travel one typical floor does not exceed the time shown in the data table.
- .2 Measure this time under the following conditions:
  - .1 A typical floor height of less than 4000 mm (13');
  - .2 Floor levelling accuracy of  $\pm 6$  mm (1/4");
  - .3 Start time when the fully opened doors begin to close;
  - .4 Stop time when the car is stopped level with the next floor and the car and hall doors are 800 mm (32") open;
  - .5 Time measured with full load in the car and in both directions of travel;
  - .6 Power door operation for the hall and car doors conforms to the elevator code requirements.
- .3 Adjust the equipment so that the operating time is compatible with dependable, consistent operation without undue wear or excessive maintenance and so that this operating time can be readily maintained over the life of the elevator installation.
- .4 Adjust the equipment so that, with the control functioning so as to give the required time, the elevator operates under smooth acceleration and retardation and provides a comfortable and agreeable ride.

**1.94 Firefighters' Emergency  
Operation: automatic recall**

- .1 Provide Firefighters' Emergency Operation including:
  - .1 Phase I automatic Emergency Recall Operation;
  - .2 Phase II Emergency In-Car Operation.

.2 Provide control "handshaking" compatible with the building interconnections.

.3 Provide switches and indicators in the hall and car stations as required by Code.

\*\*\*\*\*END OF SECTION\*\*\*\*\*

## **PART 1 - GENERAL**

### **1.1 DOCUMENTS**

- .1 The contract documents are complementary, what is required by any one shall be as binding as if required by all. Specification sections and drawings cannot be read in isolation and it shall be the responsibility of the contractor and suppliers to ensure they have sufficient information to provide specified material and services as required by the complete contract documents
- .2 These specifications are an integral part of the Contract Documents. Refer to other Sections to ensure a completed operational product and fully coordinated standard of work.
- .3 Definitions:
  - .1 "Provide" means to "supply and install".
  - .2 "Concealed" means within chase, furred space, shaft, or hung ceiling.
  - .3 "Exposed" means "not concealed" as defined herein.
  - .4 "Demolish" means to "remove from site and dispose of in an appropriate manner".
- .4 Conform to Canadian Metric Practice Guide CSA CAN3- 234.1.
- .5 Provide all required adapters between "metric" and "Imperial" installations.
- .6 Metric descriptions in this Division are nominal equivalents of Imperial values.
- .7 "NPS" refers to Nominal Pipe Size and is the ASME B36 designation for various standard pipe sizes.
- .8 Drawings do not indicate exact architectural, structural or electrical features. Examine drawings prior to fabricating and installing work to ensure no interference exists. Report conflict with work to Consultant before proceeding.
- .9 Drawings show general design and arrangement of mechanical system installation, and are diagrammatic in some details. Coordinate all drawings and with all trades for complete operational system.
- .10 Do not scale drawings to order material. Take field measurements before ordering materials and make material conform to site conditions.

### **1.2 SEPARATE PRICING**

- .1 The contractor shall provide pricing with the submission of their tender for the removal from the contract of the following items.
- .2 The contractor within the bid shall identify separate pricing as follows;
  - .1 Demolition of the digester system as identified on drawing DM16. Including all tanks, pumps, and piping.
  - .2 Demolition and replace of all above grade storm piping, including insulation and concealment of the piping

### 1.3 COOPERATION WITH OTHER TRADES

- .1 Review all contract documents, including those of the other trades, and coordinate with work of other Divisions and trades.
- .2 Cooperate fully with Divisions 21, 22, 23, 25 and Division's 26 and 27 prior to installation to lay out location of ducts, diffusers, piping, lighting fixtures and other mechanical and electrical components in all areas.
- .3 Report areas of conflict immediately to Consultant for comment. Do not continue work until corrective measures are prescribed.
- .4 Locate distribution systems, access doors, equipment and materials for maximum useable space to satisfaction of Consultant.

### 1.4 CONTRACTOR COORDINATION SUBMITTALS

- .1 This Contractor shall prepare and submit Interference and Coordination drawings for the following spaces / floor plans:
  - .1 Mechanical Penthouse
  - .2 Mechanical Rooms
  - .3 Ground and Second Floors, for all services in ceiling spaces
- .2 These coordination drawings shall represent:
  - .1 The available space including all relevant structural and architectural components. The contractor shall review existing conditions and take dimensions as required to prepare the coordination submission. The contractor shall also coordinate the installation of new structural elements.
  - .2 All purchased / ordered equipment dimensions.
  - .3 Coordinate the installations of this trade as well as all divisions.
  - .4 Coordinate the installation of all Div 22 plumbing piping (including insulation), Div 23 equipment, ductwork and piping (including insulation), Div 25 Controls wiring, Div 26 Lighting and power wiring, Div 27 communication wiring including cable tray installation.
  - .5 The contractor shall coordinate the hanging and support of work, and utilize common support methods where possible.
  - .6 The contractor shall complete these co ordination drawings from field measurements completed post demolition work.
- .2 These drawings shall be submitted in both AutoCAD format and printed PDF, for Consultant for

### 1.5 CONTRACTOR REQUESTS FOR INFORMATION

- .1 The Contractor may, after exercising due diligence to locate required information, request from the Consultant clarification or interpretation of the requirements of the Contract Documents. The Consultant shall, with reasonable promptness, respond to the Contractor's requests for clarification or interpretation. However, if the information requested by the Contractor is apparent from field observations, is contained in the Contract Documents or is reasonably inferable from them, the Contractor shall be responsible to the Client for all reasonable costs charged by the Consultant to the Client for the Additional Services required to provide such information.

## **1.6 CODES AND BYLAWS PERMITS AND FEES**

- .1 Comply with all Codes and By-laws relating to system and equipment installations. Provide certificates to verify that the work installed conforms to the laws and regulations of all authorities having jurisdiction.
- .2 Give all necessary notice, obtain all permits and pay all fees in order that the work specified herein may be completed.
- .3 Coordinate with all other contractors prior to tender submission the application and payment, for all required building permit and inspection fees. The costs for these regulatory requirements shall be borne by this contract.
- .4 Employ all sub-consultants or testing agencies required for completion of the work specified herein may be completed and properly verified.

## **1.7 TSSA CERTIFICATION**

- .1 It will be the responsibility of this Contractor to apply for and pay for any inspections required to achieve a TSSA certification.
- .2 Prior to ordering of equipment, contractor will ensure the equipment has the required CRN number if required.
- .3 The Contractor to determine the requirements of the TSSA inspector prior to installation and install the systems to meet the requirements of the TSSA inspector.

## **1.8 FIRE STOPPING**

- .1 Reference Section 07 84 00 – Fire Stopping.
- .2 All fire stopping to be performed by a single certified contractor.
- .3 This contractor will coordinate the construction of all openings through fire rated assemblies with the fire stopping contractor.

## **1.9 COMMISSIONING**

- .1 Reference Section 01 91 01 – Commissioning.
- .2 The Contractor to make themselves, their subcontractors and their suppliers aware of the commissioning requirements for this project.
- .3 The Contractor shall work with the designated commissioning agent to achieve a completely commissioned system. The contractor shall provide all material and labour to achieve the project commissioning objectives as specified.

## 1.10 COMPONENT AND SYSTEM TESTS

- .1 Perform systematic check, test components in all systems and ensure that each system functions correctly before commencing balancing work.
- .2 Provide all primary elements, test wells, balancing dampers, balancing valves and parts that are required for testing and balancing.
- .3 Provide isolation valves on all instrumentation and on vents and other devices that require isolation during testing due to high pressures.
- .4 Record all checks and tests. Manufacturer or supplier of the component tested to provide signed confirmation that installation is in accordance with their written recommendation. Contractor to countersign, identify system and component status with System Check Lists.
- .5 Equipment and System start up documentation shall include but not be limited to the verification of the following;
  - .1 Check alignment of all drives and end clearance on couplings.
  - .2 Check seals on pumps and packing on valves.
  - .3 Clean hydronic systems and fill with heat transfer fluid.
  - .4 Verify rotation of electric motors and ratings of overload heaters.
  - .5 Verify that control, interlock and power wiring are correct.
  - .6 Complete lubrication of equipment.
  - .7 Complete filter installation.
  - .8 Adjust rotating equipment alignment and belt drive tension.
  - .9 Check safety and operating control set points and automatic control sequences with design requirements.
  - .10 Clean-up installation and temporary coverings, remove stickers and tags.
  - .11 Touch-up painted finishes where damaged.
  - .12 Complete equipment and piping identification work with valve tags, schedules and piping identification system.
  - .13 Comb out fins on extended surface heat transfer coils where damaged.
  - .14 Implement water treatment program with initial quality test of fluids in systems and domestic water supply, check chemical feeder equipment, and instruct chemical supplier in desired results.
  - .15 Perform operational check of systems in conjunction with Control Contractor and Electrical Contractor representatives.

## 1.11 TEMPORARY AND TRIAL USE

- .1 Obtain written permission from Consultant to use and test permanent equipment and systems prior to Substantial Performance.
- .2 Trial usage may be required of equipment and systems for test purposes prior to acceptance. Provide labour, material and instruments required for testing. Rectify incomplete work immediately prior to acceptance
- .3 Protect equipment and system openings from dirt, dust and other foreign materials during temporary usage.

- .4 Warranty, including duration and commencement date, not to be affected by start-up date of equipment.
- .5 Rectify deficiencies and complete all work before submitting request for Substantial Performance inspection.

#### **1.12 PROJECT SCHEDULE**

- .1 Phase work in accordance with Division 1.
- .2 Provide Consultant with Material Delivery Schedule and preliminary project construction schedule milestones within three (3) weeks of executing the agreement.

#### **1.13 PROGRESS PAYMENTS**

- .1 Mechanical Progress Payment requests are to separately identify labour and material costs on a system-by-system basis. Each line item on the progress payment shall not exceed 10% of the total mechanical contract value.
- .2 As a minimum, the following shall be separately identified and listed as a separate line item on the progress draw:
  - .1 Mobilization, shop drawings, etc..
  - .2 Commissioning.
  - .3 Testing, adjusting, and balancing.
  - .4 Identification.
  - .5 All working below grade.
  - .6 Close-out documentation.
- .3 Payment for equipment: maximum of 90% of labour and material until the successful completion of the following:
  - .1 Equipment manufacturer's start up tests.
  - .2 Final testing and balancing.
  - .3 Commissioning verification of proper (fully automatic) operation.
  - .4 Equipment manufacturer's approval of installation and operation.
- .4 Payment for control system: maximum 90% of labour and material until the successful completion of the following:
  - .1 Commissioning verification of proper (fully automatic) operation and performance under all load conditions (part load, seasonal).
  - .2 Operational review of the control system by the Consultant.

#### **1.14 CONTRACTOR QUALITY ASSURANCE PROGRAM**

- .1 Contractor is solely responsible for the control, charge and supervision of construction means, methods, techniques, sequences and procedures, and for safety precautions and programs required in connection with the work.

- .2 Contractor is solely responsible for the discovery and correction of deficiencies, errors and omissions in the execution and performance of the work and for the preparation of submissions (shop drawings, reports, etc.) relating to the work.
- .3 Contractor is solely responsible for providing the appropriate quality assurance program to ensure that the work is carried out and performs in accordance with the Contract Documents, industry standards and relevant codes and legislation. Contractor Quality Assurance Program to ensure:
  - .1 The use of qualified tradesmen, experts and professionals with the level of skill and experience required for the proper execution and performance of the work.
  - .2 The level of direction, supervision and inspection required for the proper execution and performance of the work.
  - .3 The level of coordination between trades, field conditions, material requirements and product requirements required for the proper execution and performance of the work.
  - .4 The level of management required for the quality assurance program to operate effectively so that deficiencies, errors and omissions in the work are identified by the Contractor on a continuous basis and that corrective action is carried out promptly.
  - .5 The level of management and communication required for the status of the work to be properly monitored and reported to the Consultant.
- .4 Field review (observations) of the work by the Consultant is not to be considered part of the Contractor Quality Assurance Program.
- .5 The review of Contractor prepared submissions (shop drawings, reports, etc.) by the Consultant is not to be considered part of the Contractor Quality Assurance Program.

#### 1.15 CONTRACTOR STATUS REPORTS

- .1 Contractor is to submit a status report on a monthly basis, outlining the status of the following aspects of the work for each mechanical system. This is integral and supplementary to the requirements of commissioning.
  - .1 Distribution Systems:
    - .1 Installation Inspections.
    - .2 Integrity (Pressure, Leakage) Tests.
    - .3 Support System Inspection and Certification (by Contractor's Engineer).
    - .4 Inspections by Authorities having Jurisdiction (Municipal, Provincial).
  - .2 Equipment:
    - .1 Installation Inspections.
    - .2 Manufacturer Installation Acceptance.
    - .3 Start-up Inspections.
    - .4 Manufacturer Start-up Acceptance;
    - .5 Support System Inspection and Certification (by Contractor's Engineer).
  - .3 Balancing and Testing:
    - .1 Balancing Device Installation Inspection and Approval (by Contractor's Balancing Specialist).
    - .2 Preliminary Balancing of Equipment.
    - .3 Equipment Capacity Tests.
    - .4 Preliminary Balancing of Distribution Systems.
    - .5 Final Balancing of Equipment.
    - .6 Final Balancing of Distribution Systems.

- .4 .Commissioning and Performance Verification:
  - .1 Control Device Operation Verification.
  - .2 Normal Operation Verification (part load, full load, seasonal).
  - .3 Upset Condition Operation Verification (safety devices, equipment failure).
  - .4 Failure Condition Operation (power failure, emergency power, control failure).

#### **1.16 WARRANTIES**

- .1 Contractor to provide all labour and material to promptly correct defects or deficiencies in the work and the performance of the work, which appear prior to and during the one year Warranty period. Warranty is to include complete labour and material Product warranties for all Products included in the work.
- .2 Warranty period for the corrected work is to be extended for an additional year following the correction of defects and deficiencies in the work carried out in the initial warranty period.

#### **1.17 MECHANICAL SUBMITTALS**

- .1 Submittals: in accordance with Section 01 33 01 – Submittals.
- .2 Shop drawings to show mounting arrangements and operating and maintenance clearances.
- .3 Shop drawings and product to include:
  - .1 Detailed drawings of bases, supports, and anchor bolts.
  - .2 Acoustic sound power data, where applicable.
  - .3 Points of operation on performance curves.
  - .4 Manufacturer certification of current equipment production.
  - .5 Certification of compliance to applicable codes.
- .4 In addition to transmittal letter referred to in Section 01 33 00 - Submittal Procedures: provide a "Shop Drawing Submittal Title Sheet" and identify specification section and paragraph number.
- .5 Closeout Submittals:
  - .1 Provide operation and maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
  - .2 Operation and maintenance manual to be approved by, and final copies deposited with, Consultant before final inspection.
  - .3 Operation data to include:
    - .1 Control schematics for all systems, including environmental controls.
    - .2 Description of systems and respective controls.
    - .3 Description of operation of systems at various loads, with reset schedules and seasonal variances.
    - .4 Operation instructions for systems and components.
    - .5 Description of actions to be taken in event of equipment failure.
    - .6 Valve schedule and flow diagram.
    - .7 Colour coding chart.

- .4 Maintenance data to include:
  - .1 Servicing, maintenance, operation and trouble-shooting instructions for all equipment.
  - .2 Data to include schedules of tasks, frequency, tools required and task time.
- .5 Performance data to include:
  - .1 Equipment manufacturer's performance datasheets with point of operation as set after commissioning is complete.
  - .2 Equipment performance verification test results.
  - .3 Special performance data as specified.
  - .4 Testing, adjusting and balancing reports as specified in Division 23 - Testing, Adjusting and Balancing for HVAC.
- .6 Approvals:
  - .1 Submit two copies of draft Operation and Maintenance Manual to Consultant for review. Submission of individual data will not be accepted.
  - .2 Make changes as required and re-submit when completed.
- .7 Additional data:
  - .1 Prepare and insert into operation and maintenance manual additional data when need for it becomes apparent during specified demonstrations and instructions.
- .8 Site records:
  - .1 This Contractor shall maintain, on site, a complete set of the contract documents. This contractor shall mark changes as work progresses and as changes occur. Include control systems and low voltage control wiring.
  - .2 Use different colour waterproof ink for each service.
  - .3 Make available as requested for reference purposes and inspection.
  - .4 Upon request deliver the site record drawings to a local print shop so that colour copies of the site record drawings can be produced.
- .9 Record drawings:
  - .1 Prior to start of Testing, Adjusting and Balancing for HVAC, finalize production of record drawings.
  - .2 Identify each drawing in lower right hand corner in letters at least 12 mm high as follows: - "RECORD DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW MECHANICAL SYSTEMS AS INSTALLED" (Signature of Contractor) (Date).
  - .3 Submit to Consultant for review and make corrections as directed.
  - .4 Perform testing, adjusting and balancing, as specified in Division 23, for HVAC utilizing the record drawings.
  - .5 Submit completed record drawings with Operating and Maintenance Manuals.
  - .6 Submit copies of record drawings for inclusion in final TAB report.
  - .7 Record Drawings should provide information such as:
    - .1 Record and identify all revisions made to contract drawings and reference fabrication drawings included.
    - .2 Record locations of primary isolation valves for emergency isolation of systems.
    - .3 Record locations of concealed components of mechanical and electrical services.
    - .4 Record inverts of underground piping at building entry/exit and below floor slab at each branch and riser base.

## **1.18 MAINTENANCE**

- .1 Furnish spare parts as follows:
  - .1 One set of packing for each pump.
  - .2 One filter cartridge or set of filter media for each filter or filter bank as well as final operating set.
- .2 Provide one set of special tools required to service equipment as recommended by manufacturers.

## **1.19 INSTRUCTION OF OPERATING STAFF**

- .1 Provide trained personnel to instruct operating staff in maintenance, adjustment and operation of mechanical equipment.
- .2 Provide instruction during regular work hours for a minimum 3 full days prior to acceptance and turnover to operating staff. See individual specification sections for additional training requirements.
- .3 Notify Consultant of instruction period and await written notice to proceed. Submit a detailed agenda of training activities identifying presenter and time frame for each type of equipment and system.
- .4 Utilize the Operating and Maintenance Manual and updated record drawings for instruction purposes.
- .5 Instruct staff on changes made under terms of warranty or of modifications to equipment.

## **1.20 INTERRUPTION OF EXISTING SERVICES**

- .1 Arrange schedule and perform work with minimum disturbance to existing facilities and services. Provide all overtime work required to minimize interruption of existing facilities and services.
- .2 Notify Consultant in writing at least 48 hours in advance of planned interruption to existing service.
- .3 Drawings approximately indicate known existing underground facilities. Avoid damage to existing services. Bear cost of repairs and replacements.
- .4 Immediately advise Consultant if services are not as indicated or when unknown services are encountered and await instructions.

## **PART 2 – PRODUCTS**

### **2.1 ARCHITECTURAL SERVICE ACCESS DOORS**

- .1 Coordinate with architectural drawings for locations and wall and ceiling finishes.
- .2 Size: 300 mm x 300 mm or larger, as required to properly service concealed equipment and devices
  - .1 Minimum 300x300 for hand access.
  - .2 Minimum 450x450 for arm access.
  - .3 600x600 for any other access.
- .3 Material: 2.5 mm thick, flush type steel door, frame and anchor straps, with concealed hinge.

- .4 Fire rated where penetrating fire rated assemblies.
- .5 Finish: to suit painted gypsum, plaster or suspended tile ceiling
- .6 Coordinate the products and supply of access doors with Div 9.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- .1 Location of access doors to be located by responsible division. Access doors to be installed by drywall or block installer.
- .2 Locate access doors to serve concealed equipment, fire dampers, expansion joints, valves, cleanouts and any other equipment requiring accessibility for operation and maintenance.
- .3 Be prepared to demonstrate accessibility of devices through access doors. Relocate or enlarge access doors to suit conditions.

#### **3.2 PAINTING REPAIRS AND RESTORATION**

- .1 Do painting in accordance with Section 09 91 23 - Interior Painting.
- .2 Prime and touch up marred finished paintwork to match original.
- .3 Restore finishes which have been damaged to new condition.

#### **3.3 FIELD QUALITY CONTROL**

- .1 Manufacturer's Field Services:
  - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.
  - .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.

#### **3.4 SYSTEM AND EQUIPMENT CLEANING AND OPERATIONAL STATUS**

- .1 Do not operate equipment until systems are clean.
- .2 Remove all debris from inside mechanical equipment, ductwork and piping systems.
- .3 Vacuum clean inside duct systems.
- .4 Replace construction strainers and filters with operational strainers and filters.
- .5 After completing tests, replacement and repair, flush water systems thoroughly with water to remove sediment.

### **3.5 PROTECTION OF WORK**

- .1 Protect all finished and unfinished work from damage. Protect bearings, seals, glands, shafts of rotating equipment. Cover floors and other work with tarpaulins where required.
- .2 Repair damage caused to surfaces of building without cost to Owner and to satisfaction of Consultant.
- .3 Be responsible for condition of all materials and equipment supplied and/or installed. Provide protection prior to, during and after installation until takeover by Owner.
- .4 Protect floor drains, pipe and duct openings, filters, elements and materials against dirt and abuse during construction.

### **3.6 DEMONSTRATION**

- .1 Consultant will use equipment and systems for test purposes prior to acceptance. Supply labour, material, and instruments required for testing.
- .2 Supply tools, equipment and personnel to demonstrate and instruct operating and maintenance personnel in operating, controlling, adjusting, trouble-shooting and servicing of all systems and equipment during regular work hours, prior to acceptance.
- .3 Use operation and maintenance manual, record drawings, and audio visual aids as part of instruction materials.
- .4 Instruction duration time requirements as specified in appropriate sections.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 SCOPE DESCRIPTION SUMMARY**

- .1 Provide identification system for piping, valves, ductwork, and equipment.
- .2 Identification to consist of colour codes, valve tags, equipment and system nameplates, lettered identification, and schedules.

### **1.2 REFERENCES**

- .1 Unless dated references are identified below, it shall be the latest standard issued by the regulatory agency that shall be utilized as the applicable reference.
- .2 Canadian Gas Association (CGA):
  - .1 CSA/CGA B149.1-05, Natural Gas and Propane Installation Code.
- .3 Canadian General Standards Board (CGSB):
  - .1 CAN/CGSB-1.60-97, Interior Alkyd Gloss Enamel.
  - .2 CAN/CGSB-24.3-92, Identification of Piping Systems.
- .4 ANSI:
  - .1 ANSI A13-1 Pipe Marking Standards.
- .5 National Fire Protection Association (NFPA):
  - .1 NFPA 13-2007, Standard for the Installation of Sprinkler Systems.
  - .2 NFPA 14-2007, Standard for the Installation of Standpipe and Hose Systems.

### **1.3 INFORMATIONAL SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 01 - Submittals.
- .2 Product Data:
  - .1 Product data shall be submitted for all PART 2 – PRODUCTS specified herein.
  - .2 Provide manufacturer's printed product literature and datasheets for material specified, and include product characteristics, performance criteria, physical size, finish and limitations.
  - .3 Product data shall include all relevant information to confirm the specifications have been met.
- .3 Legends: Submit list of all identification methods and means for approval prior to identification installation. List should identify system, background colour and lettering colour.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURER'S EQUIPMENT NAMEPLATES**

- .1 Provide metal or plastic laminate nameplate mechanically fastened to each piece of equipment by manufacturer.
- .2 Lettering and numbers to be raised or recessed.
- .3 Information to include, as appropriate:
  - .1 Equipment: manufacturer's name, model, size, serial number, capacity.
  - .2 Motor: voltage, Hz, phase, power factor, duty, frame size.
- .4 Ensure all equipment nameplates have not been concealed by insulation and are visible post construction.

### **2.2 PRIMARY COLOURS GENERAL**

- .1 Colours: In accordance with Canadian General Standards Board Standards:
  - .1 Hazardous: red letters, white background.
  - .2 Elsewhere: black letters, white background (except where required otherwise by applicable codes).
- .2 For primary identification of systems utilize the following colours.

<b>System Type</b>	<b>Background Primary Colour</b>	<b>Lettering / Flow Arrow Colour</b>
Inherently Hazardous Materials including: - Flammable and Explosive Fluids - Chemically Toxic or Corrosive Fluids - Extreme Temperature or Pressure - Radioactive	Yellow	Black
Flammable (Natural Gas / Propane)	Yellow	Black
Combustible Contents	Brown	White
Toxic / Corrosive Contents	Orange	Black
Water Piping (Plumbing Systems)	Green	White
Fire Quenching Fire Protection Systems	Red	White
Heating and Cooling Systems	Yellow	Black

### **2.3 VISIBILITY REQUIREMENTS**

- .1 Markers shall be located so that they are readily visible to personnel from the point of normal approach and instantly inform you about contents, direction of flow and whether hazardous or safe.

- .2 Size of lettering shall conform to the following table.

Pipe or Duct Size (Outside including Covering)	Height of Letters
NPS $\frac{3}{4}$ thru 1 $\frac{1}{4}$ ( $\frac{3}{4}$ "Ø thru 1 $\frac{1}{4}$ "Ø)	12.5 mm ( $\frac{1}{2}$ " )
NPS 1 $\frac{1}{2}$ thru 2 (1 $\frac{1}{2}$ "Ø thru 2"Ø)	20 mm ( $\frac{3}{4}$ " )
NPS 2 $\frac{1}{2}$ thru 6 (2 $\frac{1}{2}$ "Ø thru 6"Ø)	32 mm (1 $\frac{1}{4}$ " )
NPS 8 thru 10 (8"Ø thru 10"Ø)	65 mm (2 $\frac{1}{2}$ " )
NPS 12 and over (12"Ø and over)	75 mm (3" )

- .3 Length of identification markers shall be minimum 300 mm (12"), and as required for lettering.

## 2.4 CONTRACTOR'S EQUIPMENT IDENTIFICATION

- .1 Individual equipment shall be identified with nameplates, by the identification assigned on the Drawings, Schedules, and specifications.
- .2 Identification to include equipment type and number, service, area or zone of building served.
- .3 The identification name plate shall be located adjacent manufacturer's nameplate or in a conspicuous location on the equipment. Use isolating standoffs when plates mounted on hot surface.
- .4 In addition to the nameplates required for the equipment, auxiliary equipment such as starters and control panels shall be identified with similar nameplates.
- .5 Construction:
- .1 Cold Surfaces: 3 mm thick laminated plastic, with square corners, letters accurately aligned and machine engraved into core.
  - .2 Hot Surfaces: 3 mm thick white anodized aluminum, matte finish, with square corners, letters accurately aligned and machine engraved.

## 2.5 EXISTING IDENTIFICATION SYSTEMS

- .1 Apply existing identification system to new work.
- .2 Where existing identification system does not cover for new work, use identification system specified this section.
- .3 Refer to Client Identification Standards.

## 2.6 PIPING SYSTEMS GOVERNED BY CODES

- .1 The following piping systems require the minimum identification in accordance with the codes identified.
- .1 Natural gas: to CSA/CGA B149.1.
  - .2 Sprinklers: to NFPA 13.
- .2 These codes shall be adhered to, and additionally these systems shall be identified as per the requirements of this section.

## 2.7 PIPING SYSTEMS IDENTIFICATION

- .1 Pipe identifications systems shall be a manufactured system consisting of vinyl markers which will adhere to the piping or pipe covering. Identification system shall be suitable for a surface temperature of -40°C (-40°F) to 60°C (140°F).
- .2 Identification Tape: vinyl, pressure sensitive, self-adhesive pipe markers adhered to pipe and or coating. Marker ends should be banded with self-adhesive tape with directional flow arrows to indicate pipe content flow direction.
- .3 Snap-on Pipe Markers: vinyl markers minimum 0.55 mm (0.02") thick, pre-tensioned, cylindrically coiled printed plastic sheets.
- .4 Strap-on Pipe Markers: vinyl markers minimum 0.55 mm (0.02") thick, flat printed plastic sheets with strap holes.

## 2.8 VALVE IDENTIFICATION TAGS

- .1 Prepare valve list of all valves meeting the following criteria:
  - .1 Primary System Isolation Valves;
  - .2 Zone / Area Isolation Valves;
  - .3 Riser Isolation Valves;
  - .4 Any valve NOT visible from the equipment being serviced.
- .2 Valve list shall indicate location and purpose of valve. If isolation valve for a recirculation closed system, the appropriate return isolation valve shall be identified.
- .3 Provide valves with fire and heat resistant laminated plastic numbered tags 40 mm (1½") diameter with 12 mm (½") engraved code. Tag to be in system primary colour with contrasting coloured numbers.
- .4 List tag schedule designating number, service, function, and location of each tagged item. Identify normal operating position of valves.
- .5 Provide one (1) copy in plastic cover for each Operation and Maintenance.
- .6 Provide copy of valve schedule, mounted under glass in black wooden frame and mounted in the mechanical room and the penthouse.

## 2.9 DUCT SYSTEMS IDENTIFICATION

- .1 Provide 75 mm (3") high black stenciled letters, reading: Fresh Air, Supply, Return, Exhaust Air, etc. with directional flow arrow for all ducts and ducts with insulation.
- .2 Identify fire dampers and access doors on the downstream side.

## **2.10 CONTROL SYSTEM IDENTIFICATION**

- .1 Identify all systems, equipment, components, controls, sensors with system nameplates specified in this section.
  - .1 Inscriptions to include function and (where appropriate) fail-safe position.

## **2.11 CEILING AND ACCESS PANEL IDENTIFICATION**

- .1 Ceiling grids and access panels shall be identified with the following identification for mechanical services:
  - .1 Red Dot - Fire Damper
  - .2 Blue Dot - Heating & Cooling (coil, valves, etc.)
  - .3 Yellow Dot - VAV
  - .4 Green Dot - Potable & Non-Potable Water

## **2.12 JLR SPECIFIED PRODUCTS**

- .1 Refer to Division 00 and 01 for requirements for alternate manufacturer's to those listed below:
  - .1 Identification Systems: Brady.

## **PART 3 - EXECUTION**

### **3.1 GENERAL**

- .1 Prior to installation ensure that surfaces to be covered are clean and dry, and any insulation system has been completed.
- .2 Pressure-sensitive tape shall be applied with moving pressure using a squeegee or other appropriate sealing tool.
- .3 Locate markers and classifying colours to be visible from floor or platform. Where concealed above ceiling, identify marker location with circular adhesive marker on ceiling grid at partition walls. Identification easily and accurately readable from usual operating areas and from access points.
- .4 Position of identification approximately at right angles to most convenient line of sight, considering operating positions, lighting conditions, risk of physical damage or injury and reduced visibility over time due to dust and dirt.
- .5 Do not exceed 15 m (50') between identification.
- .6 Identify piping / ductwork on both sides of obscuring equipment.
- .7 Identify both sides where piping / ductwork passes through walls, partitions and floors or is concealed in chase, gallery or other confined space.
- .8 Identify systems at least once in each small room through which piping or ductwork passes.
- .9 Identify piping at all major manual and automatic valves immediately upstream of valves. Identify branch, equipment or building served after such valve.

- .10 Identify ducts at all dampers. Identify branch, equipment or building served after such damper.
- .11 Identify services in full except in cases of limited space. Avoid single letter abbreviations.
- .12 Check colour classification in table with respect to environment, location and service.

### 3.2 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

### 3.3 IDENTIFICATION CHART

- .1 Refer to the following chart for system identification requirements.

Service	Background Colour	Lettering Colour	Lettering	Painted Entire Length
Domestic Cold Water	Green	White	DOM COLD WATER	
Domestic Hot Water	Green	White	DOM HOT WATER	
Domestic Hot Water Recirculation	Green	White	DOM HOT WATER RECIRC	
Non-Potable Water - Cold	Green	White	NON-POTABLE COLD WATER	
Non-Potable Water - Hot	Green	White	NON-POTABLE HOT WATER	
Sanitary	Green	White	SANITARY	
Storm	Green	White	STORM	
Plumbing Vent	Green	White	PLUMBING VENT	
Compressed Air	Green	White	AIR	
Fire Wet Sprinkler System	Red	White	FIRE SPRINKLER	
Heating Water Supply	Yellow	Black	HEATING WATER SUPPLY	
Heating Water Return	Yellow	Black	HEATING WATER RETURN	
Heating Glycol Supply	Yellow	Black	HEATING GLYCOL SUPPLY	
Heating Glycol Return	Yellow	Black	HEATING GLYCOL SUPPLY	
Steam	Yellow	Black	XX PSI STEAM	
Steam Condensate	Yellow	Black	STEAM CONDENSATE	
Chilled Water Supply	Green	White	COOLING WATER SUPPLY	
Chilled Water Return	Green	White	COOLING WATER RETURN	
Supply Air Duct	White	Black	SUPPLY AIR DUCT	
Return Air Duct	White	Black	RETURN AIR DUCT	
Exhaust Air Duct	White	Black	EXHAUST AIR DUCT	
Outside Air Duct	White	Black	OUTSIDE AIR DUCT	

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 SCOPE DESCRIPTION SUMMARY**

- .1 Provide the standards with which all pipe shall be installed. These standards shall be inclusive of all pipe systems, valves and accessories.

### **1.2 REFERENCES**

- .1 Unless dated references are identified below, it shall be the latest standard issued by the regulatory agency that shall be utilized as the applicable reference.
- .2 Canadian General Standards Board (CGSB):
  - .1 CAN/CGSB-1.181-99, Ready-Mixed Organic Zinc-Rich Coating.
- .3 Standard GS-11-2008, 2nd Edition, Environmental Standard for Paints and Coatings.
- .4 National Fire Code of Canada (NFCC 2005).

### **1.3 MAINTENANCE REQUIREMENTS**

- .1 The Contractor shall verify and demonstrate that proper maintenance can be performed on equipment and material installed.

## **PART 2 - PRODUCTS**

### **2.1 NOT USED**

- .1 Not Used.

## **PART 3 - EXECUTION**

### **3.1 GENERAL**

- .1 Install pipes parallel and close to the building structure.
- .2 Locate groups of pipes parallel to each other and spaced at a distance to permit service access for valves or other equipment located above.
- .3 Pipe routing, connections and take-offs to follow building lines.
- .4 Provide swing joints, offsets and prefabricated expansion joints to accommodate pipe expansion or contraction due to temperature change.
- .5 Provide three (3) elbow swing joints on each branch connection to main at points of expansion or contraction due to temperature change.

- .6 Coordinate piping and pipe supporting elements with building architectural, structural, and electrical systems to ensure proper installation and access for maintenance and service.
- .7 Coordinate pipe supporting elements with other mechanical systems.
- .8 Provide all pipe supporting elements as necessary to ensure proper support under all operating conditions and in accordance with relevant standards and the constraints and requirements of the piping system manufacturer (pipe, fittings, valves, equipment, etc.).
- .9 Each pipe support to be field adjustable under full load conditions.
- .10 Re-adjust all pipe support elements after initial installation as required to suit final operating conditions.
- .11 Do not conceal piping and pipe supporting elements before the completion of the Contractor's quality assurance inspection and testing and approval of local authorities having jurisdiction.

### **3.2 PIPE INSTALLATION**

- .1 Screwed fittings jointed with Teflon tape.
- .2 Protect openings against entry of foreign material.
- .3 Install to isolate equipment and allow removal without interrupting operation of other equipment or systems.
- .4 Assemble piping using fittings manufactured to ANSI standards.
- .5 Saddle type branch fittings may be used on mains if branch line is no larger than half size of main.
- .6 Hole saw (or drill) and ream main to maintain full inside diameter of branch line prior to welding saddle.
- .7 Install exposed piping, equipment, rectangular cleanouts and similar items parallel or perpendicular to building lines.
- .8 Install concealed pipework to minimize furring space, maximize headroom conserve space.
- .9 Slope piping, except where indicated, in direction of flow for positive drainage and venting.
- .10 Install pipe to permit separate thermal insulation of each pipe.
- .11 Group piping wherever possible.
- .12 Ream pipes and remove scale and other foreign material before assembly.
- .13 Provide for thermal expansion as indicated.

### **3.3 VALVE INSTALLATION**

- .1 Install in accessible locations.
- .2 Remove interior parts before soldering.

- .3 Valves accessible for maintenance without removing adjacent piping.
- .4 Use gate, ball or butterfly valves at branch take-offs for isolating purposes except where otherwise specified.
- .5 Install silent check valves on discharge of pumps and in vertical pipes with downward flow and elsewhere as indicated.
- .6 Install swing check valves in horizontal lines on discharge of pumps and elsewhere as indicated.

### 3.4 PIPE SUPPORT

- .1 The design of pipe supporting elements is dependent on Contractor controlled methods of installation and the physical characteristics, limitations and operating characteristics of the piping system.
- .2 Contractor controlled methods of installation include the physical location of the pipe (distance to support structure), method of support (hanger, trapeze, etc.), attachment location (roof structure, column, interior wall, etc.), attachment method (cast in place, expansion inserts, structural bridging, clamping, etc.) and piping systems being supported (single, multiple, etc.).
- .3 Provide pipe supporting elements to properly support piping system (pipe, fittings, valves, equipment, etc.) such that the piping system and pipe supporting elements are protected from excessive stress and distortion.
- .4 Pipe supporting elements consist of hangers which support from above, supports which bear load from below, restraints, anchors, and guides which limit or direct movement as well as support loads and attachments between support elements and the structure.
- .5 Design the pipe supporting elements to carry the sum of all concurrently acting static and dynamic loads, including the following:
  - .1 Dead weight of pipe, fittings, valves, insulation, inline equipment, hanger system, contents and other pipes (if supported from the line under consideration).
  - .2 Live weight of contents.
  - .3 Weight of test fluid, when greater than normal fluid (not considered concurrent with occasional loads).
  - .4 Occasional loads such as ice, wind, and earthquake loads.
  - .5 Forces imposed by thermal expansion and contraction of pipe bends and loops.
  - .6 Frictional, spring and pressure thrust forces imposed by expansion joints in the system.
  - .7 Frictional forces of guides and supports.
  - .8 Forces due to internal pressure.
  - .9 Forces due to changes in direction of flow at bends and elbows.
  - .10 Forces due to operation of safety, relief, and stop valves.
- .6 Coordinate support system design and installation with the requirements and constraints of the piping system manufacturer (pipe, fittings, valves, equipment, etc.).
- .7 Coordinate support system design with the requirements and constraints of the connected equipment, structure, vibration isolation systems and seismic restraint systems.

### 3.5 HANGERS

- .1 Hangers to be capable of field adjustment while supporting the load.
- .2 Turnbuckles and adjusting nuts are to have full thread engagement and suitable locking devices.
- .3 Where piping moves horizontally due to thermal expansion/contraction, hanger components to allow for swing and travelling devices (rolling or slip supports) and restraints are to be provided as required to limit hanger swing angle to less than 4°.
- .4 Where trapeze supports are provided to reduce hanger attachments to the structure, individual hangers or base supports are to be provided for each pipe attached to the trapeze to allow for individual adjustment and support to suit requirements for sloping, horizontal movement and vertical movement.

### 3.6 SUPPORT SPACING

- .1 Support spacing to limit the stresses in the piping to be less than the allowable stress when determined on the basis of a support span twice that of the actual span.
- .2 Support spacing to limit the deflection to less than the smaller of 50 mm or 10% of the nominal diameter of the pipe, based on the weight of the empty pipe, insulation and other dead loads.
- .3 Support spacing varies with pipe material (steel, cast iron, glass, plastic, etc.), type of fitting (screwed, welded, flanged, soldered, brazed, thermoplastic welded, mechanical and proprietary joints, etc.), media contained (fluid, gas), ambient temperature and temperature of media contained.
- .4 Provide support spacing in accordance with MSS SP-69, relevant ASME standards and piping/fitting manufacturer's standards.

### 3.7 ANCHORS, GUIDES AND RESTRAINTS

- .1 Provide anchors, guides, pivots and other restraints required to secure piping (fittings, expansion joints, elbows, etc.) while withstanding thrusts, moments and other imposed loads.
- .2 Where Z-bends, U-bends or pipe loop expansion arrangements are used, provide anchors and guides to direct movement along axis of joint. Guide spacing to take into consideration the column buckling strength of the pipe.

### 3.8 PIPE ATTACHMENTS

- .1 Provide non-integral type pipe attachments including clamps, slings, cradles, saddles, straps, clevises and rollers for support of horizontal piping.
- .2 Non-integral pipe attachments (clamps) for vertical pipes are to incorporate shear lugs or be welded to the pipe to prevent slippage.
- .3 Attachments for piping systems which require movement due to thermal expansion are to include rolling or sliding supports. The support is to include for free movement of the pipe or the imposed loads and friction forces of the supports.

- .4 Provide protective surfaces (pads, cushions, shields, etc.) on supports for piping which requires protection against contact damage in accordance with the pipe manufacturer's requirements. Examples: glass, plastic, fiberglass piping.
- .5 Pipe attachment material to be compatible with the pipe material or be suitably isolated to prevent corrosion due to contact of dissimilar metals.
- .6 Pipe attachments for insulated pipe not to pierce insulation and to be provided with shields and/or insulated saddles to prevent insulation damage from the loads transmitted to the pipe support.
- .7 Where welded integral type attachments are required (ears, shoes, lugs, cylindrical attachments, rings, and skirts, etc.) for multi-axial type loading, materials to be compatible with piping and strength to be adequate for all expected loads.

### **3.9 CONNECTIONS TO BUILDING STRUCTURE**

- .1 Spacing, location and loading of individual attachments and all piping system attachments not to exceed capacity of structure.
- .2 Attachments to concrete floor to be at least 400 mm from edge of slab.
- .3 Attachments to concrete floor to be cast in place inserts or expansion studs and anchors. Explosive actuated fasteners not permitted.
- .4 Attachments to composite metal roof deck not to interfere with composite behaviour of roof deck structure.
- .5 Attachments to metal roof deck not permitted.
- .6 Locate connections to open web steel joists at panel points.
- .7 Attachments to steel structure to be bolted type connections.
- .8 Beam attachments to provide concentric support on both sides of beam.
- .9 Maximum loads on attachments to concrete not to exceed one-fifth of the ultimate strength of the attachment as determined by manufacturer's tests. Install attachments in accordance with manufacturer's requirements.

### **3.10 SLEEVES**

- .1 General: install where pipes pass through masonry, concrete structures, fire rated assemblies, and elsewhere as indicated.
- .2 Material: schedule 40 black steel pipe.
- .3 Construction: foundation walls and where sleeves extend above finished floors to have annular fins continuously welded on at mid-point.
- .4 Sizes: 12 mm (1/2") minimum clearance between sleeve and uninsulated pipe or between sleeve and insulation.

- .5 Installation:
  - .1 Concrete, masonry walls, concrete floors on grade: terminate flush with finished surface.
  - .2 Other floors: terminate 25 mm above finished floor.
  - .3 Before installation, paint exposed exterior surfaces with heavy application of zinc-rich paint to CAN/CGSB-1.181.
- .6 Sealing:
  - .1 Foundation walls and below grade floors: fire retardant, waterproof non-hardening mastic.
  - .2 Elsewhere: Provide space for fire stopping. Maintain fire rating integrity.
  - .3 Sleeves installed for future use: fill with lime plaster or other easily removable filler.
- .7 Ensure no contact between copper pipe or tube and sleeve.

### 3.11 FIRE STOPPING

- .1 All fire stopping shall be the work of one contractor. Material and installation within annular space between pipes, ducts, insulation and adjacent fire separation Division 07 Standards.
- .2 Uninsulated unheated pipes not subject to movement: no special preparation.
- .3 Uninsulated heated pipes subject to movement: wrap with non-combustible smooth material to permit pipe movement without damaging fire stopping material or installation.
- .4 Insulated pipes and ducts: ensure integrity of insulation and vapour barriers.

### 3.12 ESCHECHEONS

- .1 Install on pipes passing through walls, partitions, floors, and ceilings in finished areas.
- .2 Construction: one piece type with set screws. Polished chrome plated brass.
- .3 Sizes: outside diameter to cover opening or sleeve. Inside diameter to fit around pipe or outside of insulation if so provided.

### 3.13 CONNECTIONS TO EQUIPMENT

- .1 Piping shall be independently supported from equipment. Weight of piping shall not be imposed upon connections to equipment.
- .2 In accordance with manufacturer's instructions unless otherwise indicated.
- .3 Use valves and either unions or flanges for isolation and ease of maintenance and assembly.
- .4 Use double swing joints when equipment mounted on vibration isolation and when piping subject to movement.
- .5 Provide immediate elbows to clear path for coil removal for coils requiring removal.

### **3.14 CLEARANCES**

- .1 Provide clearance around systems, equipment and components for observation of operation, inspection, servicing, maintenance and as recommended by manufacturer.
- .2 Provide space for disassembly, removal of equipment and components as recommended by manufacturer or as indicated (whichever is greater) without interrupting operation of other system, equipment and components.

### **3.15 DRAINS**

- .1 Install piping with grade in direction of flow except as indicated.
- .2 Install drain valve at low points in piping systems, at equipment and at section isolating valves.
- .3 Pipe each drain valve discharge separately to above floor drain. Discharge to be visible.
- .4 Drain valves: NPS ½ (½"Ø) ball valves unless indicated otherwise, with hose end male thread, cap and chain.

### **3.16 AIR VENTS**

- .1 Install manual air vents at high points in piping systems.
- .2 Install isolating valve at each automatic air valve.

### **3.17 DI-ELECTRIC COUPLINGS**

- .1 General: compatible with system, to suit pressure rating of system.
- .2 Locations: where dissimilar metals are joined.
- .3 NPS 2½ (2½"Ø) and under: isolating unions or bronze valves.
- .4 Over NPS 3 (3"Ø): isolating flanges.

### **3.18 PRESSURE TESTING**

- .1 Advise Consultant 48 hours minimum prior to performance of pressure tests.
- .2 Pipework: test as specified in relevant sections of heating, ventilating and air conditioning work.
- .3 Maintain specified test pressure without loss for 4 hours minimum unless specified for longer period of time in relevant mechanical sections.
- .4 Prior to tests, isolate equipment and other parts which are not designed to withstand test pressure or media.

- .5 Conduct tests in presence of Consultant.
- .6 Pay costs for repairs or replacement, retesting, and making good. Consultant to determine whether repair or replacement is appropriate.
- .7 Insulate or conceal work only after approval and certification of tests by Consultant.

### **3.19 SYSTEM CLEANING**

- .1 Preparatory to acceptance, clean and refurbish equipment and leave in operating condition, including replacement of filters in piping systems.
- .2 Replace construction screens on strainers with service screens.

### **3.20 EXISTING SYSTEMS**

- .1 Connect into existing piping systems at times approved by Consultant.
- .2 Request written approval 10 days minimum, prior to commencement of work.
- .3 Be responsible for damage to existing plant by this work.
- .4 Ensure daily clean-up of existing areas.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 SCOPE DESCRIPTION SUMMARY**

- .1 This section describes the requirements for piping support and hangers and equipment supports and bases.

### **1.2 REFERENCES**

- .1 Unless dated references are identified below, it shall be the latest standard issued by the regulatory agency that shall be utilized as the applicable reference.
- .2 American Society of Mechanical Engineers (ASME):
  - .1 ASME B31.1-07, Power Piping.
- .3 ASTM International:
  - .1 ASTM A 125-1996(2007), Standard Specification for Steel Springs, Helical, Heat-Treated.
  - .2 ASTM A 307-07b, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
  - .3 ASTM A 563-07a, Standard Specification for Carbon and Alloy Steel Nuts.
- .4 Factory Mutual (FM).
- .5 Manufacturer's Standardization Society of the Valves and Fittings Industry (MSS):
  - .1 MSS SP 58-2002, Pipe Hangers and Supports - Materials, Design and Manufacture.
  - .2 MSS SP 69-2003, Pipe Hangers and Supports - Selection and Application.
  - .3 MSS SP 89-2003, Pipe Hangers and Supports - Fabrication and Installation Practices.
- .6 Underwriter's Laboratories of Canada (ULC).

### **1.3 INFORMATIONAL SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 01 - Submittals.
- .2 Product Data:
  - .1 Product data shall be submitted for all PART 2 – PRODUCTS specified herein.
  - .2 Provide manufacturer's printed product literature and datasheets for material specified, and include product characteristics, performance criteria, physical size, finish and limitations.
  - .3 Product data shall include all maintenance access points and dimensional clearances, such that the contractor can properly layout the equipment to ensure proper access.
  - .4 Product data shall include all relevant information to confirm the specifications have been met.
  - .5 Product data shall provide all relevant data and operational points that verify the engineered criteria have been met and that field operational tolerances can be accommodated, i.e., equipment are not supplied, which are operating at their upper and lower limits for their design duty performance.
  - .6 Product data shall identify all ancillary field installed devices and provide all information required for the co-ordination of the installation with other trades.
  - .7 Product data shall include information as specified in Section 20 01 01 – Common Work Results – Mechanical Submittals unless modified with additional information required below.

- .3 Refer to Section 20 05 48 - Vibration and Seismic Controls for Piping, Ducts and Equipment. When the piping and equipment support system is required to be seismically engineered, all product information and shop drawings related to this section shall be submitted as per the requirements of Section 20 05 48. Submit drawings stamped and signed by professional engineer licensed in Province of Ontario, Canada.

## **1.4 MAINTENANCE REQUIREMENTS**

- .1 The Contractor shall verify and demonstrate that proper maintenance can be performed on equipment and material installed.

## **PART 2 - PRODUCTS**

### **2.1 GENERAL**

- .1 Fabricate hangers, supports and sway braces in accordance with MSS SP 58.
- .2 Design Requirements:
  - .1 Construct pipe hanger and support to manufacturer's recommendations utilizing manufacturer's regular production components, parts and assemblies.
  - .2 Base maximum load ratings on allowable stresses prescribed by ASME B31.1 or MSS SP 58.
  - .3 Ensure that supports, guides, anchors do not transmit excessive quantities of heat to building structure.
  - .4 Design hangers and supports to support systems under conditions of operation, allow free expansion and contraction, prevent excessive stresses from being introduced into pipework or connected equipment.
  - .5 Provide for vertical adjustments after erection and during commissioning.
- .3 Hangers and supports subject to interior conditions with high humidity levels will be hot dipped galvanized.
- .4 Hangers and supports subject to exterior conditions shall be hot dipped galvanized.
- .5 Hangers and supports subject to corrosive conditions shall be epoxy coated.
- .6 Hangers and supports in contact with copper pipe will be epoxy coated.
- .7 Hangers and support utilized for insulated piping shall be selected (up sized) and installed to accommodate the insulation requirements of the pipe supported.

### **2.2 SEISMIC REQUIREMENTS**

- .1 Refer to Section 20 05 48 - Vibration and Seismic Controls for Piping, Ducts and Equipment for seismic requirements for this project.

### **2.3 PIPE HANGERS**

- .1 Adjustable Swivel Type Hanger:
  - .1 Application: Stationary Pipe (Copper and Steel), not insulated, NPS ½ (½"Ø) thru NPS 4 (4"Ø).
  - .2 Carbon steel construction.

- .3 Finish meeting the conditional requirements.
- .4 Hangers shall be UL listed and FM approved.
- .2 Adjustable Clevis Hanger:
  - .1 Application: Stationary Pipe (Copper and Steel), insulated and not insulated, NPS ½ (½"Ø) thru NPS 24 (24"Ø).
  - .2 Carbon steel construction.
  - .3 Finish meeting the conditional requirements.
  - .4 Hangers shall be UL listed and FM approved.
- .3 Adjustable Yoke, Pipe Roller Hanger:
  - .1 Application: Non-stationary for longitudinal movement, pipe (Copper and Steel), insulated and not insulated, NPS 2½ (2½"Ø) thru NPS 24 (24"Ø).
  - .2 Carbon steel construction, cast iron roller.
  - .3 Finish meeting the conditional requirements.
- .4 Trapeze Hanger Assemblies, Shop and Field Fabricated:
  - .1 Utilized for support of multiple pipes either for hanger attachment or support from beneath. Steel construction, shop or field fabricated meeting the requirements of ASME B31.1 and MSS SP 58.
- .5 Steel Brackets Shop and Field Fabricated:
  - .1 Utilized for support of pipes from a wall, r for hanger attachment or support from beneath. Steel construction, shop or field fabricated meeting the requirements of ASME B31.1 and MSS SP 58.
- .6 Hanger Rod: carbon steel threaded rod, size to suit load and application, material to MSS SP 58. Ensure that hanger rods are subject to tensile loading only.
- .7 U-bolts: carbon steel to MSS SP 69 with 2 nuts at each end to ASTM A 563.
- .8 Pipe Guides and Anchors:
  - .1 Carbon steel alignment guides for maintaining alignment of piping through its axial expansion and contraction cycles.
  - .2 Anchors shall be directly connected to the structure and prevent axial expansion at the anchor point.
  - .3 For all anchors and guides piping shall be installed to maintain maximum insulation values.

## **2.4 RISER CLAMPS**

- .1 Steel or Cast Iron Pipe: carbon steel. UL listed and FM approved complying with MSS-SP 58 and MSS-SP 69.
- .2 Copper Pipe: carbon steel copper plated. UL listed and FM approved complying with MSS-SP 58 and MSS-SP 69.
- .3 Bolts: to ASTM A 307.
- .4 Nuts: to ASTM A 563.

## **2.5 INSULATION PROTECTION SHIELDS**

- .1 For cold insulated piping the hangers shall support from the exterior jacket and shall not penetrate the insulation or the insulation jacket / vapor barrier.

- .2 For NPS ½ (½"Ø) thru NPS 4 (4"Ø) insulated pipe (any application) and standard insulation the pipe insulation shall be protected with a metal shield installed between the hanger and the insulation jacket. The shield shall be minimum 1.3 mm thick (18 ga.) and be installed centred on the pipe hanger and shall extend 150 mm either side of the hanger. The shield shall provide 180 degree protection of the insulation and be installed centred on the base of the pipe.
- .3 For NPS 6 (6"Ø) pipe and greater insulated pipe, the insulation shall be protected with an insulation saddle. The saddle shall provide direct transfer of pipe loads to the pipe hanger without the insulation being compressed. The saddle shall be constructed from similar material as the pipe or be of a dielectric construction. The saddle shall be attached to the pipe and insulation shall be installed in the interstitial space. The saddle shall be installed centred on the pipe hanger and shall extend 100 mm either side of the hanger. The vapor barrier shall be installed around the pipe saddle.
- .4 For all pipe installed with roller style hangers the insulation shall be protected with pipe saddles.

## **2.6 CONNECTIONS TO STRUCTURE**

- .1 All connections to new or existing structure shall be reviewed and coordinated with both Division 3 and Division 5.
- .2 Attachment Structural Steel:
  - .1 Piping NPS 2 (2"Ø) maximum: malleable iron C-clamp with hardened steel cup point setscrew and locknut. UL listed and FM approved complying with MSS-SP 58 and MSS-SP 69.
  - .2 Piping NPS 2½ (2½"Ø) or greater: malleable iron beam clamp, eye rod, jaws and extension, tie rod, nuts and washers. UL listed and FM approved complying with MSS-SP 58 and MSS-SP 69.
  - .3 Rod: carbon steel threaded rod, size to suit loading applied. Complying with MSS-SP 58 and MSS-SP 69.
- .3 Attachment to Concrete New Construction / New Concrete Pour:
  - .1 Prior to concrete pour install wedge style concrete inserts. Carbon steel construction with knock out plates and malleable iron nut. UL listed and FM approved complying with MSS-SP 58 and MSS-SP 69.
- .4 Attachment to Existing Concrete:
  - .1 Concrete rod attachment plate. Carbon steel plate, welded eye rod, clevis plate, clevis pin and cotters with forged steel eye nut. UL listed and FM approved complying with MSS-SP 58 and MSS-SP 69.
  - .2 Bolting and attachment to existing concrete to Divisions 3 and 5 standards.

## **2.7 EQUIPMENT SUPPORTS PLATFORMS AND CATWALKS**

- .1 Fabricate equipment supports not provided by equipment manufacturer from structural grade steel meeting requirements of Section 05 12 23 - Structural Steel for Buildings. Submit calculations with shop drawings.
- .2 For both manufactured, shop fabricated and field fabricated support systems, provide templates to ensure accurate location of anchor bolts.

## **2.8 HOUSEKEEPING PADS**

- .1 Provide 100 mm high concrete housekeeping pads for base-mounted equipment; size pads 150 mm (6") larger than equipment; chamfer pad edges and corners.

- .2 Concrete: to Section 03 30 00 - Cast-in-Place Concrete.

## **2.9 JLR SPECIFIED PRODUCTS**

- .1 Refer to Division 00 and 01 for requirements for alternate manufacturer's to those listed below.
- .2 The following are Owner acceptable manufacturers, all others will be rejected unless pre-approved during tender:
  - .1 E Myatt and Company Inc.
  - .2 Taylor Pipe Supports

## **PART 3 - EXECUTION**

### **3.1 GENERAL**

- .1 Coordinate the installation with other divisions to ensure that the piping and equipment support systems are incorporated into the design and installation activities of those divisions.

### **3.2 MANUFACTURER'S INSTRUCTIONS**

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

### **3.3 INSTALLATION**

- .1 Clevis plates:
  - .1 Attach to concrete with minimum 4 concrete inserts, one at each corner.
  - .2 Provide supplementary structural steelwork where structural bearings do not exist or where concrete inserts are not in correct locations.
- .2 Transfer of load to adjacent hangers or connected equipment is not permitted.
- .3 Clamps on riser piping:
  - .1 Support independent of connected horizontal pipework using riser clamps and riser clamp lugs welded to riser.
- .4 Vibration Control Devices:
  - .1 Install on piping systems at pumps and as indicated.

### **3.4 HANGER SPACING**

- .1 Plumbing piping: to Ontario Plumbing Code and National Plumbing Code or to the authority having jurisdiction.
- .2 Fire protection: to applicable NFPA fire code.
- .3 Gas and fuel oil piping: up to NPS  $\frac{3}{4}$  ( $\frac{3}{4}$ "Ø): every 1.8 m.
- .4 Copper piping: up to NPS  $\frac{3}{4}$  ( $\frac{3}{4}$ "Ø): every 1.5 m.

- .5 Flexible joint roll groove pipe: in accordance with table below for steel, but not less than one hanger at joints. Table listings for straight runs without concentrated loads and where full linear movement is not required.
- .6 Within 300 mm (12") of each elbow.

Pipe Size	Steel Pipe Maximum Spacing	Copper Pipe Maximum Spacing
NPS ¾ (¾"Ø)	2.4M (8')	1.8M (6')
NPS 1 (1"Ø)	2.4M (8')	1.8M (6')
NPS 1¼ (1 ¼"Ø)	2.4M (8')	1.8M (6')
NPS 1½ (1 ½"Ø)	3.0M (10')	2.4M (8')
NPS 2 (2"Ø)	3.0M (10')	2.4M (8')
NPS 2½ (2 ½"Ø)	3.7M (12')	3.0M (10')
NPS 3 (3"Ø)	3.7M (12')	3.0M (10')
NPS 4 (4"Ø)	3.7M (12')	3.0M (10')
NPS 6 (6"Ø)	4.3M (14')	
NPS 8 (8"Ø)	4.3M (14')	
NPS 10 (10"Ø)	4.9M (16')	
NPS 12 (12"Ø)	4.9M (16')	
Pipework greater than NPS 12: to MSS SP 69		

### 3.5 HANGER INSTALLATION

- .1 Install hanger so that rod is vertical under operating conditions.
- .2 Adjust hangers to equalize load.
- .3 Support from structural members. Where structural bearing does not exist or inserts are not in suitable locations, provide supplementary structural steel members.
- .4 Angularity of rod hanger resulting from horizontal movement of pipework from cold to hot position not to exceed 4 degrees from vertical.

### 3.6 ADJUSTMENT

- .1 Adjust hangers and supports:
  - .1 Ensure that rod is vertical under operating conditions.
  - .2 Equalize loads.
- .2 Adjustable clevis:
  - .1 Tighten hanger load nut securely to ensure proper hanger performance.
  - .2 Tighten upper nut after adjustment.
- .3 C-clamps:
  - .1 Follow manufacturer's recommended written instructions and torque values when tightening C-clamps to bottom flange of beam.
- .4 Beam clamps:
  - .1 Hammer jaw firmly against underside of beam.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 SCOPE DESCRIPTION SUMMARY**

- .1 This section will define the design requirements for vibration isolation and seismic control systems. The contractor, or their agent will design these systems, and shop drawings will be submitted for the systems.

### **1.2 REFERENCES**

- .1 Unless dated references are identified below, it shall be the latest standard issued by the regulatory agency that shall be utilized as the applicable reference.
- .2 National Building Code of Canada (NBC).
- .3 Ontario Building Code.
- .4 National Fire Protection Association (NFPA):
  - .1 NFPA 13, Standard for the Installation of Sprinkler Systems.
  - .2 NFPA 14, Standard for the installation of Standpipe Systems.
- .5 ASHRAE and SMACNA Standards for Seismic Restraint.

### **1.3 INFORMATIONAL SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 01 – Submittals.
- .2 Product Data:
  - .1 Product data shall be submitted for all PART 2 – PRODUCTS specified herein.
  - .2 Provide manufacturer's printed product literature and datasheets for material specified, and include product characteristics, performance criteria, physical size, finish and limitations.
  - .3 Product data shall include all relevant information to confirm the specifications have been met.
  - .4 Equipment vibration control devices, seismic control devices and equipment bases are to be from one manufacturer.
- .3 Shop Drawings:
  - .1 Submit drawings stamped and signed by professional engineer licensed in Province of Ontario, Canada.
  - .2 Provide detailed drawings of all seismic control measures for equipment piping, and ductwork.
  - .3 Contractor to provide all necessary data on equipment, pipe support and duct support requirements to the vibration and seismic control manufacturer, supplier, or design engineer.
  - .4 Shop drawings to be reviewed and approved by Contractor's Structural Engineer responsible for design of supports, anchors and restraints prior to submission. Shop Drawings to bear the signature of Contractor's Structural Engineer or be accompanied by a signed letter indicating his review and acceptance of the seismic design.
  - .5 Shop Drawings to include design stresses and loads imposed upon the structure and identify method of attachment.

## **1.4 QUALITY ASSURANCE**

- .1 Performance Requirements defined: Catalogued or published ratings for manufactured items obtained from tests carried out by manufacturer or those ordered by manufacturer from an independent testing agency signifying adherence to codes and standard and standardized testing of performance criteria.
- .2 Vibration control measures to conform to latest edition of ASHRAE standards for vibration control and isolation.

## **1.5 DESIGN STANDARDS**

- .1 Refer to architectural and structural drawings for seismic requirements for this project prior to design and construction.
- .2 Refer to the applicable building code for the Stainless Steel Mapped Horizontal Spectral Response Acceleration Factors.
- .3 Refer to the architectural and structural drawings, for the importance factor to be applied to the design.
- .4 Review and understand the structural drawings, construction methodology and related design information prior to preparing and design of the seismic restraint systems.
- .5 No equipment, equipment supports or mounts to fail before failure of structure.

## **PART 2 – PRODUCTS**

### **2.1 GENERAL**

- .1 The products identified below are specified as minimum standards of manufactured equipment to be utilized for vibration isolation.
- .2 Static equipment: Anchor equipment to equipment supports. Anchor equipment supports to structure.
- .3 Suspended equipment: Use one or more of following methods:
  - .1 Install tight to structure.
  - .2 Cross brace in every direction.
  - .3 Brace back to structure.
  - .4 Cable restraint system.
  - .5 Cushioning action gentle and steady.
- .4 Cable restraint system incorporating grommets, shackles and other hardware to ensure alignment of restraints and to avoid bending of cables at connection points. Incorporate neoprene into cable connections to reduce shock loads.

## **2.2 METAL HOSE PIPING PUMP CONNECTORS**

- .1 Type 304 stainless steel, braided outer core and inner core with annular corrugation, rated for 2070 kPa (300 psi) operation.
- .2 Provide with carbon steel flanged ends to ANSI B16.5 for piping NPS 2½ (2½") diameter and larger, screwed ends to ANSI B52.1 for piping NPS 2 (2") and smaller.
- .3 Use minimum end to end dimension of 300 mm (12").

## **2.3 RUBBER PAD ISOLATORS**

- .1 Rubber-steel-rubber; 9 mm minimum thick rubber bonded to 1.71 mm steel plate; 30 durometer natural rubber, waffle or ribbed; holes sleeved with isolation washers; maximum loading 415 kPa.

## **2.4 NEOPRENE ISOLATORS**

- .1 Double deflection neoprene mountings and double deflection rails are recommended for minor equipment or basement locations only. This limitation on all rubberlike materials because of their relatively minor deflections.
- .2 Neoprene mountings shall have a minimum static deflection of 9 mm (0.35"). All metal surfaces shall be neoprene covered and have friction pads both top and bottom. Bolt holes shall be provided on the bottom and a tapped hole and cap screw on top. Steel rails shall be used above the mountings under equipment such as small vent sets to compensate for the overhang.

## **2.5 SPRING MOUNTS ISOLATORS**

- .1 Spring isolators shall be free standing and laterally stable without any housing and complete with a molded neoprene cup or 6 mm (¼") neoprene acoustical friction pad between the baseplate and the support. All mountings shall have leveling bolts that must be rigidly bolted to the equipment. Installed and operating heights shall be equal. The ratio of the spring diameter divided by the compressed spring height shall be no less than 0.8. Springs shall have a minimum additional travel to solid equal to 50% of the rated deflection.
- .2 Zinc or cadmium plated hardware; housings coated with rust resistant paint.
- .3 Open Spring: 6 mm (¼") minimum thick ribbed neoprene or rubber friction and acoustic pad, bonded under isolator and on isolator top plate; levelling bolt for rigidly mounting to equipment.
- .4 Restrained Open Spring: supported on bonded 6 mm (¼") minimum thick ribbed neoprene or rubber friction and acoustic pad; built-in resilient limit stops, removable spacer plates.

## **2.6 NEOPRENE AND SPRING ISOLATED HANGERS**

- .1 Colour coded springs, rust resistant, painted box type hangers. Hangers shall consist of rigid steel frame containing a minimum 32 mm (1¼") thick, Low Dynamic Stiffness (LDS) rubber element at the top and a steel spring seated in a steel washer reinforced LDS rubber cup on the bottom. The LDS rubber element and the cup shall have molded bushings projecting through the steel box. Spring and hanger lower hole diameters shall be large enough to permit the hanger rod to swing through a 30° arc from side to side before contacting the cup bushing and short circuiting the spring.

## **2.7 HORIZONTAL THRUST RESTRAINTS**

- .1 Spring and elastomeric element housed in box frame; assembly complete with rods and angle brackets for equipment and ductwork attachment; provision for adjustment to limit maximum start and stop movement to 9 mm. Arrange restraints symmetrically on either side of unit and attach at centerline of thrust.

## **2.8 JLR AND OWNER SPECIFIED PRODUCTS**

- .1 Refer to Division 00 and 01 for requirements for alternate manufacturer's to those listed below.
- .2 The following are Owner acceptable manufacturers, all others will be rejected unless pre-approved during tender:
  - .1 Senior Flexonics
  - .2 Metalflex Inc.
  - .3 Vibra-Sonic Control

## **PART 3 - EXECUTION**

### **3.1 GENERAL**

- .1 Coordinate vibration isolation and seismic restraint with structural, architectural and electrical building systems.

### **3.2 MANUFACTURER'S INSTRUCTIONS**

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 SUMMARY**

- .1 This Section includes requirements for selective demolition and removal of plumbing, sanitation, sprinkler systems, heating, ventilation and air conditioning systems, refrigerant systems, controls and automated automation components, and related mechanical components and incidentals required to complete work described in this Section and make site ready for new construction.

### **1.2 REFERENCES**

- .1 CSA S350 M1980 (R2003), Code of Practice for Safety in Demolition of Structures

### **1.3 DEFINITIONS**

- .1 Demolish: Detach items from existing construction and legally dispose or recycle items off site, unless indicated as removed and salvaged, or removed and reinstalled.
- .2 Remove: Planned deconstruction and disassembly of mechanical, plumbing, heating, ventilation, air conditioning, and fire suppression systems tanking care not to damage adjacent assemblies designated to remain while maintaining the integrity and functionality of the remaining portions of systems.
- .3 Remove and Salvage: Detach items from existing construction and deliver them to Owner ready for reuse.
- .4 Remove and Reinstall: Detach items from existing construction, prepare them for reuse, and reinstall them where indicated.
- .5 Existing to Remain: Existing items of construction that are not removed and that are not otherwise indicated as being removed and salvaged, or removed and reinstalled.
- .6 Hazardous Substances: Dangerous substances, dangerous goods, hazardous commodities and hazardous products may include asbestos, mercury and lead, PCB's, poisons, corrosive agents, flammable substances, radioactive substances, or other material that can endanger human health or wellbeing or environment if handled improperly as defined by the Federal Hazardous Products Act (RSC 1985) including latest amendments.

### **1.4 ACTION AND INFORMATION SUBMITTALS**

- .1 Action Submittals: Provide the following in accordance with Section 01 33 00 - Submittal Procedures before starting work of this Section:
  - .1 Construction Waste Management Plan (CWM Plan): Submit plan addressing opportunities for reduction, reuse, or recycling of materials prepared in accordance with Section 01 74 03 - Waste Management.
  - .2 Mechanical system pre-demolition flow rate report: Submit a report containing the fluid flow rates of the heating, ventilation and air condition system to be altered as part of the scope of work. Measure the flow rates in accordance with Section 23 05 93 Testing, Adjusting, and Balancing of Mechanical HVAC.

- .2 Landfill Records: Indicate receipt and acceptance of selective demolition waste and hazardous wastes by a landfill facility licensed to accept hazardous wastes.
- .3 Schedule of Selective Demolition Activities: Indicate detailed sequence of selective demolition and removal work, with starting and ending dates for each activity and interruption of utility services.
- .4 Predemolition Photographs: Show existing conditions of adjoining construction and site improvements, including finished surfaces, which might be misconstrued as damage caused by selective demolition operations.
- .5 Disposal Records: If hazardous wastes are removed by the contractor, submit the following:
  - .1 Hazardous Waste Transporter License.
  - .2 Permit or license for hazardous waste treatment or disposal facilities.
  - .3 Completed Uniform Hazardous Waste Manifest for all shipments.

## **1.5 ADMINISTRATIVE REQUIREMENTS**

- .1 Coordination: Coordinate work of this Section to avoid interference with work by other Sections.
- .2 Scheduling: Account for Owner's continued occupancy requirements during selective demolition with Division 00 and Division 01 and schedule staged occupancy and worksite activities.

## **1.6 SITE CONDITIONS**

- .1 Existing Conditions: Condition of materials identified as being salvaged or demolished are based on their observed condition on date that tender is accepted.
- .2 Owner will occupy buildings immediately adjacent to selective demolition areas. Conduct selective demolition so Owner's operations will not be disturbed.
- .3 Condition existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
- .4 Hazardous Materials: Hazardous materials are present in the interior of the building to be selectively demolished.
- .5 If materials suspected of containing hazardous materials are encountered that have not been indicated in the contract documents, do not disturb: immediately notify Engineer and Construction Representative.
- .6 Hazardous material remediation will be completed as a portion of this contract. This work is anticipated to be sequenced with the proposed phasing of construction activities.
- .7 Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
- .8 Where demolition activities affect services for adjacent buildings that are outside of the demolition work, work shall be performed outside of normal operating hours of the occupants of the building.
- .9 Maintain fire-protection and life safety facilities in service during selective demolition operations.

## **1.7 PRE-DEMOLITION MEETING**

- .1 Pre-demolition Conference: Conduct conference at Project site.
  - .1 Inspect and discuss condition of construction to be selectively demolished.
  - .2 Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
  - .3 Review requirements of work performed by other trades to coordinate selective demolition work.
  - .4 Review areas where existing construction is to remain and requires protection.

## **1.8 COORDINATION**

- .1 It is the intent of these Specifications that all mechanical demolition work specified herein be coordinated as required with the work of all other Divisions of the Specifications and Drawings.
- .2 Review requirements of General Demolition Contractor and work performed by other trades that rely on demolition of plumbing equipment and materials to allow for structural demolition or removal of equipment.
- .3 Arrange demolition schedule so as not to interfere with Owner's on-site operations and the operations of adjacent occupied buildings.

## **1.9 WARRANTY**

- .1 Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials so as not to void existing warranties.

## **1.10 MATERIALS OWNERSHIP**

- .1 Except for items or materials to be reused, salvaged, reinstalled or otherwise indicated to remain the Owner's property, demolished materials shall become the Contractor's property and shall be removed from the site with further disposition at the Contractor's option but in compliance with ordinances and regulations related to the materials being disposed.

## **PART 2 - PRODUCTS**

### **2.1 REPAIR MATERIALS**

- .1 Plumbing Repair Materials: Use only new materials required for completion or repair matching materials damaged during performance of work of this Section; new materials are required to meet assembly or system characteristics as existing systems indicated to remain and carry CSA approval labels required by the Authority Having Jurisdiction.
- .2 HVAC Repair Materials: Use only new materials required for completion or repair matching materials damaged during performance of work of this Section; new materials are required to meet assembly or system characteristics as existing systems indicated to remain and carry CSA approval labels required by the Authority Having Jurisdiction.

- .3 Fire stopping Repair Materials: Use fire stopping materials compatible with existing fire stopping systems where removal or demolition work affects rated assemblies, restore to match existing fire rated performance.

## **2.2 DEBRIS MATERIALS**

- .1 Material Ownership: Demolished materials become Contractor's property and will be removed from Project site; except for items indicated as being reused, salvaged, or otherwise indicated to remain Owner's property.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- .1 Verification of Existing Conditions: Visit site, thoroughly examine and become familiar with conditions that may affect the work of this Section before tendering the Bid; Owner will not consider claims for extras for work or materials necessary for proper execution and completion of the contract that could have been determined by a site visit.
- .2 Verify that utilities have been disconnected and capped before starting demolition.
- .3 Survey existing conditions and correlate with requirements indicated to determine extent of demolition required.
- .4 Inventory and record the condition of items to be removed and reinstalled and items to be removed and salvaged. Use photographs to document pre-existing damage.
- .5 When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of the conflict. Promptly submit a written report to the Construction Representative.
- .6 Engage a professional engineer to survey conditions of existing structures to determine whether excavations or the removal of any element might result in structural deficiency or unplanned collapse of any portion of the existing structures during selective demolition operations.
- .7 Perform surveys as the work progresses to detect hazards resulting from the execution of the work.

### **3.2 COORDINATION**

- .1 No demolition work shall be performed without prior approval of the Owner's Representative.
- .2 Demolition work shall be carried on in a manner so as not to interfere with operation of the Owner's facilities.
- .3 Any demolition work which interferes with Owner's operations shall be scheduled with the Owner's Representative and be subject to the Owner's approval.
- .4 Maintain existing services required to avert disruption to the Owner's on-going operations and protect them against damage during the performance of work.

- .5 Do not interrupt existing utilities serving occupied facilities except when authorized in writing by the Owner and authorities having jurisdiction.
- .6 Provide temporary services during interruptions to existing utilities, as acceptable to the Owner and authorities having jurisdiction.
- .7 Unless noted otherwise, provide not less than two weeks' notice to the Owner if shutdown of service is required during the execution of the work.
- .8 The Contractor shall not remove any material beyond the limits indicated on the Drawings unless given permission to do so by the Owner's Representative. Any such material removed shall be replaced by the Contractor at his/her expense. If the items removed are damaged and/or cannot be satisfactorily reinstalled, new material of like construction shall be furnished and installed by the Contractor at his/her expense.
- .9 All damage to buildings and utilities to remain in place shall be promptly repaired at no cost to the Owner. Repairs and restoration of accidental utility interruptions shall be made before the person responsible for the repair and restoration leaves the job site on the day of such interruption occurred.

### **3.3 PREPARATION**

- .1 Protection of Existing Systems to Remain: Protect systems and components indicated to remain in place during selective demolition operations and as follows:
  - .1 Prevent movement and install bracing to prevent settlement or damage of adjacent services and parts of existing buildings scheduled to remain.
  - .2 Notify Consultant and cease operations where safety of buildings being demolished, adjacent structures or services appears to be endangered and await additional instructions before resuming demolition work specified in this Section.
  - .3 Prevent debris from blocking drainage inlets.
  - .4 Protect mechanical systems that must remain in operation.
- .2 Protection of Building Occupants: Sequence demolition work so that interference with the use of the building by the Owner and users is minimized and as follows:
  - .1 Prevent debris from endangering the safe access to and egress from occupied buildings.
  - .2 Notify Owner and cease operations where safety of occupants appears to be endangered and await additional instructions before resuming demolition work specified in this Section.

### **3.4 SELECTIVE DEMOLITION – MECHANICAL**

- .1 Demolition and Removal: Coordinate requirements of this Section with information contained in Division 00 and Division 01 and as follows:
  - .1 Disconnect and cap mechanical services in accordance with requirements of local Authority Having Jurisdiction.
  - .2 Do not disrupt active or energized utilities without approval of the Owner.
  - .3 Erect and maintain dust proof and weather tight partitions to prevent the spread of dust and fumes to occupied building areas; remove partitions when complete.
  - .4 Demolish parts of existing building to accommodate new construction and remedial work as indicated.
  - .5 At end of each day's work, leave worksite in safe condition.

- .6 Perform demolition work in a neat and workmanlike manner:
  - .1 Remove any tools or equipment after completion of work, and leave site clean and ready for subsequent renovation work.
  - .2 Repair and restore damages caused as a result of work of this Section to match existing materials and finishes.
- .2 The Contractor shall use caution in the demolition of mechanical systems and shall become familiar with the conditions (fluid pressure, type, temperature) of all systems to be demolished before making any cuts or breaking any joints.
- .3 All chilled water, heating water, steam, steam condensate, domestic water, waste, vent, compressed air, and fire suppression shutdowns shall be coordinated and scheduled with Owner.
- .4 Prior to breaking or cutting piping or tubing within the demolished area, the Contractor shall ascertain that the system has been marked in the field or shown on the Drawings to be removed under this contract. Contact Consultant for clarification prior to demolishing or removing questionable items.
- .5 Contractor shall be responsible for all isolation, draining and refilling of HVAC and plumbing piping as required by the work indicated on the drawings including planning and existing conditions research. Piping connections and local drain downs shall be coordinated for extent and timing with the Owner on an individual basis.
- .6 Existing materials and equipment that remain shall be protected from damage during all disciplines of construction work. Any damage of existing materials and equipment shall be repaired or replaced to the level of existing conditions. Temporarily open pipes and equipment shall be temporarily capped and protected from construction debris and dirt.
- .7 Arrange for shutoff, isolation, and lock-out of services with Owner's Representative or utility companies.
- .8 When indicated on the drawings, before proceeding with selective demolition, provide temporary services/systems that bypass area of selective demolition and maintain continuity of services/systems.
- .9 All remaining piping with open ends resulting from demolition work shall be promptly capped, plugged or blind flanged.
- .10 Remove equipment, ductwork, and piping as indicated including hangers, rods, brackets, anchor bolts, seismic brackets and cables and other associated supports, bases, accessories and specialties.
- .11 Refrigerant: Remove refrigerant from equipment to be selectively demolished. Store, transport, and dispose of hazardous liquids as per local authorities having jurisdiction.
- .12 Hazardous Liquids: Remove hazardous liquids from all equipment and piping to be selectively demolished. Store, transport, and dispose of hazardous liquids as per local authorities having jurisdiction.

### **3.5 CLOSEOUT ACTIVITIES**

- .1 Demolition Waste Disposal: Arrange for legal disposal and remove demolished materials to accredited provincial landfill site or alternative disposal site (recycle centre).
- .2 Indicate on as-built drawings: All areas where sanitary/storm piping has been cut and capped below grade for owner's record.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 SCOPE DESCRIPTION SUMMARY**

- .1 The following provide insulation requirements for the following systems:
  - .1 All plumbing systems.
  - .2 All heating and cooling piping distribution systems.
  - .3 All ventilation distribution systems.
  - .4 All equipment requiring insulation.

### **1.2 REFERENCES**

- .1 Unless dated references are identified below, it will be the latest standard issued by the regulatory agency that will be utilized as the applicable reference.
- .2 Thermal Insulation Association of Canada (TIAC):
  - .1 TIAC Best Practices Guide 2013.
- .3 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE):
  - .1 ANSI/ASHRAE 90.1-04-SI Edition, Energy Standard for Buildings except Low-Rise Residential Buildings.
- .4 ASTM International Inc.:
  - .1 ASTM C177 – 13, Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus
  - .2 ASTM C 335-05ae1, Standard Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.
  - .3 ASTM C 449/C 449M-07, Standard Specification for Mineral Fibre-Hydraulic-Setting Thermal Insulating and Finishing Cement.
  - .4 ASTM C 533-07, Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation.
  - .5 ASTM C 547-07, Standard Specification for Mineral Fibre Pipe Insulation.
  - .6 ASTM C 553-02, Standard Specification for Mineral Fibre Blanket Thermal Insulation for Commercial and Industrial Applications.
  - .7 ASTM C 612-04e1, Standard Specification for Mineral Fibre Block and Board Thermal Insulation.
  - .8 ASTM C 795-03, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
  - .9 ASTM C 921-03a, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
- .5 Canadian General Standards Board (CGSB):
  - .1 CGSB 51-GP-52MA-89, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
  - .2 CAN/CGSB 51.53-95, Poly (Vinyl Chloride) Jacketing Sheet, for Insulated Pipes, Vessels and Round Ducts.
- .6 Health Canada/Workplace Hazardous Materials Information System (WHMIS):
  - .1 Material Safety Data Sheets (MSDS).

- .7 Underwriters Laboratories of Canada (ULC):
  - .1 CAN/ULC-S102-07, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

### **1.3 INFORMATIONAL SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 01 – Submittals.
- .2 Product Data:
  - .1 Product data will be submitted for all PART 2 – PRODUCTS specified herein.
  - .2 Provide manufacturer's printed product literature and datasheets for material specified, and include product characteristics, performance criteria, physical size, finish and limitations.
  - .3 Product data will include all relevant information to confirm the specifications have been met.
- .3 Provide copies WHMIS MSDS - Material Safety Data Sheets in accordance with Division 1 where material specified has MSDS Sheets.

### **1.4 QUALITY ASSURANCE**

- .1 The manufacturer of the insulation will be a listed member of TRIC (Thermal Insulation Association of Canada).
- .2 Performance Requirements defined: Catalogued or published ratings for manufactured items obtained from tests carried out by manufacturer or those ordered by manufacturer from an independent testing agency signifying adherence to codes and standard and standardized testing of performance criteria.
- .3 The contractor performing the work of this section will be a recognized installer of insulation systems and have a minimum of five (5) years' experience which can be documented and verified. The contractor will be a current and listed member of TIAC (Thermal Insulation Association of Canada).
- .4 Installation will be in accordance with TIAC (Thermal Insulation Association of Canada) National Insulation Standards.
- .5 Where applicable products will bear a ULC or UL label.

### **1.5 DEFINITIONS**

- .1 "Concealed": insulated piping in chase, trench, furred space, shaft, or hung ceiling. Services in tunnels are not considered concealed.
- .2 "Exposed": pipe not "concealed" as defined herein.
- .3 Mineral fibre: includes glass fibre, rock wool, slag wool.

## **PART 2 - PRODUCTS**

### **2.1 FIRE AND SMOKE RATING**

- .1 All insulation systems will be ULC listed and certified.
- .2 Flame spread and smoke development ratings will be in accordance with CAN/ULC S102-M88:
  - .1 Maximum flame spread rating: 25.
  - .2 Maximum smoke developed rating: 50.
- .3 Flame proofing treatment to withstand high humidity conditions without deterioration.
- .4 Materials containing asbestos are strictly prohibited.

### **2.2 EQUIPMENT INSULATION MATERIALS**

- .1 Provide adhesives, sealers, vapour coating, mastics, laggings and bedding compounds compatible with materials to which they are applied. Material not to soften, corrode or otherwise deteriorate in either wet or dry state and be of type recommended by insulation manufacturer as suitable for proposed application. Apply material within ambient temperatures recommended by manufacturer.
- .2 Hot Tanks Breeching and Equipment - TIAC Code 1503-H:
  - .1 Application surface temperature not to exceed 177°C (350°F).
  - .2 Type: rigid mineral fibre board, without factory applied vapor retarder jacket.
  - .3 Density: 68 kg/cuM (4.25 lb/cu.ft.).
  - .4 R – Value 25 mm (1”) Thick Board: 0.8 K·m<sup>2</sup>/W (4.2 h·sq.ft.°F/Btu)
  - .5 Conductivity: 0.032 W/sqM°C @ 24°C (0.22 Btu-in/hr.ft<sup>2</sup>°F @ 75°F).
  - .6 Refer to installation instructions for material thickness required.

### **2.3 EQUIPMENT INSULATION FASTENINGS AND JACKETS**

- .1 Fastenings:
  - .1 For circular tanks and vessels not exceeding 600 mm diameter utilize tie wire: 304 stainless steel, 1.5 mm (0.06”) diameter.
  - .2 For circular tanks and vessels equal to or exceeding 600 mm diameter utilize bands: 304 stainless steel, 19 mm wide, 0.5 mm thick.
- .2 Jackets Interior Application:
  - .1 TIAC Code: CEF/2 Indoor.
  - .2 Interior Jacket will be:
    - .1 Canvas: plain weave cotton fabric, 220 g/m (6.5 oz./yd.), ULC rated. Lagging adhesive: compatible with insulation. Cement: Thermal insulating and finish air drying on mineral wool.
    - .2 PVC Sheet: rigid, high gloss, white pre-formed PVC jacket, UV and bacteria resistant, flame spread 25, smoke developed 50, colour white.
    - .3 Aluminum: 0.50 mm (24 ga.) sheet, smooth finish.
    - .4 Type: 316 Stainless steel: 0.50 mm (24 ga.) sheet, smooth finish.
    - .5 Self-adhesive fabric: 11 ply fabric with zero permeability with white finish.

- .3 Miscellaneous Materials:
  - .1 Tape: self-adhesive, aluminum, reinforced, 75 mm (3") wide minimum.
  - .2 Contact adhesive: quick-setting, low VOC content.
  - .3 Vapor retarder lap adhesive: water based, fire retardant type, compatible with insulation.

## 2.4 PIPE INSULATION MATERIALS

- .1 Provide adhesives, sealers, vapor coating, mastics, laggings and bedding compounds compatible with materials to which they are applied. Material not to soften, corrode or otherwise deteriorate in either wet or dry state and be of type recommended by insulation manufacturer as suitable for proposed application. Apply material within ambient temperatures recommended by manufacturer.
- .2 All Pipe (Hot or Cold) - TIAC Code 1501-C:
  - .1 Application surface temperatures not to exceed 177°C (350°F).
  - .2 Type: Rigid mineral fibre board, molded to fit pipe, with factory applied vapor retarder jacket.
  - .3 Factory Applied Facing: ASJ (All Service Jacket) vapor barrier consisting of a fiberglass yarn reinforced high density white kraft paper laminated to a thin layer of aluminum foil. The jacket will include a longitudinal, self-sealing closure lap for securing to the pipe.
  - .4 Density: 68 kg/cuM (4.25 lb/cu.ft.).
  - .5 R – Value 25 mm (1") Thick Board: 0.8 K•m<sup>2</sup>/W (4.2 h•sq.ft°F/Btu).
  - .6 Conductivity: 0.032 W/sqM°C @ 24°C (0.22 Btu-in/hr.ft<sup>2</sup>°F @ 75°F).
  - .7 Refer to installation instructions for material thickness required.
- .3 Pipe Fittings:
  - .1 Type: rigid mineral fibre board, molded to fit fitting or valve body, with factory applied white pre-formed PVC jacket. These PVC fitting covers and jacketing, when combined, form a completely sealed system, integral to the pipe insulation system.
  - .2 Pre-manufactured fitting insulation assemblies will meet the performance criteria established for the Pipe insulation system.

## 2.5 PIPE INSULATION FASTENINGS AND JACKETS

- .1 Fastenings:
  - .1 Stainless Steel Staples.
  - .2 Tie Wire: 304 stainless steel, 1.5 mm (0.06") diameter.
  - .3 Bands: 304 stainless steel, 19 mm wide, 0.5 mm thick.
- .2 Jackets Interior Application:
  - .1 TIAC Code: CEF/2 Indoor.
  - .2 Exterior Jacket will be:
    - .1 Canvas: plain weave cotton fabric, 220 g/m (6.5 oz./yd.), ULC rated. Lagging adhesive: compatible with insulation. Cement: Thermal insulating and finish, air drying on mineral wool.
    - .2 PVC Sheet: rigid, high gloss, white pre-formed PVC jacket, UV and bacteria resistant, flame spread 25, smoke developed 50, colour white.
    - .3 Aluminum: 0.50 mm (24 ga.) sheet, smooth finish.
    - .4 Type: 316 Stainless Steel: 0.50 mm (24 ga.) sheet, smooth finish.
    - .5 Self-adhesive fabric: 11 ply fabric with zero permeability with white finish.

- .3 Miscellaneous Materials:
  - .1 Tape: self-adhesive, aluminum, reinforced, 75 mm (3") wide minimum.
  - .2 Contact Adhesive: quick-setting, low VOC content.
  - .3 Vapor Retarder Lap Adhesive: water based, fire retardant type, compatible with insulation.

## 2.6 DUCT INSULATION MATERIALS

- .1 Provide adhesives, sealers, vapor coating, mastics, laggings and bedding compounds compatible with materials to which they are applied. Material not to soften, corrode or otherwise deteriorate in either wet or dry state and be of type recommended by insulation manufacturer as suitable for proposed application. Apply material within ambient temperatures recommended by manufacturer.
- .2 Concealed Square / Rectangular Duct (Hot, Cold, or Dual Temp) - TIAC Code CEF/2:
  - .1 Application surface temperatures not to exceed 120°C (250°F).
  - .2 Type: flexible mineral fibre blanket, with factory applied vapor retarder jacket.
  - .3 Factory Applied Facing: FSK (foil-scrim-kraft), vapour barrier consisting of aluminum foil reinforced with fibre glass yarn and laminated with fire-resistant adhesive to kraft.
  - .4 R – Value 38 mm (1½") Thick Batt: 0.8 K•m<sup>2</sup>/W (4.2 h•sq.ft.°F/Btu). Installed R-value calculated with a material thickness compressed to a maximum of 25%.
  - .5 Conductivity: 0.042 W/sqM°C @ 24°C (0.29 Btu-in/hr.ft<sup>2</sup>°F @ 75°F).
  - .6 Refer to installation instructions for material thickness required.
- .3 Exposed Square / Rectangular Duct (Hot, Cold, or Dual Temperature) - TIAC Code CER/2:
  - .1 Application surface temperatures not to exceed 177°C (350°F).
  - .2 Type: rigid mineral fibre board, with factory applied vapor retarder jacket.
  - .3 Factory Applied Facing: ASJ (all service jacket) vapor barrier consisting of a fiberglass yarn reinforced high density white kraft paper laminated to a thin layer of aluminum foil. The jacket will include a longitudinal, self-sealing closure lap for securing to the pipe.
  - .4 Density: 68 kg/cuM (4.25 lb/cu.ft.).
  - .5 R – Value 25 mm (1") Thick Board: 0.8 K•m<sup>2</sup>/W (4.2 h•sq.ft.°F/Btu).
  - .6 Conductivity: 0.032 W/sqM°C @ 24°C (0.22 Btu-in/hr.ft<sup>2</sup>°F @ 75°F).
  - .7 Refer to installation instructions for material thickness required.
- .4 Exposed or Concealed Round Duct (Hot, Cold, or Dual Temp) - TIAC Code CEF/2:
  - .1 Application surface temperatures not to exceed 120°C (250°F).
  - .2 Type: flexible mineral fibre blanket, with factory applied vapor retarder jacket.
  - .3 Factory Applied Facing: FSK (foil-scrim-kraft), vapour barrier consisting of aluminum foil reinforced with fibre glass yarn and laminated with fire-resistant adhesive to kraft.
  - .4 R – Value 38 mm (1½") Thick Batt: 0.8 K•m<sup>2</sup>/W (4.2 h•sq.ft.°F/Btu). Installed R-value calculated with a material thickness compressed to a maximum of 25%.
  - .5 Conductivity: 0.042 W/sqM°C @ 24°C (0.29 Btu-in/hr.ft<sup>2</sup>°F @ 75°F).
  - .6 Refer to installation instructions for material thickness required.

## 2.7 DUCT INSULATION FASTENINGS AND JACKETS

- .1 Fastenings:
  - .1 Stainless steel staples.
  - .2 Tie Wire: 304 stainless steel, 1.5 mm (0.06") diameter.
  - .3 Bands: 304 stainless steel, 19 mm wide, 0.5 mm thick.
- .2 Jackets Interior Application:
  - .1 TIAC Code: CRF/ 1 CRD/1 Indoor.
  - .2 Exterior Jacket will be:
    - .1 Canvas: plain weave cotton fabric, 220 g/m (6.5 oz/yd), ULC rated. Lagging adhesive: compatible with insulation. Cement: Thermal insulating and finish, air drying on mineral wool.
    - .2 PVC Sheet: rigid, high gloss, white pre-formed PVC jacket, UV and bacteria resistant, flame spread 25, smoke developed 50, colour white.
    - .3 Aluminum: 0.50 mm (24 ga.) sheet, smooth finish.
    - .4 Type: 316 Stainless Steel: 0.50 mm (24 ga.) sheet, smooth finish.
- .3 Miscellaneous Materials:
  - .1 Tape: self-adhesive, aluminum, reinforced, 75 mm (3") wide minimum.
  - .2 Contact Adhesive: quick-setting, low VOC content.
  - .3 Vapor Retarder Lap Adhesive: Water based, fire retardant type, compatible with insulation.

## 2.8 JLR AND OWNER SPECIFIED PRODUCTS

- .1 Refer to Division 00 and 01 for requirements for alternate manufacturer's to those listed below.
- .2 The following are Owner acceptable manufacturers, all others will be rejected unless pre-approved during tender:
- .3 Specified Products:

.1 Equipment Insulation	John's Manville / Owens Corning
.2 Pipe Insulation	John's Manville / Owens Corning
.3 Preformed Elbows	John's Manville / Owens Corning
.4 Duct Insulation	John's Manville / Owens Corning
.5 Peel and Stick weatherproofing membrane	John's Manville / Owens Corning
.6 Jacket Canvas	Childers
.7 Jacket PVC	Childers

## **PART 3 - EXECUTION**

### 3.1 GENERAL

- .1 Install will be in accordance with TIAC (Thermal Insulation Association of Canada) National Standards.
- .2 Prior to installation ensure that surfaces to be covered are clean and dry, insulation is clean and dry.

- .3 Prior to installation ensure all pressure tests and verification of system integrity has been completed, that inspections have been performed, and that the installation of insulation systems will not hide incomplete or defective distribution systems.
- .4 Cold Surfaces: Insulate all surfaces which may have a surface temperature of less than 20°C (68°F), both for energy conservation as well as to prevent ambient air meeting dew point to prevent surface condensation.
- .5 Hot Surfaces: Insulate all surfaces which may have a surface temperature of greater than 62°C (145°F), both for energy conservation as well as to reduce surface temperature and prevent injury due to contact by personnel during normal duties.
- .6 Maintain uninterrupted continuity and integrity of vapor retarder jacket and finishes. Ensure hangers, and supports are outside vapor retarder jacket. Provide all saddles and spacers as required.
- .7 With multi-layered insulation use staggered butt joint construction. When double layering, the inner layer should not be jacketed.
- .8 Identify system devices which may require periodic maintenance or inspection and provide insulating systems at such devices which permit periodic removal and replacement without damage to adjacent insulation.
- .9 Locate insulation and cover seams in the least visible location. All surface finishes will be extended in such a manner as to protect all raw edges, ends and surfaces of insulation. Exposed insulation will be coated to prevent deterioration.
- .10 Pressure-sensitive tape will be applied with moving pressure using a squeegee or other appropriate sealing tool.

### **3.2 MANUFACTURER'S INSTRUCTIONS**

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

### **3.3 EQUIPMENT INSULATION APPLICATION SCHEDULE**

- .1 Apply thickness of insulation as listed in following table.

Equipment Insulation Application Schedule				
Equipment	Surface Temperature	Insulation Material (TIAC Code)	Insulation Thickness	Jacket (TIAC Code)
Domestic Hot Water Heat Exchangers	24°C – 82°C (75°F-180°F)	Rigid Fibre Board (1503-H)	50 mm (2")	PVC (Green) (CEF/2)
Heating Water Heat Exchanger	61°C – 99°C (140°F-210°F)	Rigid Fibre Board (1503-H)	50 mm (2")	Aluminum Stucco Embossed (CEF/2)
Heating Steam Heat Exchanger	38°C – 60°C (100°F-140°F)	Rigid Fibre Board (1503-H)	50 mm (2")	Aluminum Stucco Embossed (CEF/2)
Condensate Receiver / Pumps	24°C–110°C (75°F-230°F)	Rigid Fibre Board (1503-H)	25 mm (1")	Canvas (CEF/2)
Heating Pumps	61°C – 99°C (140°F-210°F)	Rigid Fibre Board (1503-H)	25 mm (1")	PVC (White) (CEF/2)
Expansion Tanks	0°C – 99°C (32°F - 210°F)	Rigid Fibre Board (1501-C)	25 mm (1")	Canvas (CEF/2)

### 3.4 EQUIPMENT INSULATION INSTALLATION REQUIREMENTS

- .1 In addition to general installation requirements, listed above
- .2 Install insulation with smooth and even surfaces, with round shapes laid to true circular and concentric shape, shaped to blend with fitting insulation and adjacent covering.
- .3 Apply insulation and secure firmly with mechanical fasteners
- .4 Allow for radial expansion of equipment and permit equipment to move longitudinally inside insulation and to expand and contract without opening up joints between sections.
- .5 Gouge out insulation for proper fit where there is interference between weld bead and insulation.
- .6 Bevel insulation away from studs and nuts to permit their removal without damage to insulation and neatly trim around extending parts of supports, sealed with insulating cement.
- .7 Joints: adhere and seal laps of vapor barrier cover or vapor barrier strip of 75 mm (3") minimum width furnished with insulation, using vapor seal adhesives.
- .8 Provide factory fabricated easily disassembled insulation for equipment requiring periodic maintenance of parts and sub-assemblies.

### 3.5 PIPE INSULATION APPLICATION SCHEDULE

- .1 Apply thickness of insulation as listed in following table.
- .2 The following table will encompass all piping for the systems identified as well as all in line devices and valves.

Pipe Insulation Application Schedule							
Piping Service	Pipe Surface Temperature	Insulation Material (TIAC Code)	Insulation Thickness			Jacket Exposed (TIAC Code)	Jacket Concealed (TIAC Code)
			Pipe Size ≤ NPS 2 (2"Ø)	Pipe Size NPS 2 ½ (2½"Ø) to NPS 4 (4"Ø)	Pipe Size ≥ NPS 6 (6"Ø)		
<b>Domestic Cold Water</b>	0°C – 24°C (32°F – 75°F)	Rigid Fibre Board (1501-C)	25 mm (1")	25 mm (1")	25 mm (1")	PVC (Green) (CPF/4)	Factory ASJ Vapor Barrier (CPF/2)
<b>Domestic Hot Water</b>	24°C – 82°C (75°F-180°F)	Rigid Fibre Board (1501-C)	25 mm (1")	25 mm (1")	38 mm (1½ ")	PVC (Green) (CPF/4)	Factory ASJ Vapor Barrier (CPF/2)
<b>Domestic Hot Water Recirculation</b>	24°C – 82°C (75°F-180°F)	Rigid Fibre Board (1501-C)	25 mm (1")	25 mm (1")		PVC (Green) (CPF/4)	Factory ASJ Vapor Barrier (CPF/2)
<b>Sanitary with Condensate Drain 2.1m (7') from discharge</b>	0°C – 24°C (32°F – 75°F)	Rigid Fibre Board (1501-C)	25 mm (1")	25 mm (1")	25 mm (1")	PVC (Green) (CPF/4)	Factory ASJ Vapor Barrier (CPF/2)
<b>Sanitary Storm Drain 1.5m (5') from Roof Drain Sump</b>	0°C – 24°C (32°F – 75°F)	Rigid Fibre Board (1501-C)	25 mm (1")	25 mm (1")	25 mm (1")	PVC (Green) (CPF/4)	Factory ASJ Vapor Barrier (CPF/2)
<b>Chilled Water or Chilled Glycol Supply and Return</b>	0°C – 24°C (32°F – 75°F)	Rigid Fibre Board (1501-C)	25 mm (1")	38 mm (1½")	38 mm (1½")	PVC (Green) (CPF/4)	Factory ASJ Vapor Barrier (CPF/2)
<b>Low Temp Heating Water or Heating Glycol Supply and Return</b>	38°C – 60°C (100°F-140°F)	Rigid Fibre Board (1501-C)	25 mm (1")	25 mm (1")	25 mm (1")	PVC (Yellow) (CPF/4)	Factory ASJ Vapor Barrier (CPF/2)
<b>Steam Low Pressure Humidifier Supply</b>	100°C (212°F)	Rigid Fibre Board (1501-C)	38 mm (1")	-	-	PVC (Yellow) (CPF/4)	
<b>Steam Low / High Pressure Low Temp</b>	100°C–175°C (212°F-350°F)	Rigid Fibre Board (1501-C)	38 mm (1 ½")	50 mm (2")	75 mm (3")	PVC (Yellow) (CPF/4)	Factory ASJ Vapor Barrier (CPF/2)
<b>Steam High Temperature Super-heated</b>	≥175°C (350°F)	Rigid Fibre Board (1501-C)	38 mm (1½ ")	65 mm (2½")	X2 Layers 50 mm (2") 100 mm (4") Total	Aluminum Stucco Embossed (CPF/3)	
<b>Steam Condensate Pumped or Gravity</b>	24°C–110°C (75°F-230°F)	Rigid Fibre Board (1501-C)	25 mm (1")	38 mm (1½")	38 mm (1½")	PVC (Yellow) (CPF/4)	Factory ASJ Vapor Barrier (CPF/2)

### 3.6 PIPE INSULATION INSTALLATION REQUIREMENTS

- .1 In addition to general installation requirements, listed above.
- .2 Install insulation with smooth and even surfaces, with round shapes laid to true circular and concentric shape, shaped to blend with fitting insulation and adjacent covering.
- .3 Apply insulation and secure firmly with factory supplied self-sealing closure lap. Additionally utilize mechanical staples (outward facing) and self-adhesive tape where pipe size precludes use of self-sealing closure lap. Insure proper sealing of self-sealing tape with moving pressure using a squeegee or other appropriate sealing tool. Gouge out insulation for proper fit where there is interference between weld bead and insulation.
- .4 Flanged Fittings: Butt insulation up to edge of flanges. Bevel insulation away from studs and nuts to permit their removal without damage to insulation. Adhere additional layer of insulation over flanged fittings overlap under laying insulation by 50 mm (2") either side. Seal ends of additional insulation.
- .5 Elbows: Utilize preformed elbows or obtain approval to utilize miter, sectional insulation for elbow insulation installation.
- .6 Screwed Joints: Utilize preformed elbows or utilize excessive thickness insulation at fittings to maintain specified thickness at fittings. Gouge out insulation for proper fit at fittings. Exposed insulation will be coated to prevent deterioration.
- .7 Provide factory fabricated easily disassembled insulation for equipment requiring periodic maintenance of parts and sub-assemblies.
- .8 For electrically traced piping, increase insulation one size to accommodate wiring.
- .9 Where pipes pass through sleeves, pack solid with mineral fibre insulation for depth of penetration. Vapor barrier jacket to be continuous. Pipe sleeves to accommodate full insulation thickness and allow pipe expansion. Provide mastic caulking.
- .10 Terminate insulation at each end of unions and flanges and at other points where required, with insulation cement, CGSB 5I-GP-6M, troweled on a bevel.

### 3.7 DUCT INSULATION APPLICATION SCHEDULE

- .1 Apply thickness of insulation as listed in following table.
- .2 The following table will encompass all ducts for the system identified as well as all in line devices, dampers, etc.

Duct Insulation Application Schedule				
Service		Insulation Material (TIAC Code)	Insulation Thickness	Jacket (TIAC Code)
<b>Supply Air Duct</b> Cooling or Dual Temperature Service	Exposed Rectangular / Square	Rigid Fiber Board (CER/2)	25 mm (1")	Canvas Jacket Vapor Retarder (CRF/1)
	Concealed Rectangular / Square	Flexible Batt (CEF/2)	25 mm (1")	Factory ASJ Vapor Retarder (CRF/2)
	Exposed Round	Flexible Batt (CEF/2)	25 mm (1")	Canvas Jacket Vapor Retarder (CRD/1)
	Concealed Round	Flexible Batt (CEF/2)	25 mm (1")	Factory ASJ Vapor Retarder (CRD/2)
<b>Supply Air Duct</b> Heating Temperature Service	Exposed Rectangular / Square	Rigid Fiber Board (CER/2)	25 mm (1")	Canvas Jacket Vapor Retarder (CRF/1)
	Concealed Rectangular / Square	Flexible Batt (CEF/2)	25 mm (1")	Factory ASJ Vapor Retarder (CRF/2)
	Exposed Round	Flexible Batt (CEF/2)	25 mm (1")	Canvas Jacket Vapor Retarder (CRF/1)
	Concealed Round	Flexible Batt (CEF/2)	25 mm (1")	Factory ASJ Vapor Retarder (CRF/2)
<b>Return Air Ducts</b>	Exposed	None		
	Concealed	None		
<b>Exhaust Air Ducts</b> within 2.4 m (8') Upstream of Exhaust Discharge or Back Draft Damper or Motorized Damper	Exposed	None	50 mm (2")	Canvas Jacket (CRF/1)
	Concealed	None	50 mm (2")	Factory ASJ Vapor Retarder (CRF/2)
<b>Outside Air Ducts</b> Up to the Air Handling Unit or Up to and Extending Downstream of the Heating Coil 1.0 m (3') Ducts to be Considered Outside Air Downstream of any Mixing Box Section	Exposed	Rigid Fiber Board (CER/2)	x2 layers 38 mm (1½") Offset joints Total 75 mm (3")	Canvas Jacket (CRF/1)
	Concealed	Rigid Fiber Board (CER/2)	x2 layers 38mm (1½") Offset joints Total 75mm (3")	Factory ASJ Vapor Retarder (CRF/2)

### **3.8 DUCT INSULATION INSTALLATION REQUIREMENTS**

- .1 Where access doors are provided, insulation will not impede access.
- .2 Provide factory fabricated easily disassembled insulation for equipment requiring periodic maintenance of parts and sub-assemblies.
- .3 All longitudinal and transverse joints having a 75 mm (3") staple flap will be secured with outward-cinching staples on approximate 150 mm (6") centres. The seam of the joint will then be sealed with self-adhesive tape.
- .4 Transverse shiplap joints not having staples flaps, or transverse butt joints will be secured with 200 mm (8") long cross tabs running perpendicular to the joint seam on 300 mm (12") centres. Cross tabs will be made from an approved closure tape. The seam of the joint will then be sealed with self-adhesive tape.

### **3.9 CLEANING**

- .1 During the course of, and upon completion of installation of insulation systems, remove surplus materials, rubbish, tools and equipment.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 SCOPE DESCRIPTION SUMMARY**

- .1 This section will describe:
  - .1 Cleaning and disinfection of potable water systems.
  - .2 Cleaning and flushing requirements prior to the start-up of hydronic piping systems.
  - .3 Air duct cleaning requirements prior to the start-up of ventilation systems.

### **1.2 COMMISSIONING**

- .1 Refer to Section 01 91 01 – Commissioning.

## **PART 2 - PRODUCTS**

### **2.1 GENERAL**

- .1 In addition to those listed below, refer to the appropriate specification section for additional requirements.

### **2.2 POTABLE SYSTEMS**

- .1 Clean and Flush Medium: fresh potable water.
- .2 The disinfection will be carried out by thorough flushing and then filling the system with chlorinated water at an initial concentration of 50 ppm for a contact period of 1 hour. The process has been successful if the free residual chlorine level is not less than 30 ppm at the end of this period.
- .3 System will be completely flushed following disinfection.

### **2.3 HYDRONIC SYSTEMS**

- .1 All heating and cooling piping systems will be cleaned and flushed according to procedures provided by the University's approved water treatment supplier prior to operation and before being connected to the University's distribution systems.
- .2 Clean and Flush Medium: fresh potable water.
- .3 Water treatment chemicals to remove thread compounds, oil, grease, iron oxides.
  - .1 Tri-sodium phosphate: 0.40 kg per 100 L water in system.
  - .2 Sodium carbonate: 0.40 kg per 100 L water in system.
  - .3 Low-foaming detergent: 0.01 kg per 100 L water in system.

## **2.4 VENTILATION SYSTEM CLEANING ACCESS**

- .1 Equipment Access Doors and Panels: construct from same materials as equipment paneling complete with sealing gasket and positive locking device. Size access doors and panels in equipment to allow for inspection and cleaning.
- .2 Ductwork Access Doors: construct access doors from same material and gauge of existing duct with gasketed seal. Ensure access door is 25 mm (1") greater in every dimension than access opening. Secure access doors with sheet metal screws on 75 mm centres minimum. Ensure [3] screws per side, top and bottom minimum.
- .3 Where access doors are cut into an acoustically lined duct, utilize a water-based duct sealer for repairing cut acoustic lining.

## **2.5 DUCT CLEANING EQUIPMENT**

- .1 In duct cleaning equipment will be manual or powered equipment with the following requirements:
  - .1 Ensure brushes are specifically manufactured and shaped to fit individual ducts, equipment and components of HVAC system.
  - .2 Ensure brushes are sized to fit various duct sizes in HVAC system.
  - .3 Ensure brushes make scrubbing motion and full contact with HVAC system interior surfaces to be cleaned.
  - .4 Replace worn and ineffective brushes when required.
- .2 Vacuum Unit: includes vacuum fan, integral HEPA filter, suction hose and vacuum head, capable of maintaining HVAC System debris and particulates airborne in air stream until they reach vacuum unit and maintaining system under negative pressure.
  - .1 Ensure HEPA filters are clean and maintain vacuum unit and HEPA filter to run efficiently.

## **PART 3 - EXECUTION**

### **3.1 GENERAL**

- .1 The procedures listed below are minimum standards and do not reflect the additional requirements of any Authority having Jurisdiction that may impose additional requirements above and beyond those listed below.

### **3.2 MANUFACTURER'S INSTRUCTIONS**

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

### **3.3 POTABLE WATER CLEANING PROCEDURES**

- .1 After completing tests, replacement and repairs, flush domestic water systems thoroughly with potable water for 30 minutes to remove sediment.
- .2 Perform disinfection as required by local authorities.
- .3 Refill system immediately after flushing operation.

### **3.4 HYDRONIC SYSTEMS CLEANING PROCEDURES**

- .1 All heating and cooling piping systems will be cleaned and flushed according to procedures provided by the University's approved water treatment supplier prior to operation and before being connected to the University's distribution systems.
- .2 Systems will be operational, hydrostatically tested and with safety devices functional, before cleaning is carried out.
- .3 Understand and inspect all piping and devices within the hydronic system. Ensure cleaning procedures and cleaning solution concentrations will do no harm to any device within the system. Replace any seals, valving, equipment damaged during the cleaning procedures.
- .4 Ensure the follow prior to cleaning procedures implementation:
  - .1 Strainers: clean prior to initial fill.
  - .2 Control Valves: operational, fully open to ensure that terminal units can be cleaned properly.
- .5 Hydronic Water Circulating System:
  - .1 Thoroughly flush out each system with water.
  - .2 Refill system with water chemically treated; ensure air is vented from system. Circulate for 48 to 72 hours at 80°C (180°F) temperature. Flush clean strainers. Refill immediately and add chemicals specified for system operation.
  - .3 Flush velocity in system mains and branches to ensure removal of debris. System pumps may be used for circulating cleaning solution provided that velocities are adequate.
- .6 Glycol Systems:
  - .1 In addition to procedures specified above perform specified procedures.
  - .2 Test to prove concentration will prevent freezing to -40°C (-40°F).

### **3.5 HYDRONIC SYSTEMS START-UP PROCEDURES**

- .1 After cleaning is completed and system is filled.
- .2 Establish circulation and expansion tank level, set pressure controls.
- .3 Ensure air is removed.
- .4 Check pumps to be free from air, debris, possibility of cavitation when system is at design temperature.

- .5 Dismantle system pumps used for cleaning, inspect, replace worn parts, install new gaskets and new set of seals.
- .6 Clean out strainers repeatedly until system is clean.
- .7 Commission water treatment systems as specified.
- .8 Commission water/glycol fill systems as specified.
- .9 Check water level in expansion tank with cold water with circulating pumps OFF and again with pumps ON.
- .10 Repeat with water at design temperature.
- .11 Check pressurization to ensure proper operation and to prevent water hammer, flashing, cavitation. Eliminate water hammer and other noises.
- .12 Bring system up to design temperature and pressure over a 48-hour period.
- .13 Perform TAB (balancing) as specified.
- .14 Adjust pipe supports, hangers and springs as necessary.
- .15 Monitor pipe movement, performance of expansion joints, loops, guides, anchors.
- .16 If expansion joints bind or if bellows type expansion joints flex incorrectly, shut down system, re-align, repeat start-up procedures.
- .17 Re-tighten bolts using torque wrench, to compensate for heat-caused relaxation. Repeat several times during commissioning.
- .18 Check operation of drain valves.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 SCOPE DESCRIPTION SUMMARY**

- .1 This will describe the system components associated with a water sprinkler fire suppression system.
- .2 This will describe the requirements for the installation of portable fire extinguishers.

### **1.2 RELATED REQUIREMENTS**

- .1 The contract documents are complementary, what is required by any one shall be as binding as if required by all. Specification sections and drawings cannot be read in isolation and it shall be the responsibility of the contractor and suppliers to ensure they have sufficient information to provide specified material and services as required by the complete contract documents.
- .2 Refer to Specification Section 20 01 01 – Common Work Results Mechanical for general mechanical requirements.
- .3 For equipment requiring electrical wiring connections, refer to Division 26 specification sections for applicable wiring requirements.
- .4 For systems and equipment requiring painting, refer to Division 9 for painting requirements and coordinate the work with the Painting Contractor.

### **1.3 REFERENCES**

- .1 Unless dated references are identified below, it shall be the latest standard issued by the regulatory agency that shall be utilized as the applicable reference.
- .2 National Fire Protection Association (NFPA):
  - .1 NFPA 13, Standard for the Installation of Sprinkler Systems.
  - .2 NFPA 10, Standard for Portable Fire Extinguishers.
  - .3 NFPA 25, Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems.
  - .4 NFPA 70 National Electrical Code (Fire Pump Wiring).
- .3 Underwriter's Laboratories of Canada (ULC).
- .4 Factory Mutual (FM).

### **1.4 INFORMATIONAL SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 01 --Submittals.
- .2 Product Data:
  - .1 Product data shall be submitted for all PART 2 –PRODUCTS specified herein.
  - .2 Provide manufacturer's printed product literature and datasheets for material specified, and include product characteristics, performance criteria, physical size, finish and limitations.

- .3 Product data shall include all maintenance access points and dimensional clearances, such that the contractor can properly layout the equipment to ensure proper access.
- .4 Product data shall include all relevant information to confirm the specifications have been met.
- .5 Product data shall identify all ancillary field installed devices and provide all information required for the coordination of the installation with other trades.
- .6 Product data shall include any relevant information which Division 25 requires for a properly functioning building automation system.
- .7 Product data shall include any relevant information which Division 28 requires for a properly functioning fire alarm system.
- .8 Product data shall include information as specified in Section 20 01 01 — Common Work Results Mechanical unless modified with additional information required below.
- .9 Fire Pump additional information required:
  - .1 Fire Pump product data shall include, flow, head, NPSH, pump curves, electrical characteristics, pump controller wiring diagrams, accessories, and mounting arrangement. Certified curves shall be supplied.
- .3 Shop Drawings:
  - .1 Drawings to provide layouts and design data for the following systems:
    - .1 Wet Pipe Sprinkler Systems;
  - .2 Submit drawings and design calculations, stamped and signed by professional engineer licensed in Province of Ontario, Canada.
  - .3 Drawings: Sprinkler heads and piping system layout:
    - .1 Prepare detail working drawings of system layout in accordance with NFPA 13, "Working Drawings (Plans)".
    - .2 Show data essential for proper installation of each system.
    - .3 Show details, plan view, elevations, and sections of systems supply and piping.
    - .4 Indicate grooved joint couplings and fittings on drawings.
    - .5 Show piping schematic of systems supply, devices, valves, pipe, and fittings.
    - .6 Show point to point electrical wiring diagrams.
  - .4 Design Data:
    - .1 Hydraulic calculations of sprinkler system design.
- .4 Submit complete plans to Authority having Jurisdiction for review and approval before commencement of work.
- .5 Commissioning Submissions:
  - .1 Test Reports: submit certified test reports for all fire suppression systems from an approved independent testing laboratories, indicating compliance with specifications for specified performance characteristics and physical properties.
- .6 Maintenance Data:
  - .1 Provide maintenance data including certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties, for incorporation into manuals specified in Section 01 77 00 – Closeout Procedures.
  - .2 Maintenance data shall include but not be limited to:
    - .1 Certificates, signed by the manufacturer or their representative, certifying the materials have been installed as per their installation instructions.
    - .2 The approved shop drawings with performance criteria edited with field observations and commissioned operational set points and adjustments.
    - .3 The manufacturer's maintenance and installation data.

- .4 Safety informational data for maintenance staff prior to performing maintenance requirements.
- .5 List of all routine maintenance requirements as well as monthly, annual or other periodical maintenance recommendations from the manufacturer.
- .6 Any maintenance requirements that may affect the warranty periods of the associated equipment.

## **1.5 MAINTENANCE REQUIREMENTS**

- .1 The Contractor shall verify and demonstrate that proper maintenance can be performed on equipment and material installed.
- .2 The Contractor shall supply the following materials to site just prior to substantial being awarded:
  - .1 Provide cabinet with spare sprinklers and tools in accordance with NFPA 13.

## **1.6 QUALITY ASSURANCE**

- .1 Sprinkler system installation contractor to be a member in good standing of Canadian Automatic Sprinkler Association.
- .2 Installer: company or person specializing in sprinkler system installation with 5 years documented experience and approved by manufacturer.
- .3 Supply grooved joint couplings, fittings, valves, grooving tools and specialties from a single manufacturer. Use date stamped castings for coupling housings, fittings, valve bodies, for quality assurance and traceability. Couplings shall be UL and FM approved.
- .4 Equipment and components shall bear a ULC or UL label.
- .5 The Fire Pump shall be subjected to an operation test at rated speed. Performance curves are to be plotted showing the efficiency, brake-horsepower and total head developed at shut-off, at rated capacity and at 150% of rated capacity. Test each pump/driver package at factory to provide detailed performance data and to demonstrate compliance with NFPA and specification. Submit certified test curves for approval Consultant.

## **1.7 SPRINKLER SYSTEM DESIGN**

- .1 Design system in accordance with NFPA 13, using following parameters:
- .2 Hazard: as indicated on drawings.
- .3 Zoning: System zoning as indicated on the drawings.
- .4 Water Supply: for the purposes of tendering only, the recorded water flow tests for this site were as indicated on the drawings.
- .5 Water Entry: the Contractor shall arrange for, supervise and/or conduct flow and pressure test of water supply in vicinity of project to obtain criteria for bases of design in accordance with NFPA 13.

- .6 Pipe Layout: some sprinkler piping has been indicated on the design drawings, coordinate locations with other trades and existing conditions.
- .7 Pipe Sizing: pipe sizes are not shown on the drawings with the exception of water entry piping. Hydraulic design all piping to NFPA 13.
- .8 Sprinkler Head Layout: locate sprinkler heads as required to provide design sprinkler coverage to all spaces within the building utilizing the following:
  - .1 Sprinkler layout will incorporate and coordinate with the lighting and diffuser layout for the space.
  - .2 Sprinkler heads located in a suspended tile ceiling shall be located centre of tile or centre of half tile.
  - .3 Sprinkler heads shall be arranged in patterns and not randomly placed within a space.

## **PART 2 - PRODUCTS**

### **2.1 GENERAL**

- .1 System shall be installed using industry best practices for pipe installation and run parallel to building lines. Refer to Section 20 05 05 – Installation of Pipe for piping layout and methodology.
- .2 System shall be supported in accordance with NFPA 13. Refer to Section 23 05 48 – Vibration and Seismic Controls for Piping Ducts and Equipment.

### **2.2 WATER ENTRY**

- .1 Coordinate the installation of the water supply into the building with the general contractor.
- .2 The water entry into the building is sized based upon expected flow to satisfy the requirements of the buildings fire suppression systems, once detailed design information is available from flow tests confirm that this pipe sizing is adequate and if advantageous to the owner, suggest revisions if required.
- .3 Provide electrically supervised isolation valve at water entry.
- .4 Refer to water entry detail on drawings.
- .5 Slab-at-Grade Water Entry: all exterior piping shall be installed at depth to prevent freezing and conform to NFPA installation requirements. Provide seismically restrained and hydraulically braced piping for water entry into building. The sleeve or water entry pipe passing thru a foundation wall or floor will provide 100 mm (4") clearance, 360 degrees around the pipe. The pipe penetration through the floor slab will be provided with a 2 mm (14 ga.) thick steel escutcheon plate, 50 mm (2") greater than floor slab opening. Escutcheon plate shall not be attached to floor slab. Anchor piping at all changes of direction with concrete deadmen and clamp at building entry.

## 2.3 BACKFLOW PREVENTOR

- .1 Preventers: to CSA-B64 Series, double check valve assembly back flow preventer. Epoxy coated cast iron construction with bronze fittings and stainless steel trim.
- .2 Isolation Valves: Electrically supervised OS&Y gate valves.
- .3 Size to accommodate fire suppression water flow and pressure requirements.

## 2.4 PIPING, FITTINGS AND VALVES

- .1 Sprinkler System Pipe and Joints:
  - .1 Black Steel Ferrous Pipe: to NFPA requirements and as follows:
    - .1 Up to NPS 3 (3"Ø): Schedule 40.
    - .2 NPS 4 (4"Ø) and over: Schedule 30.
  - .2 Pipe Joints:
    - .1 NPS 2 (2"Ø) and under: screwed fittings with PTFE tape.
    - .2 NPS 2½ (2½"Ø) and over: welding fittings and flanges or roll grooved: [standard] [rigid] coupling to CSA B242.
- .2 Fittings to NFPA Requirements:
  - .1 Screwed Fittings: malleable iron, Class 150.
  - .2 Welded Fittings: butt weld fittings.
  - .3 Grooved Piping Fittings: grooved joints designed with two ductile iron housing segments, flush seal gasket for dry service, and zinc-electroplated steel bolts and nuts. Cast with offsetting angle-pattern bolt pads for rigidity and visual pad-to-pad offset contact. EPDM gaskets.
- .3 Pipe Hangers: ULC listed for fire protection services.
- .4 Electrically Supervised Isolation Valves:
  - .1 Gate Valves: UL and FM approved and labeled.
    - .1 NPS 2½ (2½"Ø) – NPS 10 (10"Ø), ductile iron bonnet, outside screw and yoke (OS&Y), bronze trim, solid taper wedge disc, with hand wheel operator. Class 125.
    - .2 Supervisory switch, electric, signals valve shut-off, two sets of single-pole, double-throw contacts with roller type switch actuator and spring loaded plunger mounted in cast aluminum housing with tamperproof cover, ULC and UL listed and labelled, FM approved.
  - .2 Butterfly Valves: UL and FM approved and labeled.
    - .1 NPS 2½ (2½"Ø) – NPS 10 (10"Ø), ductile Iron body, plated ductile iron disc, EPDM seat, stainless steel shaft, with manual enclosed gear operator. Class 125.
    - .2 Integral electric supervisory switch.
- .5 Swing Check Valves, Class 125:
  - .1 Ductile Iron Body and Bolted Cover: with tapped and plugged opening on each side for hinge pin. Pressure rating for tight shut-off at temperatures up to maximum for seat material.
- .6 Drain Valves: Ball Type, Class 125, NPS 2 (2"Ø) and under:
  - .1 Body and Cap: cast high tensile bronze, screwed ends.
  - .2 Ball and Seat: stainless steel solid ball and Teflon seats.
  - .3 Stem Seal: TFE with external packing nut.
  - .4 Operator: removable lever handle.

## **2.5 WET PIPE ALARM CHECK VALVES**

- .1 Provide wet pipe alarm check valve equipped with standard accessories, drain valves, check valves, alarm connections, pressure gauges. Valves controlling water supply and alarm shutoff to be OS&Y type with rising stem or butterfly type.
- .2 Wet pipe sprinkler alarm valve shall be a straight flow design UL Listed and FM approved check type valve with grooved seat design. Alarm valve shall be listed for installation in the vertical or horizontal position. Cast or ductile iron, with bronze seat. Flanged or grooved end type, sized to suit system requirements. Alarm valve trim to be galvanized. Provide valve complete with internal components that are replaceable without removing valve from installed position.
- .3 Alarm valve shall have a rated working pressure of 1250 kPa (175 PSI).
- .4 Pressure type flow switch: for connection to alarm part of wet sprinkler system alarm check valve, factory adjusted to operate between 28 Pa and 56 Pa (4 and 8 PSI) on rising pressure, two sets of Form C (SPDT) contacts, instantly recycling, pneumatic retard to guard against water pressure fluctuations.

## **2.6 EXCESS PRESSURE PUMP**

- .1 Provide excess pressure pump to maintain pressure in sprinkler system piping. Pump to be capable of producing pressure boost 70 kPa (10 PSI) in excess of system pressure.
- .2 Pump to be provided with necessary control valves, check valves and relief valves and to take its suction or supply side from sprinkler valve.
- .3 Pump shall be 120 V / 1 phase motor and be rigidly supported.
- .4 Pump to be controlled by combined manual/automatic start interconnected with high-low pressure switch installed on sprinkler valve discharge line. Pressure switch to trip on drop to pressure.

## **2.7 PRESSURE GAUGES**

- .1 Gauge shall be round, 112 mm (4"), dial type. Stainless steel bourdon tube having 0.5% accuracy.
- .2 Maximum limit of not less than twice normal working pressure at point where installed.

## **2.8 ZONE ALARM CONTROL VALVES**

- .1 Zone alarm control valves shall be installed as indicated and consist of a zone isolation valve, check valve, flow switch, and inspector's test connection with full drain capability.
- .2 Isolation valve shall be butterfly type with integral electric supervisory signal wiring. Check valve to be provided to prevent system pressure fluctuation, false alarms.
- .3 Flow Switch:
  - .1 Vane type: for wet sprinkler systems without alarm check valve, electric with pneumatic retard adjustable from 0-90 seconds, signals water pressure fluctuations to indicate leaks or flow water in excess of 38 L/m (10 USGpm), two sets of single-pole, double-throw contacts, coil spring, vane adjustment, saddle strap support unit. Assembly to be ULC and UL listed, FM approved.

- .4 Test and Drain Valve:
  - .1 Bronze construction, brass ball, screwed connections, double outlet ball valve with one outlet with orifice equal to a single sprinkler head in the system. The second outlet would be full pipe size for drainage capacity. Fitting shall be equipped with visual site glass on the discharge side.

## 2.9 BUILDING FIRE DEPARTMENT PUMPER CONNECTION

- .1 Unit shall be ULC listed and FM approved and bear the certification marking and location as indicated. Threads to be compatible with local fire department complete with threaded metal caps and chains.
- .2 Flush Mounted Type: Double Inlet (2 x) NPS 2½ (2½"Ø) threaded swivel fire hose connections. Base with NPS 4 (4"Ø) female NPT outlet. Cast brass body with polished brass, snoots and plug caps with attaching chain. Integral double swing clappers to prevent water from exiting the second inlet when not in use. Escutcheon plate, polished brass, with lettering identifying service. Standard plate lettering either "AUTO SPKR.", "STANDPIPE" or "AUTO SPKR / STANDPIPE" to suit service.
- .3 Piping from connection not to be less than NPS 4 (4"Ø). Connecting piping shall have a check valve. When installation requires that the check valve and connecting piping to fire department connection, be installed below the level of the fire department connection. The check valve will be equipped with a ball drip valve to ensure proper drainage of exterior fire department connection. Ball drip valve shall discharge to the nearest floor drain.
- .4 Locate not lower than 500 mm (20"), or higher than 1000 mm (40"), from adjacent grade.

## 2.10 FIRE SUPPRESSION SPRINKLERS

- .1 All sprinkler heads shall be standard coverage, quick response type, FM listed and ULC approved and bear the certification marking. Sprinklers shall have a rated working pressure of 1200 kPa (175 PSI).
- .2 Unless indicated below all sprinklers shall be the glass bulb type, rated for 68°C (165°F) (orange or red in colour).
  - .1 Sprinklers in kitchen areas shall be high temperature type, 141°C (286°F) rated, (blue in colour).
  - .2 Sprinklers in Mechanical Rooms containing boilers or steam equipment will be sprinklers in kitchen areas shall be high temperature type, 141°C (286°F) rated, (blue in colour).
- .3 Upright Sprinkler Heads (Exposed):
  - .1 Sprinkler frame and deflector shall be of bronze frame construction having a NPS ¾ (¾"Ø) NPT thread. Water seal assembly shall consist of an approved painted beryllium-nickel fusible solder link assembly, utilizing a strut and lever principle of operation, with Teflon-coated copper alloy cap. Bronze finish.
  - .2 Where upright sprinklers are installed in areas prone to access from the public (garages) or maintenance staff (Mechanical Rooms), protect sprinklers against mechanical injury by protective wire cages.
- .4 Pendant Sprinkler Heads (Exposed):
  - .1 Sprinkler frame and deflector shall be of bronze frame construction having a NPS ¾ (¾"Ø) NPT thread. Water seal assembly shall consist of a Teflon-coated spring washer and top-loaded extruded cup with 3 mm glass bulb. Standard finish: chrome-plated. Recessed escutcheon assembly shall be a steel, two-piece escutcheon utilizing a push-on/ thread-off design with ½" adjustment. Standard finish shall be bright chrome.

- .5 Sidewall Sprinkler Heads (Exposed and Semi Recessed):
  - .1 Sprinkler frame and deflector shall be of bronze frame construction having a NPS  $\frac{3}{4}$  ( $\frac{3}{4}$ "Ø) NPT thread. Water seal assembly shall consist of a Teflon-coated spring washer and top-loaded extruded cup with 3 mm glass bulb. Standard finish: chrome-plated. Recessed escutcheon assembly shall be a steel, two-piece escutcheon utilizing a push-on/ thread-off design with  $\frac{1}{2}$ " adjustment. Standard finish shall be bright chrome.
- .6 Refer to Part 3 for project sprinkler application.

## **2.11 SPRINKLER SPARE PARTS CABINET**

- .1 For storage of maintenance materials, spare sprinkler heads and special tools.
- .2 Cabinets: 1.4 mm (18 ga.) thick steel, with baked on, red enamel corrosion resistant paint finish. Provide metal cabinet containing spare sprinklers of each type and of each melting point temperature, keys for emergency repair work and sprinkler wrench.
- .3 Spare Sprinklers:
  - .1 System up to 300 sprinklers: 6 spare sprinklers required.
  - .2 System of 300 to 1000 sprinklers: 12 spare sprinklers required.
  - .3 System larger than 1000 sprinklers: 24 spare sprinklers required.

## **2.12 PORTABLE FIRE EXTINGUISHERS**

- .1 Multi-Purpose Dry Chemical Extinguishers: 3A 40BC rating, 2.2 kg (5 lb.) capacity, 2.4M (8') range, 13 second discharge time, stored pressure type having ammonium phosphate base with hose and shut-off nozzle labelled by Underwriters' Laboratories with wall brackets where required.
- .2 Carbon Dioxide Extinguishers: 5BC rating, 2.2 kg (5 lb.) capacity, 2.4M (8') range, 9 second discharge time, insulated handle, hose and horn discharge assembly, squeeze-grip operation, fully charged, labelled by Underwriters' Laboratories with mounting brackets where required.
- .3 Pressurized Water Extinguishers: 2A rating, 9 litre (2.4 gal.) capacity, 12M (40') range, 40 second discharge time, stainless steel construction with hose and shut-off nozzle labelled by Underwriters' Laboratories with wall brackets where required.
- .4 Multi-Purpose Wet Chemical Extinguishers: 1A / K rating, 8 litre (2.0 gal.) capacity, 2.4M (8') range, 55 second discharge time, stainless steel construction with hose and shut-off nozzle labelled by Underwriters' Laboratories with wall brackets where required.

## **2.13 INDEPENDENT PORTABLE FIRE EXTINGUISHER CABINETS**

- .1 Locations as indicated on the drawings and meeting the requirements of NFPA 10.
- .2 Cabinets to maintain fire resistive rating of construction in which they occur.
- .3 All cabinets penetrating a fire rated wall assembly shall be double wall, insulated construction and be UL listed with a two hour vertical fire rated assembly rating: Warnock Hersey International Test Report WHI-495-1534.

- .4 Tubs: 1.4 mm (18 ga.) thick steel, with baked on, white enamel corrosion resistant paint finish. Dimensions to support installed fire extinguisher.
- .5 Cabinet Door: 304 Stainless Steel with satin finish. Front door will be equipped with 5 mm (1/4") thick plexi-glass full panel occupying 70% of the door area. Non-locking, flush mounted, stainless steel finger pull style latching device.

## **2.14 JLR AND OWNER SPECIFIED PRODUCTS**

- .1 Refer to Division 00 and 01 for requirements for alternate manufacturer's to those listed below:
- .2 The following are Owner acceptable manufacturers, all others will be rejected unless pre-approved during tender:
  - .1 Backflow Preventor Conbraco
  - .2 Supervised Valves Kitz or Nibco
  - .3 Excess Pressure Pump: Armstrong, Taco, B&G, Grundfos, Goulds
- .3 JLR Specified Products and bases of design:
  - .1 Alarm Check Valve: Grinnel
  - .2 Alarm Switches Potter
  - .3 Sprinklers Grinnel
  - .4 Test and Drain Valve AGF Manufacturing Ltd
  - .5 Portable Fire Extinguishers: Kidd

## **PART 3- EXECUTION**

### **3.1 GENERAL**

- .1 Do not recess, paint or conceal piping, accessories or work prior to inspection and approval by the (AHJ) Authority having Jurisdiction. Install signs required by (AHJ) Authority having Jurisdiction.
- .2 Allow for expansion and contraction when installing pipe hangers.
- .3 Discharge full flow drains to safe location outside building. Pipe other drains as indicated or to nearest floor drain.
- .4 Assume full responsibility for protecting sprinkler heads during painting. Replace damaged and painted component.
- .5 Coordinate system installation with electric lighting, mechanical ductwork and piping.
- .6 Provide openings into structure necessary to install systems.

### **3.2 MANUFACTURER'S INSTRUCTIONS**

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

### 3.3 PIPE IDENTIFICATION AND PAINTING

- .1 Install pipe identification in accordance with Section 20 04 01 – Mechanical Identification, supplemented as specified.
- .2 Paint all standpipe piping, fittings and valves red.
- .3 Paint all sprinkler piping, fittings and valves red.

### 3.4 SPRINKLER INSTALLATION

- .1 Install and test to acceptance in accordance with NFPA 13 requirements.
- .2 Install pipework in accordance with Section 20 05 05 - Installation of Pipe, supplemented as specified.
- .3 Install pressure gauge at top of the highest and most remote riser.
- .4 Locate components and valve operators at locations to provide clear and frequent access.
- .5 Install sprinkler types as per the following table.

Location	Sprinkler Type	Sprinkler Finish
High Bay Areas Storage Areas Exposed Ceiling Areas	Upright Sprinkler Head	Bronze
Office Areas with suspended TBar Ceilings	Exposed Pendant Sprinkler Head	White
Office Areas with suspended Gypsum Ceilings	Exposed Pendant Sprinkler Head	White

### 3.5 TESTING

- .1 General:
  - .1 In accordance with NFPA requirements, supplemented as specified herein.
- .2 Testing shall be witnessed by [Fire Commissioner of Canada] [Canadian Forces Fire Marshal] [authority having jurisdiction].
- .3 Disposal of water used in flushing and testing to a safe location.
- .4 Procedures:
  - .1 Verify that system is complete prior to start-up and testing procedures.
  - .2 Verify that ULC labels are visible.
  - .3 Fill system with water for pressure. Record water supply pressure.
  - .4 Pressure test piping system as required by authority having jurisdiction.

- .5 Start-up jockey pumps.
- .6 Verify flow switches are operational.
- .7 Verify valves in system are visible and monitored.
- .8 Flushing: fill with water, let stand at operating pressure for 1 week.
- .9 Drain risers separately, then drain main.
- .10 Flush buried mains and lead-in connections before making connection to indoor sprinkler system.
- .11 Perform flow tests, including tests of pre-action systems, as required by:
  - .1 Authority having jurisdiction.
  - .2 Applicable NFPA standards such as 13, 14, 20, 1273.
  - .3 Local building codes.
  - .4 Record incoming pressure to building for 10 days prior to activating system.
  - .5 Fill glycol legs, confirming proper operation of backflow preventers.
  - .6 Adjust pressure switches.
- .5 Identification: verify devices are properly labelled, identifying area served, etc.
- .6 Posted Instructions: prepare schematic, mount behind glare-free glass and install where directed.
- .7 Prepare valve schedule, mount behind glare-free glass and install where directed.

### **3.6 CERTIFICATION**

- .1 Perform all required acceptance tests and complete the Contractor's Material and Test Certificates as per NFPA and forward certificate to Consultant and the authority having jurisdiction.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 SCOPE DESCRIPTION SUMMARY**

- .1 The section describes the pumps utilized for plumbing applications.

### **1.2 REFERENCES**

- .1 Unless dated references are identified below, it shall be the latest standard issued by the regulatory agency that shall be utilized as the applicable reference.
- .2 NSF International / American National Standards Institute (ANSI):
  - .1 NSF/ANSI 61, Drinking Water System Components – Health Effects.
- .3 Part 7 National Building Code.
- .4 Part 7 Ontario Building Code.

### **1.3 INFORMATIONAL SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 01 – Submittals.
- .2 Product Data:
  - .1 Product data shall be submitted for all PART 2 – PRODUCTS specified herein.
  - .2 Provide manufacturer's printed product literature and datasheets for material specified, and include product characteristics, performance criteria, physical size, finish and limitations.
  - .3 Product data shall include all maintenance access points and dimensional clearances, such that the contractor can properly layout the equipment to ensure proper access.
  - .4 Product data shall include all relevant information to confirm the specifications have been met.
  - .5 Product data shall provide all relevant data and operational points that verify the engineered criteria have been met and that field operational tolerances can be accommodated, i.e., equipment is not supplied which is operating at their upper and lower limits for their design duty performance.
  - .6 Product data shall identify all ancillary field installed devices and provide all information required for the coordination of the installation with other trades.
  - .7 Product data shall include any relevant information which Division 25 requires for a properly functioning building automation system.
  - .8 Product data shall include information as specified in Section 20 01 01 - Common Work Results for Mechanical unless modified with additional information required below.
- .3 Maintenance Data:
  - .1 Provide maintenance data including certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties, for incorporation into manuals specified in Section 01 78 00 – Closeout Submittals.
  - .2 Maintenance data shall include but not be limited to:
    - .1 Certificates, signed by the manufacturer or their representative, certifying that the materials have been installed as per their installation instructions.

- .2 The approved shop drawings with performance criteria edited with field observations and commissioned operational set points and adjustments.
  - .3 The manufacturer's maintenance and installation data.
  - .4 Safety informational data for maintenance staff prior to performing maintenance requirements.
  - .5 List of all routine maintenance requirements as well as monthly, annual or other periodical maintenance recommendations from the manufacturer.
  - .6 Any maintenance requirements that may affect the warranty periods of the associated equipment.
- .4 Provide copies WHMIS MSDS – Material Safety Data Sheets in accordance with Division 1 where material specified has MSDS Sheets.

#### **1.4 MAINTENANCE REQUIREMENTS**

- .1 The contractor shall verify and demonstrate that proper maintenance can be performed on equipment and material installed.

#### **1.5 QUALITY ASSURANCE**

- .1 Performance Requirements defined: catalogued or published ratings for manufactured items obtained from tests carried out by manufacturer or those ordered by manufacturer from an independent testing agency signifying adherence to codes and standard and standardized testing of performance criteria.
- .2 Electrical Equipment shall bear a CSA label or have an ESA certification.
- .3 Where applicable equipment shall bear a ULC or UL label.

#### **1.6 COMMISSIONING**

- .1 Pumps shall be commissioned in accordance with Section 01 91 01 – Commissioning.
- .2 The commissioning shall verify that the equipment is installed in accordance with the manufacturer's requirements and that the equipment has been adjusted to conform to the design performance.

#### **1.7 TRAINING**

- .1 The manufacturer's representative shall be present for the training of the operational staff, on the operation and maintenance of the systems installed.
- .2 The maintenance staff shall be instructed on the required maintenance schedule as well as the proper maintenance requirements and procedures for the equipment installed.
- .3 The training shall inform the maintenance staff of any applicable warranties the manufacturer provides for defective material.

## **PART 2 - PRODUCTS**

### **2.1 GENERAL**

- .1 The products utilized shall be those accepted by the local AHJ (Authority Having Jurisdiction).
- .2 The installation of the plumbing pumps shall be reviewed and installed in accordance with the local AHJ (Authority Having Jurisdiction).

### **2.2 DOMESTIC HOT WATER RECIRCULATION PUMP**

- .1 Domestic hot water booster pump shall provide circulation of domestic hot water during periods of low usage to maintain temperature of domestic hot water.
- .2 Pump: Centrifugal vertical or horizontal In-Line pump style:
  - .1 Casing and Volute: cast (lead free) bronze or stainless steel. Standard 2 bolt flanged connections.
  - .2 Impeller: brass or bronze (lead free), hydraulically balanced.
  - .3 Shaft: stainless steel with bronze sleeve bearing, mechanical seals.
- .3 Motor: TEFC type with a 1.15 service factor. CSA approved and listed, with thermal overload protection, three speed.
- .4 Clock/Timer: 12 hour analog clock with am/pm indication, adjustable 24/7 timer with 15 minute intervals, manual override.
- .5 860 kPa (125 PSI) maximum pressure, 107°C (225°F) maximum temperature, continuous service.
- .6 Supports: provide as recommended by manufacturer.
- .7 Recirculation Pump Capacity: as indicated on the drawings

### **2.3 ELEVATOR SUMP PUMP SUBMERSIBLE – SIMPLEX**

- .1 Effluent Sump Pump system shall pump sewage, not containing solids, from a sump to a gravity sewage pipe. The system shall be complete with concrete basin with cover, pump, piping, floats and controls.
- .2 Pump: Centrifugal submersible pump assembly:
  - .1 Casing: cast iron housing, totally enclosing and sealing electrical components. Standard NPT discharge connection.
  - .2 Volute: cast Iron Housing. The volute shall have integrally cast legs for mounting pump on bottom of sump.
  - .3 Impeller: non-clogging, cast iron recessed type, machined and hydraulically balanced.
  - .4 Shaft: stainless steel with carbon / ceramic shaft seal.

- .3 Motor: hermitically sealed within cast iron oil filled casing, CSA approved and listed, with heat sensor protection with automatic reset when motor cools to a safe operating temperature.
- .4 Power Cord: power cord shall be 6M (20') in length, and sealed at the pump connection. Cords shall withstand a pull of 45 Kg (100#).
- .5 Finish: exterior shall surface shall have a baked on epoxy paint finish. Pump shall have an integral stainless lifting ring mounted to the top of the pump for attachment of a lifting cable.
- .6 Control and Alarm Panel: NEMA 1 enclosure, power cord, receptacle, indicator lights, audible alarm and backup power.
- .7 Floats: Tilt sensitive, wide-angle, non-corrosive PVC enclosure and UL listed and CSA certified.
- .8 Probes: Stainless steel.
- .9 Sump high level alarm to be connected to the EMCS system.
- .10 Concrete Sump: concrete, as indicated, refer to and coordinate with Division 3. Provide steel cover plate bolted and sealed to sump edge angle. Cover plate shall withstand human traffic and have rubber grommets as required sealing the installation. Refer to detail included on the drawings.
- .11 Sump Pump Capacity: As indicated on drawings

## **2.4 CONDENSATE DRAIN PUMP**

- .1 Self-contained, packaged Condensate Sump Pump shall pump sewage, not containing solids, from a sump to a gravity sewage pipe or floor drain.
- .2 Pump: Centrifugal Submersible Pump Assembly:
  - .1 Casing: ABS plastic housing, totally enclosing electrical components. Standard barbed discharge connection.
  - .2 Volute: ABS plastic.
  - .3 Impeller: ABS plastic impellor, integral to pump assembly.
  - .4 Shaft: stainless steel with carbon / ceramic shaft seal.
  - .5 ABS plastic motor and tank cover.
- .3 Motor: CSA approved and listed with thermal overload protection. Power Cord; The power cord shall be 3M (10') in length
- .4 Control: integral to the pump assembly
- .5 Integral check valve.
- .6 Plastic ABS Sump: two litre (½ gallon) capacity.

## **2.5 JLR AND OWNER SPECIFIED PRODUCTS**

- .1 Refer to Division 00 and 01 for requirements for alternate manufacturer's to those listed below:
- .2 The following are Owner acceptable manufacturers, all others will be rejected unless pre-approved during tender:
  - .1 Domestic Hot Water Recirculation Pump: Armstrong, Taco, B&G, Grundfos, Goulds
- .3 JLR Specified Products and bases of design:
  - .1 Submersible Sump Pump Myers
  - .2 Condensate Drain Pumps Little Giant

## **PART 3 - EXECUTION**

### **3.1 GENERAL**

- .1 Installation of all plumbing pumps shall meet the requirements of the AHJ (Authority Having Jurisdiction).
- .2 Refer to details on drawings for specific installation details.
- .3 Mount domestic hot water recirculation pump as indicated, support piping either side of pump, independently from pump. Provide isolation valves either side of pump and check valve on pump discharge. Discharge piping to connect to domestic cold water supply directly upstream of domestic water heater inlet. Equip cold water inlet with isolation valve and check valve. Balance the flow rate from each domestic hot water loop.
- .4 Ensure sumps are clean and water tight prior to installation of Sump Pumps. Provide non slam check valve and full flow isolation valve on discharge of sump pump, above the floor level to provide easy access. Provide chains for lifting of pumps, and secure to basin wall below access cover. Provide quick disconnecting means at pump and at main pipe connection to assist in removal of pump for servicing. Verify operation and alarm capability of sump pump controls.

### **3.2 MANUFACTURER'S INSTRUCTIONS**

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

### **3.3 PUMP START-UP PROCEDURES**

- .1 General:
  - .1 In accordance with commissioning requirements defined herein and as supplemented with the following:
    - .1 Procedures:
      - .1 Check power supply.
      - .2 Check starter O/L heater sizes.
      - .3 Start pumps, check impeller rotation.
      - .4 Check for safe and proper operation.

- .5 Check settings, operation of operating, limit, safety controls, over-temperature, audible/visual alarms, other protective devices.
- .6 Test operation of hands-on-auto switch.
- .7 Test operation of alternator.
- .8 Adjust leakage through water-cooled bearings.
- .9 Adjust shaft stuffing boxes.
- .10 Adjust leakage flow rate from pump shaft stuffing boxes to manufacturer's recommendations.
- .11 Check base for free-floating, no obstructions under base.
- .12 Run-in pumps for 12 continuous hours.
- .13 Check installation, operation of mechanical seals, packing gland type seals. Adjust as necessary.
- .14 Adjust alignment of piping and conduit to ensure full flexibility.
- .15 Eliminate causes of cavitation, flashing, air entrainment.
- .16 Measure pressure drop across strainer when clean and with flow rates as finally set.
- .17 Replace seals if pump used to degrease system or if pump used for temporary heat.
- .18 Verify lubricating oil levels.

### **3.4 SUMP PUMP PERFORMANCE VERIFICATION**

- .1 PV Procedures:
  - .1 Fill sump at rate slower than capacity of Pump No.1.
  - .2 Record levels at which Pump No.1 starts and stops. Determine flow rate by observing time taken to down water level.
  - .3 Fill sump at rate faster than capacity of Pump No. 1.
  - .4 Record levels at pump starts and stops - water level rising and falling.
  - .5 Check operation of alternator.
  - .6 Adjust level controls as necessary.
  - .7 Check level at which high water level alarm starts and stops. Adjust as necessary.
- .2 Check removability of pumps for servicing without interfering with installation or operation of other equipment.
- .3 Verify non-clog capability and maximum size of solids, using procedures recommended by manufacturer.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 SCOPE DESCRIPTION SUMMARY**

- .1 This section describes the materials and methods for the installation of plumbing water distribution piping within the building.
- .2 This section describes the requirements for water entry piping when not attached to a fire suppression system.

### **1.2 REFERENCES**

- .1 Unless dated references are identified below, it shall be the latest standard issued by the regulatory agency that shall be utilized as the applicable reference.
- .2 American National Standards Institute (ANSI)/American Society of Mechanical Engineers International (ASME):
  - .1 ANSI/ASME B16.15, Cast Bronze Threaded Fittings, Classes 125 and 250.
  - .2 ANSI/ASME B16.18, Cast Copper Alloy Solder Joint Pressure Fittings.
  - .3 ANSI/ASME B16.22, Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
  - .4 ANSI/ASME B16.24, Cast Copper Alloy Pipe Flanges and Flanged Fittings, Class 150, 300, 400, 600, 900, 1500 and 2500.
  - .5 ANSI/SP-58, Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation.
- .3 ASTM International Inc.:
  - .1 ASTM A 307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
  - .2 ASTM A 536, Standard Specification for Ductile Iron Castings.
  - .3 ASTM B 88M, Standard Specification for Seamless Copper Water Tube (Metric).
- .4 American National Standards Institute/American Water Works Association(ANSI)/AWWA):
  - .1 ANSI/AWWA C111/A21.11, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
- .5 American National Standards Institute/NSF International (ANSI)/NSF):
  - .1 ANSI/NSF 61, Drinking Water System Components – Health Affects.
- .6 Canadian Standards Association (CSA International):
  - .1 CSA B242, Groove and Shoulder Type Mechanical Pipe Couplings.
- .7 Manufacturer's Standardization Society of the Valve and Fittings Industry (MSS):
  - .1 MSS-SP-67, Butterfly Valves.
  - .2 MSS-SP-70, Grey Iron Gate Valves, Flanged and Threaded Ends.
  - .3 MSS-SP-71, Grey Iron Swing Check Valves, Flanged and Threaded Ends.
  - .4 MSS-SP-80, Bronze Gate, Globe, Angle and Check Valves.
- .8 Part 7 National Building Code.
- .9 Part 7 Ontario Building Code.

### 1.3 INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 01 – Submittals.
- .2 Product Data:
  - .1 Product data shall be submitted for all PART 2 – PRODUCTS specified herein.
  - .2 Provide manufacturer's printed product literature and datasheets for material specified, and include product characteristics, performance criteria, physical size, finish and limitations.
  - .3 Product data shall include all maintenance access points and dimensional clearances, such that the contractor can properly layout the equipment to ensure proper access.
  - .4 Product data shall include all relevant information to confirm the specifications have been met.
  - .5 Product data shall provide all relevant data and operational points that verify the engineered criteria have been met and that field operational tolerances can be accommodated, i.e., equipment is not supplied which is operating at their upper and lower limits for their design duty performance.
  - .6 Product data shall identify all ancillary field installed devices and provide all information required for the coordination of the installation with other trades.
  - .7 Product data shall include any relevant information which Division 25 requires for a properly functioning building automation system.
  - .8 Product data shall include information as specified in Section 20 01 01 - Common Work Results for Mechanical unless modified with additional information required below.
  - .9 Additional information required;
- .3 Maintenance Data:
  - .1 Provide maintenance data including certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties, for incorporation into manuals specified in Section 01 78 00 – Closeout Submittals.
  - .2 Maintenance data shall include but not be limited to:
    - .1 Certificates, signed by the manufacturer or their representative, certifying that the materials have been installed as per their installation instructions.
    - .2 The approved shop drawings with performance criteria edited with field observations and commissioned operational set points and adjustments.
    - .3 The manufacturer's maintenance and installation data.
    - .4 Safety informational data for maintenance staff prior to performing maintenance requirements.
    - .5 List of all routine maintenance requirements as well as monthly, annual or other periodical maintenance recommendations from the manufacturer.
    - .6 Any maintenance requirements that may affect the warranty periods of the associated equipment.

### 1.4 MAINTENANCE REQUIREMENTS

- .1 The contractor shall verify and demonstrate that proper maintenance can be performed on equipment and material installed.

### 1.5 QUALITY ASSURANCE

- .1 Performance Requirements Defined: catalogued or published ratings for manufactured items obtained from tests carried out by manufacturer or those ordered by manufacturer from an independent testing agency signifying adherence to codes and standard and standardized testing of performance criteria.

## **PART 2 - PRODUCTS**

### **2.1 GENERAL**

- .1 The products utilized shall be those accepted by the local AHJ (Authority Having Jurisdiction).

### **2.2 EXISTING DOMESTIC WATER ENTRY**

- .1 Install meter inside building, with ball valve on either side of meter and drain with ball valve and hose nipple for NPS 3/4 (3/4"Ø) hose on building side of valve downstream from meter. Provide locked (lock shield) valve, water meter bypass of size to comply with local water authority. If meter is not immediately available, provide companion pieces and filler pipe section. Remove filler pieces; install meter when available. Provide stanchion supports within 150 mm (6") of water meter inlet and outlet.
- .2 Install pressure gauge on downstream side of meter.
- .3 Provide reduced pressure principle backflow preventer downstream of meter and on building side of by-pass.

### **2.3 DOMESTIC WATER PIPING – BUILDING INTERIOR – COPPER**

- .1 Applications:
  - .1 Potable Domestic Cold Water Distribution;
  - .2 Potable Domestic Hot Water Distribution;
  - .3 Potable Domestic Hot Water Recirculation.
- .2 Piping:
  - .1 Seamless copper tube, hard drawn, type L to ASTM B 88M.
- .3 Fittings:
  - .1 Full flow, standard radius, wrought copper and copper alloy, solder type: to ANSI/ASME B16.22.
- .4 Joints:
  - .1 Soldered Joints: Soldered connections utilizing lead free, 95-5 tin-antimony solder, to ASTM B 32.

### **2.4 DOMESTIC WATER PIPING – BUILDING INTERIOR – COPPER NPS 3 (3"Ø) AND LARGER**

- .1 Applications:
  - .1 Potable Domestic Cold Water Distribution.
  - .2 Potable Domestic Hot Water Distribution.
- .2 Piping:
  - .1 Seamless copper tube, hard drawn, Type L to ASTM B 88M.
- .3 Fittings:
  - .1 Full flow, standard radius, wrought copper and copper alloy, with roll grooves for couplings.
- .4 Joints:
  - .1 Ductile Iron, Grooved Couplings: designed with angle bolt pads to provide rigid joint, complete with flush seal EPDM gasket. Conforming to ANSI 61 for cold and hot potable water service (Temperature Range below freezing to 110°C (230°F)).

## 2.5 BALL VALVES

- .1 Ball Valve, Soldered End:
  - .1 NPS 2 ½ (2 ½"Ø) and under, soldered.
  - .2 2 piece forged brass body, full port, stainless steel ball, PTFE adjustable packing, brass gland and PTFE seat.
  - .3 Extended stainless steel stem for handle operation outside insulation.
  - .4 Steel lever handle, with plastic coated contact surface. Provide locking handle type for lockshield service.
  - .5 Class 150 WSP, with CSA, UL and FM approval.
  - .6 For services 2" and under, 600 psi WOG valves shall be used.
- .2 Ball Valve, Grooved End:
  - .1 NPS 3 (3"Ø) and over, grooved end.
  - .2 2 piece forged brass body, full port, stainless steel ball, PTFE adjustable packing, brass gland and PTFE seat.
  - .3 Extended stainless steel stem for handle operation outside insulation.
  - .4 Steel lever handle, with plastic coated contact surface. Provide locking handle type for lock shield service.
  - .5 Class 150 WSP, with CSA, UL and FM approval.

## 2.6 SWING CHECK VALVES

- .1 Swing Check Valve, Soldered End:
  - .1 NPS 2 ½ (2 ½"Ø) and under, soldered.
  - .2 Y Pattern body, all bronze construction. Cast bronze body, screw in access cap, bronze swing disk, bronze hinge and stainless steel pin.
  - .3 Class 150 WSP, conforming to MSS-SP-80.

## 2.7 BALANCING VALVES

- .1 Pressure independent balancing device, Screwed End, Replaceable flow cartridge:
  - .1 NPS ¾ (¾"Ø) and under, screwed.
  - .2 Stainless steel body, Nickel plated brass union collars, replaceable flow cartridge with stainless steel wear surfaces.
  - .3 Accuracy: Flow rate +/- 5% over 95% of the control range.
  - .4 NSF Certified in accordance with ANSI/NSF 61.

## 2.8 JLR AND OWNER SPECIFIED PRODUCTS

- .1 Refer to Division 00 and 01 for requirements for alternate manufacturer's to those listed below:
- .2 The following are Owner acceptable manufacturers, all others will be rejected unless pre-approved during tender:
  - .1 Valves: Kitz, Nibco
  - .2 Balancing Valves Victaulic Series 76X
- .3 JLR specified products and bases of design:  
Nil

### **PART 3 - EXECUTION**

#### **3.1 GENERAL**

- .1 Support piping in accordance with the AHJ (Authority Having Jurisdiction), the Building Code, and the manufacturer's requirements.
- .2 System shall be installed using industry best practices for pipe installation and run parallel to building lines. Refer to Section 20 05 05 – Installation of Pipe for piping layout and methodology.
- .3 Install cold water piping below and away from hot water piping and other hot piping so as to maintain temperature of cold water as low as possible.
- .4 Connect to fixtures and equipment in accordance with manufacturer's written instructions unless otherwise indicated.
- .5 Install groups of pipes parallel to each other on trapeze hangers spaced to permit application of insulation, identification and service access.
- .6 Install eccentric reducers in horizontal piping to permit drainage and eliminate air pockets.
- .7 Where pipe sizes differ from connection sizes of equipment, install reducing fittings close to equipment. Reducing bushings are not permitted.
- .8 Ream ends of pipes and tubes before fabrication.
- .9 Lay copper tubing so that it is not in contact with dissimilar metal or contact with hangers without protection.
- .10 Install dielectric couplings where joining dissimilar metals.
- .11 Make provision to protect water system from water hammer due to rapid operation of valves and fixtures.
- .12 Make provision for thermal expansion of piping system and building structure through use of expansion joints, expansion loops and bends.
- .13 Connect all fixtures and equipment supplied by Division 15 or others, unless detailed otherwise. Coordinate with architectural drawings.

#### **3.2 MANUFACTURER'S INSTRUCTIONS**

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

#### **3.3 VALVE INSTALLATION**

- .1 Remove internal components of valve when soldering or brazing to prevent damage internal components.
- .2 Install isolation valves to isolate individual equipment and fixtures with ball valves.
- .3 Install isolation valves to isolate branch take offs and supplies to individual grouped washrooms with ball valves.

- .4 Install valves to balance recirculation system using globe valves. Mark settings and record on as-built drawings on completion.
- .5 Ensure vales are accessible for maintenance staff and are identified as to service.
- .6 Provide hose bibs or sediment faucets for complete system drainage.

### **3.4 SYSTEM TESTING**

- .1 Contractor to complete installation inspection, integrity (pressure, leak) tests and support system inspection of piping system before system is insulated or enclosed. Piping not to be covered until all inspection and testing deficiencies have been corrected and successful re-testing has been completed.
- .2 Test Pressure: domestic potable water system to be capable of withstanding, without leakage, water test or air test greater than one times maximum system operating pressure or 860 kPa (125 PSI) or to the authority having jurisdiction.
- .3 Coordinate with authority having jurisdiction the requirement of the authority to witness tests and inspect piping system.
- .4 Isolate system components not designed for test pressure during test.

### **3.5 FLUSHING, CLEANING AND DISINFECTION**

- .1 Flushing: flush entire system for 8 hours. Ensure outlets flushed for 2 hours. Let stand for 24 hours, then draw a sample off longest run. Submit to testing laboratory to verify that system is clean to the potable water guidelines. Let system flush for additional 2 hours, then draw off another sample for testing.
- .2 Flush out, disinfect and rinse system to the requirements of authority having jurisdiction.

### **3.6 PERFORMANCE VERIFICATION AND COMMISSIONING**

- .1 Scheduling:
  - .1 Verify system performance after pressure and leakage tests and disinfection are completed.
- .2 Procedures:
  - .1 Verify that flow rate and pressure meet Design Criteria.
  - .2 Adjust and balance flow of DHWR system.
  - .3 Adjust and balance flow from fixtures to meet design specifications.
  - .4 Adjust pressure regulating valves while withdrawal is maximum and inlet pressure is minimum.
  - .5 Verify performance of temperature controls.
  - .6 Check for proper operation of water hammer arrestors. Run outlet for 10 seconds, then shut off water immediately. If water hammer occurs, replace water hammer arrestor or re-charge air chambers. Repeat for outlets and flush valves.
- .3 Include certificate of water flow and pressure tests conducted on incoming water service, demonstrating adequacy of flow and pressure.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 SCOPE DESCRIPTION SUMMARY**

- .1 This section describes the domestic water piping specialties required for plumbing applications.

### **1.2 REFERENCES**

- .1 Unless dated references are identified below, it shall be the latest standard issued by the regulatory agency that shall be utilized as the applicable reference.
- .2 In addition to those listed below, individual product specifications refer to specific references for that product.
- .3 Part 7 National Building Code.
- .4 Part 7 Ontario Building Code.
- .5 American National Standards Institute (ANSI).
- .6 American Society of Mechanical Engineers International (ASME).
- .7 ASTM International Inc.
- .8 American Water Works Association (AWWA).
- .9 American National Standards Institute/NSF International (ANSI)/NSF):
  - .1 ANSI/NSF 61, Drinking Water System Components – Health Affects.
- .10 Canadian Standards Association (CSA International).
- .11 University of Guelph Metering Standard.

### **1.3 INFORMATIONAL SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 01 – Submittals.
- .2 Product Data:
  - .1 Product data shall be submitted for all PART 2 – PRODUCTS specified herein.
  - .2 Provide manufacturer's printed product literature and datasheets for material specified, and include product characteristics, performance criteria, physical size, finish and limitations.
  - .3 Product data shall include all maintenance access points and dimensional clearances, such that the contractor can properly layout the equipment to ensure proper access.
  - .4 Product data shall include all relevant information to confirm the specifications have been met.
  - .5 Product data shall provide all relevant data and operational points that verify the engineered criteria has been met and that field operational tolerances can be accommodated, i.e., equipment is not supplied, which is operating at its upper and lower limits for its design duty performance.
  - .6 Product data shall identify all ancillary field installed devices and provide all information required for the coordination of the installation with other trades.
  - .7 Product data shall include any relevant information which Division 25 requires for a properly functioning building automation system.

- .8 Product data shall include information as specified in Section 20 01 01 - Common Work Results for Mechanical unless modified with additional information required below.

.3 Maintenance Data:

- .1 Provide maintenance data including certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties, for incorporation into manuals specified in Section 01 78 00 – Closeout Submittals.
- .2 Maintenance data shall include but not be limited to:
  - .1 The manufacturer's maintenance and installation data.
  - .2 Safety informational data for maintenance staff prior to performing maintenance requirements.
  - .3 List of all routine maintenance requirements as well as monthly, annual or other periodical maintenance recommendations from the manufacturer.
  - .4 Any maintenance requirements that may affect the warranty periods of the associated equipment.

#### 1.4 MAINTENANCE REQUIREMENTS

- .1 The contractor shall verify and demonstrate that proper maintenance can be performed on equipment and material installed.

#### 1.5 QUALITY ASSURANCE

- .1 Performance Requirements Defined: catalogued or published ratings for manufactured items obtained from tests carried out by manufacturer or those ordered by manufacturer from an independent testing agency signifying adherence to codes and standard and standardized testing of performance criteria.
- .2 Electrical equipment shall bear a CSA label or have an ESA certification.
- .3 Where applicable equipment shall bear a ULC or UL label.

### **PART 2 - PRODUCTS**

#### 2.1 GENERAL

- .1 The products utilized shall be those accepted by the local AHJ (Authority Having Jurisdiction).
- .2 Provide piping specialties as required and as specified to meet the installation requirements of the plumbing distribution systems.

#### 2.2 WATER METERS

- .1 Water meters utilized by the local utility and/or the University of Guelph, to monitor water consumption, shall be approved by the local utility and/or the University of Guelph. Coordinate the installation with the local utility and/or the University of Guelph and provide all meters required by the local utility and/or the University of Guelph.

- .2 General: Water meters shall comply with ANSI / AWWA C700-09 Cold-Water Meters—Displacement Type, Bronze Main Case and NSF/ANSI 61.
- .3 Domestic water meter electrode shall be constructed of stainless steel construction.
- .4 Units provided with a local digital display with meters cubed (M3) and digital 4-20mA output to tie into the University of Guelph building automation system or the Schneider ION system.
- .5 Provide inline electronic magnetic meter, complete with proper grounding, display and warranty.
- .6 Quantify alternate flow meter to meet accuracy, specification and range of flow rate specified.
- .7 Quantify accuracy specification through the range of flow rate specified for approval.
- .8 To use polyurethane sensor liner.
- .9 The meter body shall include grounding and empty pipe electrodes of the same material as the measuring electrodes.
- .10 Meter must be H.A.R.T. compatible.
- .11 The magnetic flowmeter shall be microprocessor based with integral electronics.
- .12 LCD display shall enable the operator to monitor flow rate in clear text messages.
- .13 The meter shall have field replaceable sensors and coils.
- .14 The magnetic flowmeter shall provide an accuracy of +/- 0.5% of flow rate.
- .15 It should be possible to check the functionality and verify deviation of the flow meter without needing to dismantle the device by using an external device. This Verification of transmitter electronics should be traceable to NIST or equivalent standards.

### **2.3 TRAP SEAL PRIMERS**

- .1 General: trap primers shall comply with ANSI/ASSE 1018-2001 -Performance Requirements for Trap Seal Primer Valves - Potable Water Supplied.
- .2 Standard Trap Seal Primer, Fixture Activated:
  - .1 Provide trap seal primers in washrooms and other areas to suit building code requirements. Primer to introduce regulated amount of water into trap or traps when the connected fixture used. Primer to be either flow activated or pressure drop activated.
  - .2 Construction: cast brass body, removable cap, equipped with internal vacuum breaker, non-liming internal operating piston, stainless steel spring, removable bronze seat with metering orifice, and sealed bronze cover. NPS 1/2 (1/2"Ø) solder ends, NPS 1/2 (1/2"Ø) drip line connection.
  - .3 Primer shall operate and provide trap flow at pressures below 175 kPA (25 PSI).

### **2.4 DIELECTRIC PIPE FITTINGS**

- .1 Provide dielectric fittings to isolate system components from galvanic currents. Material of dielectric fittings to suit dissimilar metals in system.

## **2.5 WATER HAMMER ARRESTORS**

- .1 General: water hammer arrestors shall comply with ASME A112.26.1M – Water Hammer Arrestors.
- .2 Water hammer arrestors shall be sized for application and shall be designed to protect water lines during pressure surges following quick valve closure. This excessive pressure surge shall be absorbed by the pre-charged cushion of air permanently sealed within the water hammer arrester.
- .3 Construction: lead-free copper construction, brass tailpiece and brass piston. Pre charged and sealed at the factory.

## **2.6 VACUUM BREAKERS**

- .1 General: vacuum breakers shall comply with CSA B64 SERIES-11 – Backflow Preventers and Vacuum Breakers.
- .2 Vacuum breakers shall be installed in the domestic water system wherever the possibility of back siphon age and contamination of the potable water system exists.
- .3 Construction: brass body, full size orifice for maximum flow, lightweight disc float with silicone seals.

## **2.7 REDUCED PRESSURE PRINCIPLE BACKFLOW PREVENTERS**

- .1 General: backflow preventers shall comply with CSA B64 SERIES-11 - Backflow Preventers and Vacuum Breakers.
- .2 Backflow preventers shall be selected for the appropriate application. Applications involving water supply to a system with contamination or with chemical introduced shall have a reduced pressure principle backflow preventer installed. Applications involving water supply to a system where the possible contamination is unknown, will have a reduced pressure principle backflow preventer installed.
- .3 The assembly shall also include two quarter turn ball vales for isolation at the inlet and outlet, one strainer downstream of inlet ball valve, two in-line independent check valves with an intermediate relief valve, four test cocks and an air gap drain fitting.
- .4 Construction:
  - .1 All components shall be lead free cast copper or cast bronze body construction.
  - .2 Silicone rubber disc material in the first and second check plus the relief valve. Replaceable polymer check seats for first and second checks. Removable stainless steel relief valve seat. Stainless steel cover bolts.
  - .3 Air gap drain fitting shall be cast bronze.

## **2.8 PRESSURE REDUCING REGULATORS**

- .1 General: domestic water pressure reducing regulators shall comply with CSA B356 Water Pressure Reducing Valves for Domestic Water Supply Systems.
- .2 Pressure reducing valves shall be installed on potable water lines to reduce high inlet pressure to a lower outlet pressure.
- .3 Capacity: maximum inlet pressure: 1034 kPa (150 PSI), outlet pressure of 172 kPa (25 PSI) to 518 kPa (75 PSI) field adjustable.

- .4 Construction: lead free, cast bronze body and bell, stainless steel seat, stem, and sleeve, stainless steel strainer screen, EPDM seals. Soldered inlet and outlet connections.
- .5 Pressure gauges on inlet and discharge.
- .6 Soldered inlet and outlet connections.

## **2.9 TEMPERATURE AND PRESSURE RELIEF VALVES**

- .1 General: relief valves shall comply with ANSI Z21.22 / CSA 4.4-M99 Relief Valves for Hot Water Supply Systems. Valve shall be ASME rated and CSA listed.
- .2 Pressure relief valves shall be selected for the appropriate application and exceed the required relief flow capacity. Pressure relief valves shall be provided as indicated and specified, and as required protecting the system from excessive pressure. Valves shall be complete with an extension thermostat for temperature monitoring and a test lever for periodic testing.
- .3 Construction: main valve body to be cast brass or bronze, stainless steel internal components, silicone seals, stainless steel springs, copper encased thermostat probe.
- .4 Pressure – temperature settings:
  - .1 Temperature relief 99°C (210°F).
  - .2 Pressure range 517 – 1034 kPa (75 – 150 PSI).
  - .3 Determine application pressure relief setting prior to installation.

## **2.10 MAKE-UP WATER ASSEMBLY**

- .1 Make up water assembly shall consist of a NPS 1 (1"Ø) main water line with isolation ball valve and NPS 1 (1"Ø) reduced pressure principle backwater valve. Downstream will be a tee connection to a NPS 1 (1"Ø) bypass around a pressure reducing valve. The bypass will be equipped with an isolation lock shield ball valve with the handle removed. The pressure reducing valve shall be NPS ½ (1/2"Ø) with isolation ball valves on the inlet and outlet. The discharge of the assembly shall be equipped with a pressure gauge and a temperature and pressure relief valve.

## **2.11 HOSE BIBB**

- .1 Hose bibb, angular, soldered end:
  - .1 Size as indicated, soldered.
  - .2 Cast brass body, PTFE packing, complete with attached tamper proof back flow preventer / vacuum breaker.
  - .3 Aluminum round ridged handle, with PVC coated contact surface. Zinc plated handle nut.

## **2.12 WALL HYDRANT**

- .1 Interior Wall Hydrant, Recessed / Flush Bronze Box:
  - .1 NPS 3/4 (3/4"Ø) wall hydrant.
  - .2 Chrome plated hydrant face, bronze interior parts, "anti-siphon" with integral vacuum breaker, and automatic draining wall hydrant for recessed installation. 1/2 turn ceramic disk replaceable cartridge and combination.
  - .3 Nickel bronze box and hinged cover with operating key lock and "WATER" stamped on cover.

## 2.13 NON-FREEZE WALL HYDRANT

- .1 Non Freeze Exterior Wall Hydrant, Recessed / Flush Bronze Box:
  - .1 NPS 3/4 (3/4"Ø) frost-proof wall hydrant.
  - .2 Chrome plated hydrant face, bronze interior parts, "anti-siphon" with integral vacuum breaker, and automatic draining wall hydrant for recessed installation. 1/2 turn ceramic disk replaceable cartridge and combination.
  - .3 Nickel bronze box and hinged cover with operating key lock and "WATER" stamped on cover.

## 2.14 PRESSURE GAUGES

- .1 Pressure Gauges: 112 mm (4-1/2 ") round dial type, stainless steel bourdon tube having 0.5% accuracy, aluminum case with glass dial cover.
- .2 Scale: black embossed figures on white background indicating dual kPa and PSI pressures. Providing a 0 to 700 kPa (0 to 100 PSI) range with 50 kPa (1 PSI) increments.
- .3 Provide bronze needle valve for isolation.

## 2.15 THERMOMETERS

- .1 Thermometers: industrial type, adjustable angle, with 175 mm (7") molded polyester case and brass stem, non-mercury filled with coloured indication.
- .2 Scale: black embossed figures on white background indicating dual Fahrenheit and Celsius temperatures. Providing a -1 to 115°C (30 to 240°F) range with 1°C (2°F) increments.
- .3 Provide stainless bronze thermometer wells filled with heat conductive paste.

## 2.16 JLR AND OWNER SPECIFIED PRODUCTS

- .1 Refer to Division 00 and 01 for requirements for alternate manufacturer's to those listed below:
- .2 The following are Owner acceptable manufacturers, all others will be rejected unless pre-approved during tender:
  - .1 Valves Kitz, Nibco
  - .2 Backflow Preventors Zurn, Conbraco
  - .3 Trap Primers Zurn, PPP, Milfab
  - .4 Water Hammer arrestors Watts, Zurn
  - .5 Vacuum Breakers Watts, Zurn
  - .6 T&P Relief Valves Watts, Conbraco
  - .7 Hose Bibb Zurn, Watts
  - .8 Pressure Reducing Regulators Zurn, Watts
  - .9 Wall Hydrant Zurn, Watts
  - .10 Non-Freeze Wall Hydrant Zurn, Watts
  - .11 Thermometers and Pressure Gauges Winters, Wika, Weiss
  - .12 Water Meters Endress & Hauser, Emerson Rosemount, Spirax, Sarco
- .3 JLR Specified Products and bases of design: Nil

### **PART 3 - EXECUTION**

#### **3.1 GENERAL**

- .1 Installation shall be in compliance with the AHJ (Authority Having Jurisdiction).
- .2 Remove internal components of valve when soldering or brazing to prevent damage internal components.
- .3 Where pipe sizes differ from connection sizes of equipment, install reducing fittings close to equipment. Reducing bushings are not permitted.

#### **3.2 MANUFACTURER'S INSTRUCTIONS**

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

#### **3.3 PRODUCT SPECIFIC**

- .1 Water Meters:
  - .1 Install as per utility and/or University Metering Standard and instructions and guidelines.
  - .2 All meter location must be accessible and located in a position that allows ease of maintenance and removal without interfering with the meter accuracy or installation practices.
  - .3 Meter shall be installed with proper orientation, up and down stream distances and proper grounding as per manufacturer.
  - .4 Provide all upstream and downstream minimum distances as specified by supplier.
  - .5 To make good on all surroundings after completion of installation of meter.
  - .6 Provide insulation by approved sub-contractor to include meter body, surrounding flanges and unions.
  - .7 Meters, valves, and bypasses should be supported with appropriate adjustable pipe stands. Bricks, concrete or wood blocking are not acceptable means of support.
  - .8 Meter installations must be checked for leakage or contaminants at completion of the installation, the proper operation of the meter should be established.
  - .9 For meters 2 1/2" diameter and larger provide a mechanical flange adapter on the downstream side of the meter to provide flexibility for meter and strainer case removal.
  - .10 All flange connections must be supplied with an asbestos-free gasket material to meet temperature and pressure for service.
  - .11 All documentation and related work shall be provided for the flow rate specified, commissioning, calibration, verification, performance specification and warranty related to the metering device.
- .2 Trap Primers:
  - .1 Install trap seal primers in cold water supply and connect to trap prime connection of drain. Verify automatic water supply action.
  - .2 Install for floor drains and elsewhere, as indicated.
  - .3 Install on cold water supply to nearest frequently used plumbing fixture, in concealed space.

- .4 Install plastic tubing to floor drain. Maintain pressure in tubing during the concrete pour to prevent collapse of the tubing.
- .5 Provide access door for maintenance.
- .3 Water Hammer Arrestors:
  - .1 Install on branch supplies to fixtures or group of fixtures and as indicated.
- .4 Backflow Preventers:
  - .1 Install in accordance with CSA-B64 Series, where indicated and elsewhere as required by code.
  - .2 Provide air gap and vent elbow on backflow preventers and pipe to drain.
- .5 T&P Relief Valves:
  - .1 Pipe discharge to drain.
- .6 Strainers:
  - .1 Install with strainer in the down position.
  - .2 Install with sufficient space for strainer removal.
- .7 Hose Bibb:
  - .1 Install hose bibbs as indicated for interior hose connections.
  - .2 Install at bottom of risers, at low points to drain systems, and as indicated.
- .8 Wall Hydrant:
  - .1 Install hydrant as indicated for interior hose connections.
  - .2 Install 600 mm (24") above floor height unless otherwise noted.
  - .3 Provide Owner with two control keys at time of building takeover
- .9 Non-Freeze Wall Hydrant:
  - .1 Install 600 mm (24") above finished grade unless otherwise noted.
  - .2 Provide Owner with two control keys at time of building takeover
- .10 Pressure Gauges:
  - .1 Provide isolation needle valves to isolate pressure gauge for servicing.
  - .2 Install upstream and downstream of PRVs.
  - .3 Install in other locations as indicated.
- .11 Thermometers:
  - .1 Install in wells on piping. Provide heat conductive material inside well.
  - .2 Install in the following location:
    - .1 Inlet and outlet of heat exchangers.
    - .2 Outlet of DHW tanks.
    - .3 Outlet of DHW mixing valves.
    - .4 In other locations as indicated.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 SCOPE DESCRIPTION SUMMARY**

- .1 The section describes the materials and methods for the installation of sanitary and storm drainage piping within the building.

### **1.2 REFERENCES**

- .1 Unless dated references are identified below, it will be the latest standard issued by the regulatory agency that will be utilized as the applicable reference.
- .2 ASTM International Inc.:
  - .1 ASTM B 32, Standard Specification for Solder Metal.
  - .2 ASTM A74, Standard Specification for Cast Iron Soil Pipe and Fittings.
  - .3 ASTM C 564, Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
  - .4 ASTM A 888, Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications.
  - .5 ASTM C 1277, Standard Specification for Shielded Couplings Joining Hubless Cast Iron Soil Pipe and Fittings.
  - .6 ASTM D 2235, Standard Specification for Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings.
  - .7 ASTM D 2564, Standard Specification for Solvent Cements for Poly (Vinyl-Chloride) (PVC) Plastic Piping Systems.
- .3 Canadian Standards Association (CSA International):
  - .1 CSA B67, Lead Service Pipe, Waste Pipe, Traps, Bends and Accessories.
  - .2 CAN/CSA-B70, Cast Iron Soil Pipe, Fittings and Means of Joining.
  - .3 CAN/CSA-B125.3, Plumbing Fittings.
  - .4 CAN/CSA-B1800, Thermoplastic Non-pressure Pipe Compendium - B1800 Series.
- .4 ANSI Approved / MSS Manufacturers Standardization Society:
  - .1 ANSI/SP-58, Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation.
- .5 Health Canada/Workplace Hazardous Materials Information System (WHMIS):
  - .1 Material Safety Data Sheets (MSDS).
- .6 Part 7 National Building Code.
- .7 Part 7 Ontario Building Code.

### **1.3 INFORMATIONAL SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 01 – Submittals.
- .2 Product Data:
  - .1 Product data will be submitted for all PART 2 – PRODUCTS specified herein.

- .2 Provide manufacturer's printed product literature and datasheets for material specified, and include product characteristics, performance criteria, physical size, finish and limitations.
  - .3 Product data will include all maintenance access points and dimensional clearances, such that the contractor can properly layout the equipment to ensure proper access.
  - .4 Product data will include all relevant information to confirm the specifications have been met.
  - .5 Product data will provide all relevant data and operational points that verify the engineered criteria have been met and that field operational tolerances can be accommodated, i.e., equipment is not supplied that is operating at their upper and lower limits for their design duty performance.
  - .6 Product data will identify all ancillary field installed devices and provide all information required for the coordination of the installation with other trades.
  - .7 Product data will include any relevant information which Division 25 requires for a properly functioning building automation system.
  - .8 Product data will include information as specified in Section 20 01 01 - Common Work Results for Mechanical unless modified with additional information required below.
- .3 Maintenance Data:
- .1 Provide maintenance data including certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties, for incorporation into manuals specified in Section 01 77 01 – Closeout Procedures.
  - .2 Maintenance data will include but not be limited to:
    - .1 Certificates, signed by the manufacturer or their representative, certifying that the materials have been installed as per their installation instructions.
    - .2 The approved shop drawings with performance criteria edited with field observations and commissioned operational set points and adjustments.
    - .3 The manufacturer's maintenance and installation data.
    - .4 Safety informational data for maintenance staff prior to performing maintenance requirements.
    - .5 List of all routine maintenance requirements as well as monthly, annual or other periodical maintenance recommendations from the manufacturer.
    - .6 Any maintenance requirements that may affect the warranty periods of the associated equipment.
- .4 Provide copies WHMIS MSDS - Material Safety Data Sheets in accordance with Division 1 where material specified has MSDS Sheets.

#### **1.4 MAINTENANCE REQUIREMENTS**

- .1 The contractor will verify and demonstrate that proper maintenance can be performed on equipment and material installed.

#### **1.5 QUALITY ASSURANCE**

- .1 Performance Requirements Defined: catalogued or published ratings for manufactured items obtained from tests carried out by manufacturer or those ordered by manufacturer from an independent testing agency signifying adherence to codes and standard and standardized testing of performance criteria.

## **PART 2 - PRODUCTS**

### **2.1 GENERAL**

- .1 The products utilized will be those accepted by the local (AHJ) authority having jurisdiction.

### **2.2 BELOW GRADE DRAINAGE PIPING – BUILDING INTERIOR – PVC**

- .1 All PVC piping, fitting and joining materials will conform to CAN/CSA-B1800 – Applicable Section.
- .2 Buried PVC (polyvinyl chloride) drain, solvent weld bell, waste and vent pipe and fittings. Pipe will be schedule 40 solid wall pipe, intended for use in a non-pressurized piping systems where the fluid conveyed does not exceed 60°C (140°F).
- .3 Fittings: PVC solvent weld bell type, same material as the piping.
- .4 Joints: Solvent Weld Type: pipe joint to be an integral bell used for solvent weld. Plastic solvent cement adhesive resin will be approved by the pipe manufacturer.

### **2.3 ABOVE GRADE DRAINAGE PIPING – DWV COPPER**

- .1 Above grade DWV copper, sanitary and vent, will be Type DWV copper pipe and will conform to ASTM B 306, intended for use in a non-pressurized application.
- .2 Fittings: wrought copper conforming to CAN/CSA-B125.3.
- .3 Joints: soldered connections utilizing lead free, 95-5 tin-antimony solder: to ASTM B 32.

### **2.4 ABOVE GRADE DRAINAGE PIPING – FIRE RATED PVC**

- .1 This PVC piping will not be installed within a vertical service space.
- .2 All PVC piping, fittings and joining materials will conform to CAN/CSA-B1800 – applicable section.
- .3 Above grade PVC (polyvinyl chloride) drain, solvent weld bell, waste and vent pipe and fittings. Pipe will be schedule 40 solid wall pipe, intended for use in a non-pressurized piping systems where the fluid conveyed does not exceed 60°C (140°F). The pipe will be tested to ULC S102.2 and will have a Flame spread rated of not greater than 25 and a Smoke Development of not greater than 50.
- .4 Fittings: PVC solvent weld bell type, same material as the piping.
- .5 Joints: Solvent Weld Type: pipe joint to be an integral bell used for solvent weld. Plastic solvent cement adhesive resin will be approved by the pipe manufacturer.
- .6 Fire Stops: fire stops will be installed when PVC piping penetrates a fire rated assembly. The fire stops will be factory produced and ULC listed for the appropriate size of hole and size of pipe. Fire stops will consist of a steel collar, attached to the structure, enclosing sufficient intumescent fire stop sealant to expand and close the pipe opening in the event of a fire. Prior to installation of the fire stop the appropriate fire stopping of the interstitial space has been completed and an appropriate escutcheon plate has been installed.

## **PART 3 - EXECUTION**

### **3.1 GENERAL**

- .1 Support piping in accordance with the AHJ (Authority Having Jurisdiction), the Building Code, and the manufacturer's requirements.
- .2 System will be installed using industry best practices for pipe installation and run parallel to building lines. Refer to Section 20 05 05 – Installation of Pipe for piping layout and methodology.
- .3 All drainage piping will be sloped minimum, 1:50 (1/4" per foot), unless otherwise indicated on the drawings. Prior to installation of pipe runs, coordinate piping locations and height to determine if an interference exists with other trades.
- .4 Provide all clean outs as required for drainage piping installation and in accordance with the building code.
- .5 Provide all vent piping as required in accordance with the building code and proper system operation.

### **3.2 MANUFACTURER'S INSTRUCTIONS**

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

### **3.3 BELOW GRADE PIPE INSTALLATION**

- .1 Provide trenching and backfilling to ensure uniform and continuous support of pipe in accordance with manufacturer's requirements. Where continuous support cannot be provided due to soil conditions provide a hanger support system from the structure above as required for an above ground installation.
- .2 Maintain proper alignment and sloping during backfill and concrete pour operations.
- .3 Prior to back filling, testing of the piping will be completed and inspection of the pipe by the AHJ will be completed.
- .4 Excavate the trench in accordance with applicable codes and regulations, ensuring that the sides will be stable under all working conditions. The trench should be wide enough to provide adequate room for the following:
  - .1 Joining the pipe in the trench;
  - .2 Filling and compacting the side fills.
- .5 The space between the pipe and trench wall must be wider than the compaction equipment used in the compaction of the backfill. Minimum width will be not less than the greater of either the pipe outside diameter plus 400 mm (16") or the pipe outside diameter times 1.25 plus 300 mm (12"). Trench width may be different if approved.

- .6 Sub-soil conditions vary. The pipe backfill should be stable and provide protection for the pipe. The base of the pipe will be compacted sand. The pipe should be surrounded with Grade "A" aggregate material which is easily worked around the sides of the pipe. Backfilling should be performed in layers of 150 mm (6") with each layer being sufficiently compacted to 85% compaction. A mechanical tamper is recommended for compacting sand and gravel backfill which contain a significant proportion of fine-grained material, such as silt and clay. If a tamper is not available, compacting should be done by hand.
- .7 The trench should be completely filled. The backfill should be placed and spread in uniform layers to prevent any unfilled spaces or voids. Large rocks, stones, frozen clods, or other large debris should be removed. Heavy tampers or rolling equipment should only be used to consolidate only the final backfill.

### **3.4 SYSTEM VERIFICATION**

- .1 Cleanouts:
  - .1 Ensure accessible and that access doors are correctly located.
  - .2 Open, cover with linseed oil and reseal.
  - .3 Verify cleanout rods can probe as far as the next cleanout, at least.
- .2 Test to ensure traps are fully and permanently primed.
- .3 Storm water drainage:
  - .1 Verify domes are secure.
  - .2 Ensure weirs are correctly sized and installed correctly.
  - .3 Verify provisions for movement of roof system.
- .4 Ensure fixtures are properly anchored, connected to system and effectively vented.

### **3.5 SYSTEM TESTING**

- .1 Coordinate with authority having jurisdiction the requirement of the authority to witness tests and inspect piping system. Smoke, Ball, and Pressure test systems to the requirements of the Authority having Jurisdiction.
- .2 Perform a Ball Test: roll a hard dense non-floating ball (minimum 50 mm (2") diameter down the pipe and retrieve at the end. Ball should roll freely without assistance.
- .3 Leak test buried systems before backfilling. When testing, the system should be properly restrained at all bends, changes of direction, and the end of runs.
- .4 Submit piping system to a hydrostatic test equivalent to 3M (10') head. Examine each joint visually to ensure system is leakproof. Maintain original water level without replenishing for 1 hour. No water may leak from connections in system during test.
- .5 Contractor to complete installation inspection, integrity (pressure leak) tests and support system inspection of piping system before system is insulated or enclosed. Piping not to be covered until all inspection and testing deficiencies have been corrected and successful re-testing has been completed.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 SCOPE DESCRIPTION SUMMARY**

- .1 This section shall describe specialty equipment utilized for the installation of the sanitary waste system.

### **1.2 REFERENCES**

- .1 Unless dated references are identified below, it shall be the latest standard issued by the regulatory agency that shall be utilized as the applicable reference.
- .2 In addition to those listed below, individual product specifications refer to specific references for that product.
- .3 Part 7 National Building Code.
- .4 Part 7 Ontario Building Code.
- .5 CSA International:
  - .1 CSA B79, Commercial and Residential Drains and Cleanouts.

### **1.3 INFORMATIONAL SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 01 – Submittals.
- .2 Product Data:
  - .1 Product data shall be submitted for all PART 2 – PRODUCTS specified herein.
  - .2 Provide manufacturer's printed product literature and datasheets for material specified, and include product characteristics, performance criteria, physical size, finish and limitations.
  - .3 Product data shall include all maintenance access points and dimensional clearances, such that the contractor can properly layout the equipment to ensure proper access.
  - .4 Product data shall include all relevant information to confirm the specifications have been met.
  - .5 Product data shall provide all relevant data and operational points that verify the engineered criteria have been met and that field operational tolerances can be accommodated, i.e., equipment is not supplied that is operating at their upper and lower limits for their design duty performance.
  - .6 Product data shall identify all ancillary field installed devices and provide all information required for the coordination of the installation with other trades.
  - .7 Product data shall include any relevant information which Division 25 requires for a properly functioning building automation system.
  - .8 Product data shall include information as specified in Section 20 01 01 – Common Work Results for Mechanical unless modified with additional information required below.
- .3 Maintenance Data:
  - .1 Provide maintenance data including certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties, for incorporation into manuals specified in Section 01 77 01 – Closeout Procedures.

- .2 Maintenance data shall include but not be limited to:
  - .1 The manufacturer's maintenance and installation data.
  - .2 Safety informational data for maintenance staff prior to performing maintenance requirements.
  - .3 List of all routine maintenance requirements as well as monthly, annual or other periodical maintenance recommendations from the manufacturer.
  - .4 Any maintenance requirements that may affect the warranty periods of the associated equipment.

#### **1.4 MAINTENANCE REQUIREMENTS**

- .1 The contractor shall verify and demonstrate that proper maintenance can be performed on equipment and material installed.

#### **1.5 QUALITY ASSURANCE**

- .1 Performance Requirements Defined: catalogued or published ratings for manufactured items obtained from tests carried out by manufacturer or those ordered by manufacturer from an independent testing agency signifying adherence to codes and standard and standardized testing of performance criteria.
- .2 Electrical Equipment shall bear a CSA label or have an ESA certification.
- .3 Where applicable equipment shall bear a ULC or UL label.

### **PART 2 - PRODUCTS**

#### **2.1 GENERAL**

- .1 The products utilized shall be those accepted by the local AHJ (Authority Having Jurisdiction).
- .2 Provide drainage piping specialties as required and as specified to meet the installation requirements of the plumbing drainage systems.
- .3 All drains and cleanouts shall conform to CSA B79 - Commercial and Residential Drains and Cleanouts.

#### **2.2 FLOOR DRAINS**

- .1 General Duty:
  - .1 Cast iron epoxy coated body, with anchor flange and NPS ½ (1/2"Ø) trap seal primer connection.
  - .2 Outlet, no hub mechanical joint connection. Size as indicated, minimum NPS 3 (3"Ø) for below grade piping connections.
  - .3 Cast iron epoxy coated, reversible membrane clamp with weep holes. Coordinate with Division 9 and flooring supplier to ensure suitability with flooring membrane, if required.
  - .4 Adjustable head and 150 mm (6") diameter round nickel bronze strainer.

- .5 Complete with the following:
  - .1 Sediment basket.
  - .2 Vandal-proof and secured grate.
  - .3 Recessed flooring tile flange.
- .2 Combination Funnel Drain / Floor Drain:
  - .1 Cast iron epoxy coated body, with anchor flange and NPS ½ (1/2"Ø) trap seal primer connection.
  - .2 Outlet, no hub mechanical joint connection. Size as indicated, minimum NPS 3 (3"Ø) for below grade piping connections.
  - .3 Cast iron epoxy coated, reversible membrane clamp with weep holes.
  - .4 Adjustable head and 150 mm (6") diameter round nickel bronze strainer and 100 mm x 225 mm (4"x9") oval bronze funnel.
- .3 Elevator Pit Drain:
  - .1 Cast iron epoxy coated body, with anchor flange.
  - .2 Side outlet, no hub mechanical joint connection. NPS 3 (3"Ø) for below grade piping connections.
  - .3 Cast iron epoxy coated, reversible membrane
  - .4 Cast iron epoxy coated, sloping grate.
  - .5 Complete with the following;
    - .1 Backwater valve, accessible for servicing thru grate.

## 2.3 ROOF DRAINS

- .1 Roof Drain, Built Up Roofing, Full Flow:
  - .1 Cast iron epoxy coated body with deep sump, wide serrated flashing flange, flashing clamp and integral gravel stop. Outlet size as indicated.
  - .2 Provide under deck clamp, adjustable extension, and sump receiver flange for waterproofing and drain anchoring.
  - .3 Large Area Drain: 300 mm (12") diameter at the base, aluminum self-locking mushroom dome.
  - .4 Small Area Drain: 175 mm (7") diameter at the base, aluminum self-locking mushroom dome.

## 2.4 CLEAN OUTS

- .1 Cleanout Plugs: heavy cast iron male ferrule with brass screws and threaded brass or bronze plug. Sealing-caulked lead seat or neoprene gasket.
- .2 Access Covers:
  - .1 Wall Access: face or wall type, polished nickel bronze square cover with flush head securing screws, bevelled edge frame complete with anchoring lugs.
  - .2 Floor Access: round cast iron body and frame with adjustable secured nickel bronze top.
- .3 Unfinished Concrete Floors: cast iron round or square, gasket, vandal-proof screws.
- .4 Cover for Tile and Linoleum Floors: polished nickel bronze with recessed cover for linoleum or tile infill, complete with vandal-proof locking screws.
- .5 Cover for Carpeted Floors: polished nickel bronze with deep flange cover for carpet infill, complete with carpet retainer vandal-proof locking screws.

## **2.5 JLR AND OWNER SPECIFIED PRODUCTS**

- .1 Refer to Division 00 and 01 for requirements for alternate manufacturer's to those listed below:
- .2 The following are Owner acceptable manufacturers, all others will be rejected unless pre-approved during tender:
  - .1 Floor Drains: Watts, Zurn, Milfab, Jay Smith
  - .2 Roof Drains: Watts, Zurn, Milfab, Jay Smith
  - .3 Clean-outs: Watts, Zurn, Milfab, Jay Smith
- .3 JLR Specified Products and bases of design: Nil

## **PART 3 - EXECUTION**

### **3.1 GENERAL**

- .1 Installation shall be in compliance with the AHJ (Authority Having Jurisdiction).

### **3.2 MANUFACTURER'S INSTRUCTIONS**

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

### **3.3 PRODUCT SPECIFIC**

- .1 Floor Drains:
  - .1 Provide floor drains with trap seal primers.
  - .2 Coordinate installation with floor construction. Equip floor drains with seepage flange where floor is of waterproof construction.
  - .3 Equip each floor drain with 0.15 mm (6 mil) polyethylene sheeting under strainer to prevent dirt from entering the system during construction. Remove polyethylene only after final cleanup.
  - .4 Verify operation of trap seal primer.
  - .5 Prime, using trap primer. Adjust flow rate to suit site conditions.
  - .6 Cleanout baskets.
- .2 Roof Drains:
  - .1 Coordinate roof drain installation with Division 7 Roofing Contractor. Supply roof drains to installer for mounting in roof deck.
  - .2 Make bolts for under deck clamp compatible with roof thickness.
  - .3 Adjust weirs to suit actual roof slopes, meet requirements of design.
  - .4 Clean out sumps.
- .3 Cleanouts:
  - .1 Install cleanouts at base of soil and waste stacks and rainwater leaders at locations required code, and as indicated.
  - .2 Bring cleanouts to wall or finished floor unless serviceable from below floor.
  - .3 Provide clean out at sanitary discharge from building.
  - .4 Ensure access doors are provided and the clean outs can be properly accessed.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 SUMMARY**

- .1 Section includes:
  - .1 Materials and installation for piping, fittings, equipment used in compressed air systems
- .2 The requirements for compressed air are connection to an existing CA main which is currently not identified on the drawings, this system will be located following demolition of ceilings and designated substances. The contractor will then connect to the existing system and provide a NPS ¾ (¾ "dia) valved quick connect connection and piping to a location near each chilled water coil within the penthouse.

### **1.2 REFERENCES**

- .1 American Society of Mechanical Engineers (ASME)
  - .1 ASME B16.5-03, Pipe Flanges and Flanged Fittings.
  - .2 ASME B16.11-01, Forged Fittings, Socket-Welding and Threaded.
- .2 American Society for Testing and Materials International (ASTM)
  - .1 ASTM A 53/A 53M-04, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
  - .2 ASTM A 181/A 181M-01, Standard Specification for Carbon Steel Forgings for General Purpose Piping.
- .3 Canadian Standards Association (CSA International)
  - .1 CSA B51-03, Boiler, Pressure Vessel, and Pressure Piping Code.

### **1.3 INFORMATIONAL SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 01 – Submittals.
- .2 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications and datasheet for piping, fittings and equipment.
- .3 Shop Drawings:
  - .1 Submit shop drawings to indicate project layout including layout, dimensions and extent of piping system. Submit drawings stamped and signed by professional engineer licensed in Province of Ontario, Canada.
    - .1 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.

### **1.4 MAINTENANCE REQUIREMENTS**

- .1 The contractor shall verify and demonstrate that proper maintenance can be performed on equipment and material installed.

## **1.5 QUALITY ASSURANCE**

- .1 Performance Requirements Defined: catalogued or published ratings for manufactured items obtained from tests carried out by manufacturer or those ordered by manufacturer from an independent testing agency signifying adherence to codes and standard and standardized testing of performance criteria.

## **PART 2 - PRODUCTS**

### **2.1 PIPING**

- .1 Piping: to ASTM A 53/A 53M, schedule 80 seamless black steel.
- .2 Fittings:
  - .1 NPS 2" and smaller: to ASME B16.11, schedule 80 steel, screwed.
- .3 Couplings: to ASME B16.11, threaded half coupling type.
- .4 Unions: 1000 kPa malleable iron with brass-to-iron ground seat.

### **2.2 BALL VALVES**

- .1 To ASTM A 181/A 181M, Class 70, carbon steel body socket welded or screwed ends, stainless steel ball and associated trim suitable for compressed air application.
- .2 To withstand 1034 kPa maximum pressure
- .3 Owner Specified Product: Kitz or Nibco.

### **2.3 COUPLERS/CONNECTORS**

- .1 Industrial interchange series, full-bore.
- .2 Maximum inlet pressure: 1700 kPa.
- .3 Valve seat: moulded nylon.
- .4 Body: zinc plated steel.
- .5 Threads: NPT.

## **PART 3 - EXECUTION**

### **3.1 MANUFACTURER'S INSTRUCTIONS**

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

### **3.2 COMPRESSED AIR PIPING CONNECTIONS AND INSTALLATION**

- .1 Install shut-off valves at outlets, major branch lines and in locations as indicated.
- .2 Install quick-coupler chucks and pressure gauges on drop pipes.
- .3 Install unions to permit removal or replacement of equipment.
- .4 Grade piping at 1% slope minimum.
- .5 Make branch connections from top of main.
- .6 Install compressed air trap at bottom of risers and at low points in mains, piped to nearest drain. Distance between drain points to be 30 m maximum.

### **3.3 FIELD QUALITY CONTROL**

- .1 Site Tests/Inspection:
  - .1 Testing: pressure test as per requirements of Section 20 01 01– Common Work Results Mechanical, for 4 hours minimum, to 1100 kPa with outlets closed. Pressure drop not to exceed 10 kPa.
- .2 Manufacturer's Field Services:
  - .1 Obtain reports within 3 days of review and submit immediately to Consultant.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 SCOPE DESCRIPTION SUMMARY**

- .1 This section will describe the domestic water heaters and water heater accessories to be provided.

### **1.2 REFERENCES**

- .1 Unless dated references are identified below, it shall be the latest standard issued by the regulatory agency that shall be utilized as the applicable reference.
- .2 ASHRAE American Society of Heating, Refrigeration and Air Conditioning Engineers:
  - .1 ASHRAE 90.1 - Energy Standard for Buildings Except Low-Rise Residential Buildings
- .3 American Society of Mechanical Engineers (ASME).
- .4 American National Standards Institute/NSF International (ANSI)/NSF:
  - .1 ANSI/NSF 61, Drinking Water System Components – Health Affects

### **1.3 INFORMATIONAL SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 01 - Submittals.
- .2 Product Data:
  - .1 Product data shall be submitted for all PART 2 – PRODUCTS specified herein.
  - .2 Provide manufacturer's printed product literature and datasheets for material specified, and include product characteristics, performance criteria, physical size, finish and limitations.
  - .3 Product data shall include all maintenance access points and dimensional clearances, such that the contractor can properly layout the equipment to ensure proper access.
  - .4 Product data shall include all relevant information to confirm the specifications have been met.
  - .5 Product data shall provide all relevant data and operational points that verify the engineered criteria have been met and that field operational tolerances can be accommodated, i.e., equipment is not supplied which is operating at their upper and lower limits for their design duty performance.
  - .6 Product data shall identify all ancillary field installed devices and provide all information required for the coordination of the installation with other trades.
  - .7 Product data shall include any relevant information which Division 25 requires for a properly functioning building automation system.
  - .8 Product data shall include information as specified in Section 20 01 01 - Common Work Results for Mechanical unless modified with additional information required below.
- .3 Maintenance Data:
  - .1 Provide maintenance data including certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties, for incorporation into manuals specified in Section 01 77 01 – Close-out.
  - .2 Maintenance data shall include but not be limited to:
    - .1 Certificates, signed by the manufacturer or their representative, certifying that the materials have been installed as per their installation instructions.
    - .2 The approved shop drawings with performance criteria edited with field observations and commissioned operational set points and adjustments.

- .3 The manufacturer's maintenance and installation data.
  - .4 Safety informational data for maintenance staff prior to performing maintenance requirements.
  - .5 List of all routine maintenance requirements as well as monthly, annual or other periodical maintenance recommendations from the manufacturer.
  - .6 Any maintenance requirements that may affect the warranty periods of the associated equipment.
- .4 Provide copies WHMIS MSDS - Material Safety Data Sheets in accordance with Division 1 where material specified has MSDS Sheets.

#### **1.4 MAINTENANCE REQUIREMENTS**

- .1 The contractor shall verify and demonstrate that proper maintenance can be performed on equipment and material installed.

#### **1.5 QUALITY ASSURANCE**

- .1 Performance Requirements Defined: Catalogued or published ratings for manufactured items obtained from tests carried out by manufacturer or those ordered by manufacturer from an independent testing agency signifying adherence to codes and standard and standardized testing of performance criteria.
- .2 Electrical equipment shall bear a CSA label or have an ESA certification.
- .3 Fuel fired equipment shall bear a CSA label and a CGA or AGA label.
- .4 Where applicable equipment shall bear a ULC or UL label.

#### **1.6 COMMISSIONING**

- .1 Plumbing equipment shall be commissioned in accordance with Section 20 08 02 – Commissioning – Cleaning and Start-up of Mechanical Systems.
- .2 The commissioning shall verify that the equipment is installed in accordance with the manufacturer's requirements and that the equipment has been adjusted to conform to the design performance.
- .3 Manufacturer's factory trained and certified staff to start-up and commission gas fired water heaters.

#### **1.7 TRAINING**

- .1 The maintenance staff shall be instructed on the required maintenance schedule as well as the proper maintenance requirements and procedures for the equipment installed.
- .2 The training shall inform the maintenance staff of any applicable warranties the manufacturer provides for defective material.

#### **1.8 WARRANTY**

- .1 For the Work of this Section, the 12 months contractor warranty period is extended to number of years specified for each product.
- .2 The warranty shall be inclusive of the installing contractor's labour for replacement of defective products.

## **PART 2 - PRODUCTS**

### **2.1 GENERAL**

- .1 The products utilized shall be those accepted by the local AHJ (Authority Having Jurisdiction).
- .2 Provide water heaters as required and as specified to meet the water heating requirements of the plumbing distribution systems.
- .3 Water storage systems shall operate at 60°C (140°F) to prevent the growth of legionella bacteria. Mixing valves shall be provided downstream of the water storage tanks to limit the discharge temperature to 45°C (115°F).

### **2.2 SEMI-INSTANTANEOUS DOMESTIC HOT WATER HEATER – STEAM TO WATER SHELL AND TUBE HEAT EXCHANGER**

- .1 Semi-instantaneous shell and tube water heater assembly, heat exchangers shall be vertical, constructed according to ASME Boiler and Pressure Vessel Code and complying with ASHRAE 90.1
- .2 Based on design and Specified Product: Digital-Flo® DFS-Semi Instantaneous Domestic Hot Water Heater DFS35DW40, 27 USGPM @ 100°F Delta T. (x2) mounted in series with bypass for a duty standby installation.
- .3 The assembly shall be pre-piped steam to water semi-instantaneous shell and tube water heater assembly with performance matched components and pressure tested before delivery. The semi-instantaneous shell and tube water heater shall be of double wall construction with 5/8" 90/10 Copper/Nickel U-tubes expanded into stainless steel tube sheets with steam in the tubes and water in the shell. Heat exchanger will be fixed on one end of the shell and free floating on the opposite end designed and manufactured in accordance with ASME Code Section VIII.
- .4 Temperature controller (DRV) shall be digital using integrated circuit board technology designed to deliver blended water economically at a safe, accurate temperature for sanitary use in re-circulated hot water systems. The DRV shall have a 2 line, 16 character display of delivered temperature with the option of °F or °C. Display also shows the error codes and alarm conditions. DRV shall be compliant with ASSE Standard 1017 and CSA B125, UL listed and so certified and identified. The controller shall be connected to the EMCS system and provide full functional control thru the EMCS connection.
- .5 The skid shall also be equipped with additional SS thermowells for monitoring of the system by the EMCS system.
- .6 The assembly shall comprise domestic side check valves, strainers, DRV, thermometers, ball valves with stainless steel ball and stem, safety shut-off valve, shell and tube exchanger insulated with 2" of Aspen Aerogel Pyrogel and aluminum jacket, all pre-piped with type L copper on a fabricated carbon steel heavy duty frame with machine grade enamel paint, Armstrong Float and Thermostatic steam trap. Shell side recirculation pump to keep the water moving in the shell and over the temperature sensing bulb. The piping and fittings in this pump line to be stainless steel.
- .7 Complete assembly to be Lead Free compliant
- .8 An Armstrong OB-2000 shall modulate the steam pressure on system to keep the hot water entering the DRV to be less than 250 deg. F. Designed to generate 30 GPM with a 40°F entering cold water temperature, a 140°F hot water outlet utilizing 10 PSIG steam.

- .9 Water heater assembly shall have all of the following operational capabilities:
  - .1 +/- 2°F water temperature control from 0 to full system demand.
  - .2 2°F minimum inlet to outlet water temperature differential.
  - .3 Automatic shutoff of hot water flow upon cold water inlet supply failure.
  - .4 Automatic shutoff of hot water flow in the event of a power failure.
  - .5 Programmable set point range of 81-158°F (27-70°C).
  - .6 Programmable 1st level hi/lo temp alarm display.
  - .7 Programmable error temperature error level for double safety shutdown.
  - .8 LCD display which indicates: set point, delivered temperature, error codes and alarm conditions.
  - .9 Isolation valves and clean in place connections to chemically clean the exchanger without disassembly of the exchanger.
    - .1 ¼" domestic side pressure relief pop-off valve with 165 psig crack pressure. Self-seating.
- .10 Water heater assembly shall have the following connectivity capabilities:
  - .1 SPCO relay outputs which are energized during operation.
  - .2 Temperature transmitter installed on the mixed water outlet for direct connectivity to the BAS for read only monitoring of the mixed water temperature.
- .11 Warranty: Pre-package skid shall have a 2 year warranty from date of installation but not longer than 27 months from date of shipment. DRV shall have a 5-year all components parts warranty.

## **2.3 DOMESTIC WATER EXPANSION TANKS**

- .1 Vertical mounted, steel pressurized diaphragm type expansion tank with polypropylene liner for containment of domestic hot water. Heavy Duty Butyl diaphragm suitable for 82°C (180°F) operation. Unit shall be built for 1035 kPa (150 PSI) working pressure. Factory pre-charged to 380 kPa (55 PSI). ASME rated.

## **2.4 DOMESTIC WATER TEMPERING MIXING VALVES**

- .1 NPS ¾ - NPS 2 (3/4"Ø – 2"Ø) Thermostatic mixing valve for tempered water system with check stops.
- .2 Lead free cast bronze or brass body utilizing a paraffin-based thermostat to sense and adjust outlet temperature. Valve shall be approved to ASSE 1017 & CSA B125.3 standards:
  - .1 Temperature Adjustment Range: 32 - 82°C (90 - 180°F).
  - .2 Hot Water Inlet Temperature Range: 42 - 82°C (120 - 180°F).
  - .3 Cold Water Inlet Temperature Range; 4 - 27°C (40 - 80°F).
  - .4 Complete with fail-safe cold water bypass mode.
  - .5 Outlet temperature maintained between +/- 1.2°C.

## **2.5 JLR AND OWNER SPECIFIED PRODUCTS**

- .1 Refer to Division 00 and 01 for requirements for alternate manufacturers to those listed below:
- .2 The following are Owner acceptable manufacturers, all others will be rejected unless pre-approved during tender:
  - .1 Water Heater Preston Phipps, Patterson Kelly
  - .2 Domestic Water Expansion Tank Amtrol, B&G, Armstrong
  - .3 Domestic Water Mixing Valve Bradley Navigator, Preston Phipps "Brain"
- .3 JLR Specified Products and bases of design: Nil

## **PART 3 - EXECUTION**

### **3.1 GENERAL**

- .1 Installation shall be in compliance with the AHJ (Authority Having Jurisdiction).
- .2 Where pipe sizes differ from connection sizes of equipment, install reducing fittings close to equipment. Reducing bushings are not permitted.
- .3 Install water heaters on a metal frame pad, height sufficient to permit condensate piping connections and maintenance. Size anchor bolts to withstand seismic zone acceleration and velocity forces.
- .4 Pipe temperature and pressure relief valve discharge to funnel floor drain.
- .5 Provide inlet and outlet isolation and locked bypass valve around hot water storage tanks connected in series.

### **3.2 MANUFACTURER'S INSTRUCTIONS**

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 REFERENCES**

- .1 Unless dated references are identified below, it shall be the latest standard issued by the regulatory agency that shall be utilized as the applicable reference.
- .2 In addition to those listed below, individual product specifications refer to specific references for that product.
- .3 Canadian Standards Association (CSA International):
  - .1 CAN/CSA-B45 Series - Plumbing Fixtures.
  - .2 CAN/CSA-B125.3 - Plumbing Fittings.
  - .3 CAN/CSA-B651, Accessible Design for the Built Environment.

### **1.2 INFORMATIONAL SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Product data shall be submitted for all PART 2 – PRODUCTS specified herein.
  - .2 Provide manufacturer's printed product literature and datasheets for material specified, and include product characteristics, performance criteria, physical size, finish and limitations.
  - .3 Product data shall include all maintenance access points and dimensional clearances, such that the contractor can properly layout the equipment to ensure proper access.
  - .4 Product data shall include all relevant information to confirm the specifications have been met.
  - .5 Product data shall provide all relevant data and operational points that verify the engineered criteria have been met and that field operational tolerances can be accommodated, i.e., equipment is not supplied that is operating at their upper and lower limits for their design duty performance.
  - .6 Product data shall identify all ancillary field installed devices and provide all information required for the co-ordination of the installation with other trades.
  - .7 Product data shall include any relevant information which Division 25 requires for a properly functioning building automation system.
- .3 Maintenance Data:
  - .1 Provide maintenance data including certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties, for incorporation into manuals specified in Section 01 78 00 - Closeout Submittals.
  - .2 Maintenance data shall include but not be limited to:
    - .1 Certificates, signed by the manufacturer or their representative, certifying that the materials have been installed as per their installation instructions.
    - .2 The manufacturer's maintenance and installation data.
    - .3 Safety informational data for maintenance staff prior to performing maintenance requirements.
    - .4 List of all routine maintenance requirements as well as monthly, annual or other periodical maintenance recommendations from the manufacturer.
    - .5 Any maintenance requirements that may affect the warranty periods of the associated equipment.

### 1.3 QUALITY ASSURANCE

- .1 Performance Requirements defined: Catalogued or published ratings for manufactured items obtained from tests carried out by manufacturer or those ordered by manufacturer from an independent testing agency signifying adherence to codes and standard and standardized testing of performance criteria.
- .2 Electrical equipment shall bear a CSA label or have an ESA certification.
- .3 Where applicable equipment shall bear a ULC or UL label.

## **PART 2 - PRODUCTS**

### 2.1 GENERAL

- .1 The products utilized shall be those accepted by the local AHJ (Authority Having Jurisdiction).
- .2 Fixtures, trim and accessories to be new, free from imperfections and labelled with CSA mark of approval.
- .3 Plumbing fixtures of a kind, to be product of one manufacturer and white unless otherwise noted.
- .4 All exposed piping shall be chrome plated and chrome plated escutcheon plates shall be provided at wall pipe penetrations.
- .5 All barrier-free fixtures and trim shall comply with CSA B651 - Accessible design for the built environment.

### 2.2 FIXTURE MAXIMUM FLOW RATES

- .1 Fixtures shall meet or be less than the code required maximum flow rates, or the flow rates identified below, whichever is less. With the exception of fixtures identified as an "ultra-low flow fixture" with a specified maximum flow.
  - .1 Water Closets 6.0 litre/flush (1.58 GPF)
  - .2 Urinals 1.9 litre/flush (0.50 GPF)
  - .3 Lavatory Faucet 8.35 litre/minute (2.20 GPM)
  - .4 Kitchen Faucet 8.35 litre/minute (2.20 GPM)
  - .5 Shower Heads 9.5 litre/minute (2.50 GPM)
  - .6 Residential Showers 7.6 litre/minute (2.50 GPM).

### 2.3 WATER CLOSETS

- .1 General requirements for all specified Water Closets:
  - .1 Water closets shall comply with ASME A112.19.2 / CSA B45.1 - Ceramic Plumbing Fixtures.
  - .2 Water closets shall be vitreous china construction.
  - .3 Water closet bowls shall be elongated unless otherwise identified and complete with integral P-trap.

- .4 Floor mounted water closets, top of bowl rim shall measure between 381 mm (15") and 420 mm (16.5").
- .5 Fixtures shall operate with a minimum 175 kPa (25 PSI) water pressure. Flush valves shall operate with a minimum 310 kPa (45 PSI) water pressure.
- .6 All exposed piping shall be chrome plated and chrome plated escutcheon plates shall be provided at wall pipe penetrations.
- .7 All toilet seats shall be molded solid plastic and white unless otherwise identified. Toilet seats shall have stainless steel check hinges, and solid brass insert post with brass nut.
- .8 Refer to drawings schedule of fixtures.
- .2 Flush Assembly Options:
  - .1 Type 2: flush valve, polished chrome, oscillating handle manual operation, vandal proof, externally adjustable flow, diaphragm type with NPS 1 (1" diameter) water supply. Complete with screwdriver angle stop, connection and coupling for NPS 1½ (1½" diameter) top spud, wall and spud flanges with seat bumper and vacuum breaker.
- .3 Toilet Seat Options:
  - .1 Type A: Elongated, open front, less cover.
- .4 Water Closet Type WC1 – Flush Valve / Floor Mounted / Top Spud:
  - .1 Barrier-free design, bowl lip and seat combined height of between 410 mm (16") and 450 mm (18").
  - .2 Bowl: siphon jet flush action.
  - .3 Type 2 flush assembly.
  - .4 Type A seat.
  - .5 Complete with closet carrier.

## 2.4 LAVATORIES

- .1 General requirements for all specified lavatories:
  - .1 Vitreous china lavatories shall comply with ASME A112.19.2 / CSA B45.1 - Ceramic Plumbing Fixtures.
  - .2 Porcelain enameled steel lavatories shall comply with ASME A112.19.1 / CSA B45.2 - Enameled Cast Iron and Enameled Steel Plumbing Fixtures.
  - .3 Stainless steel lavatories shall comply with ASME A112.19.3 / CSA B45.4 - Stainless Steel Plumbing Fixtures.
  - .4 All plumbing trim shall comply with ASME A112.18.1 / CSA B125.1 - Plumbing Supply Fittings.
  - .5 All plumbing waste fittings shall comply with ASME A112.18.2 / CSA B125.2 - Plumbing Waste Fittings.
  - .6 All lavatories shall be equipped with a front or back overflow.
  - .7 Countertop fixtures shall be complete with swivel clamps.
  - .8 All trim shall be lead free and comply with ANSI / NSF Standard 61.
  - .9 Trim with flexible tubing between fixture and isolation valves. Tubing shall be EPDM hose with external braided metal and brass connectors.
  - .10 Trim shall operate with a minimum 175 kPa (25 PSI) water pressure.

- .11 Supplies to fixture shall be equipped with isolation valves. All exposed piping shall be chrome plated and chrome plated escutcheon plates shall be provided at wall pipe penetrations. Provide tubing to connect to fixture, EPDM hose with external braided metal and brass connectors.
  - .12 All lavatories shall be equipped with a NPS 1 ¼ (1 ¼" diameter) metal drain and P-Trap. P-Traps shall be equipped with unions for removal of trap. P-Traps shall be chrome plated where exposed. P-Traps shall be set back recessed style for barrier-free installations and all drainage piping shall be insulated for barrier-free installation.
  - .13 Refer to drawings schedule of fixtures.
- .2 Trim / Drain Options:
- .1 Type 1: automatic electronic control, single faucet hole. Electronic faucet suitable for barrier-free operation electrically powered. Activation of valve by electronic, sensor proximity type, activated by infra-red. Waterproof, with impact-resistant, anti-scratch coated plastic lens, sensitivity adjustable from 100 mm – 450 mm (4" – 18").
    - .1 Construction: polished chrome, with NPS ½ (1/2" diameter) water supply. Power: 24V operation, powered from 120V / 24V transformer sized and provided by the contractor. Wiring between transformer and valves by Division 22.
    - .2 Single hole.
    - .3 Barrier-free compliant
    - .4 Standard Flow Aerator: low flow orifice where required by lavatory type.
    - .5 Standard stainless steel drain strainer.
  - .3 Wall Mounted Lavatory Support System: lavatory carriers, floor mounted tubular steel construction concealed carrier to match lavatory supplied. Adjustable height, with extensions and bolt connections suitable for wall depth. Unit shall be capable of supporting 136 kg (300 lbs.). Urinal shall be mounted with lavatory lip 850 mm (34") AFF for adults and 725 mm (29") AFF for children and 800 mm (32") AAF for barrier-free applications.
  - .4 Lavatory Type L1:
    - .1 Description: countertop.
    - .2 Material: vitreous china.
    - .3 Trim: Type 1 barrier-free design.
    - .4 Architectural Notes: traditional STYLE, oval BOWL, white.
  - .5 Lavatory Type L2:
    - .1 Description: wall hung with integral back.
    - .2 Material: vitreous china.
    - .3 Wall mounted lavatory support system.
    - .4 Trim: Type 1 Barrier-free design.
    - .5 Architectural Notes: traditional STYLE, oval BOWL, white.
  - .6 Lavatory Type L3:
    - .1 Description: wall hung with integral back.
    - .2 Material: vitreous china.
    - .3 Wall mounted lavatory support system.
    - .4 Trim: Type 1 Barrier-free design.
    - .5 Architectural Notes: traditional STYLE, oval BOWL, white.

## 2.5 STAINLESS STEEL SINKS

- .1 General requirements for all specified Stainless Steel Sinks unless otherwise noted:
  - .1 Stainless Steel Sinks shall comply with ASME A112.19.3 / CSA B45.4 - Stainless Steel Plumbing Fixtures.
  - .2 All plumbing trim shall comply with ASME A112.18.1 / CSA B125.1 - Plumbing Supply Fittings.
  - .3 All plumbing waste fittings shall comply with ASME A112.18.2 / CSA B125.2 - Plumbing Waste Fittings.
  - .4 Stainless Steel Sinks shall be constructed from 1 mm (20 Ga) 316 series 18-8 Stainless Steel with #5 satin finish on bowl and # 8 mirror finish on rim and counter surface. Sinks shall be self-rimming, undercoated, and countertop sinks shall be complete with swivel clamps. Each sink bowl shall be supplied with a basket strainer waste fitting with the exception of commercial dishwashing sinks which will be equipped with corner of bowl drains with standpipe overflow waste fitting. Each sink shall be factory pre drilled for trim.
  - .5 All trim shall be lead free and comply with ANSI / NSF Standard 61.
  - .6 Trim with flexible tubing between fixture and isolation valves. Tubing shall be EPDM hose with external braided metal and brass connectors.
  - .7 Trim shall operate with a minimum 175 kPa (25 PSI) water pressure.
  - .8 Supplies to fixture shall be equipped with isolation valves. All exposed piping shall be chrome plated and chrome plated escutcheon plates shall be provided at wall pipe penetrations. Provide tubing to connect to fixture, EPDM hose with external braided metal and brass connectors.
  - .9 All stainless sinks shall be equipped with a NPS 1½ (1½" diameter) metal drain and P-trap (single P-trap for double sinks). P-traps shall be equipped with unions for removal of trap. P-traps shall be chrome plated where exposed. P-traps shall be set back recessed style for barrier-free installations and all drainage piping shall be insulated for barrier-free installation.
  - .10 Where required provide tee fitting for dishwasher pumped drain connection.
  - .11 Refer to drawings schedule of fixtures.
- .2 Trim / Drain Options:
  - .1 Type 1: manual pivot action single lever handle control, single hole sink:
    - .1 Metal construction, polished chrome finish, ceramic / stainless steel cartridge style mixing assembly.
    - .2 Sink hole on sink.
    - .3 Barrier-free compliant.
    - .4 225 mm (9") long, 180° swivel spout.
    - .5 Standard Flow Aerator: low flow orifice where required by sink type.
  - .2 Type 4: bar sink style. Manual pivot action single lever handle control, single hole sink:
    - .1 Metal construction, polished chrome finish, ceramic / stainless steel cartridge style mixing assembly.
    - .2 Sink hole on sink.
    - .3 Barrier-free compliant.
    - .4 225 mm (9") high, gooseneck spout.
    - .5 Standard Flow Aerator: low flow orifice where required by sink type.
- .3 SS Sink Type SS1- Kitchen Single Compartment Sink:
  - .1 Description: single compartment countertop with ledge back.
  - .2 Compartment Size: 330 mm wide x 228 mm bowl, 150 mm deep (13"x11"x6").
  - .3 Trim: Type 4.

- .4 SS Sink Type SS1- Kitchen Double Compartment Sink:
  - .1 Description: double compartment countertop with ledge back.
  - .2 Compartment Size: both 380 mm wide x 410 mm bowl, 200 mm deep (15"x16"x8").
  - .3 Trim: Type 1.

## 2.6 SERVICE SINKS

- .1 Mop Sink – MS1 – Floor Mounted:
  - .1 Basin: floor mounted base, molded stone, 610 mm x 610 mm x 254 mm (24" x 24" x 10") deep.
  - .2 Supply: 200 mm (8") combination type, chrome plated, with vacuum breaker, indexed cross handles, heavy cast brass spout with NPS 3/4 (3/4" diameter) hose thread and pail hook, aerator, adjustable brace to wall, integral stop valves.
  - .3 Strainer: cast brass, chrome plated, coupling with two (2) neoprene gaskets, combination stainless steel dome strainer and lint basket, NPS 3 (3" diameter) outlet.
  - .4 Wall Guard: 304 Stainless Steel sheet metal, #5 satin finish, to extend 1800 mm (6') vertically above and to sides and 600 mm (24") horizontally from edge of mop sink and be glued and screwed to adjacent wall.
  - .5 Wall mounted eyewash above mop sink.
  - .6 Accessories: provide stainless steel mop hanger with 3 holders with rubber tool grips.
- .2 Service Sink:
  - .1 One piece molded fibre glass / resin reinforced design, single compartment laundry sink, bowl dimension 560 mm x 560 mm (22" x 22") exterior, 340 mm (13½") deep. Unit with back ledge and legs for floor mounting.
  - .2 Supply Fitting: cast brass deck type, 150 mm (6") swing spout, aerator, lever handles, set screw flanges.
  - .3 Stainless steel strainer, with rubber stopper. Cast brass NPS 1 ½ (1 ½" diameter) P-trap with cleanout.

## 2.7 DRINKING FOUNTAINS AND REFRIGERATED WATER COOLERS

- .1 General requirements for all specified Drinking Fountains / Water Coolers unless otherwise noted:
  - .1 Stainless Steel Drinking Fountains shall comply with ASME A112.19.3 / CSA B45.4 - Stainless Steel Plumbing Fixtures.
  - .2 All Refrigerated Drinking Fountains shall comply with ANSI / ARI Standard 1010.
  - .3 All components shall be lead free and comply with ANSI / NSF Standard 61.
  - .4 Fixtures shall operate with a minimum 175 kPa (25 PSI) water pressure.
  - .5 Supplies to fixture shall be equipped with isolation valves.
  - .6 All Drinking Fountains shall be equipped with a NPS 1¼ (1¼" diameter) metal drain and P-Trap (single P-Trap for each fountain).
- .2 Refrigerated Water Cooler: Stainless Steel, Wall Mounted, Barrier-Free with Bottle Filler:
  - .1 1.27 mm (18 Ga) 304 stainless steel with satin finish.
  - .2 Single bowl, mounted proud from wall and at height to meet barrier-free application.

- .3 Water shall be filtered and provide lead, chlorine, particulate, taste and odor reduction. Filters shall be capable of a minimum total flow of 5675 litre (1500 Gal).
- .4 Bubbler Head: polished chrome-plated forged brass, integral basin shank, and anti-squirt vandal-resistant bubbler head.
- .5 Pushbutton Valve: lead-free forged brass; push activated, stream regulator and self-closing mechanism. Adjustable flow rate. Polished chrome-plated pushbutton requiring less than 2.3 kg (5 lbs) to activate.
- .6 Infrared sensor activation bottle filler, with automatic 20-second water flow shut-off. Quick fill rate of 5.6 L/m (1.5 Gpm).
- .7 Waste Strainer: polished chrome-plated brass vandal-resistant combination waste strainer and tailpiece assembly.
- .8 Packaged hermetic R410 unit with pre-cooler, insulated double wall chiller, storage tank, air-cooled condenser, thermostatically controlled. Counter flow cooling evaporator/chiller, large capacity dryer-strainer and fan-cooled condenser, controlled by calibrated capillary tube.
- .9 Back Panel: satin finish stainless steel back panel with louvered opening as required for compressor and evaporator operation.
- .10 Electrical 115/1/60, 5.0 FLA, 370 W.
- .11 Warranty: five (5) years on sealed refrigeration system, two years on all other components.
- .12 Provide factory manufactured floor-mounted carrier systems for all wall-mounted drinking fountains.

## 2.8 TRANSFORMERS

- .1 Control Transformers shall be 120V - 24V, 60 Hertz transformers, installed to meet the power requirements of the connected devices with an additional 25% spare capacity.
- .2 Transformers shall be ULC listed and CSA certified.
- .3 Standard design shall be single phase, all welded core construction made with high quality, high permeability silicon steel laminations. Coils shall be accurately wound with high quality magnetic wire with insulation film. All units from 50VA to 5kVA are encapsulated with electrical grade silica sand and resin compounds. Transformers shall be complete with heavy duty NEMA 3 Conduit knockouts on sides and rear of enclosure. Front accessible wiring compartment with high and low voltage copper lead wires or tabs. Ample space for transformer connection for primary and secondary terminations.
- .4 Insulation: up to 1 kVA; Class B, 80°C temperature rise. 1.5 to 5 kVA; Class F, 115°C temperature rise.
- .5 Mounting: designed for vertical or horizontal mounting.

## 2.9 JLR SPECIFIED PRODUCTS

- .1 Refer to Section 20 02 15 - JLR Mechanical Manufacturer's Quality Assurance List for listing of alternate manufacturer's to those listed below.
  - .1 Water Closets, Basis of Design American Standard
  - .2 Urinals, Basis of Design American Standard
  - .3 Lavatories, Basis of Design American Standard

.4	Stainless Steel Sinks, Basis of Design	Kindred
.5	Service Sinks, Basis of Design	Fiat
.6	Drinking Fountains, Basis of Design	Haws

### **PART 3 - EXECUTION**

#### **3.1 GENERAL**

- .1 Installation shall be in compliance with the AHJ (Authority Having Jurisdiction).
- .2 Where pipe sizes differ from connection sizes of equipment, install reducing fittings close to equipment. Reducing bushings are not permitted.
- .3 Provide supports, required to set fixtures level and square. Mount fixtures so that 90 kg (200#) weight will not loosen or distort mounting. Fasten fixtures on walls or partitions with 12 mm (½") carriage bolts passing through wall to 3 mm (1/8") steel plates (recessed where required) on other side of wall.
- .4 Protect units with water-resistant temporary covering. Do not allow temporary use of plumbing fixtures.

#### **3.2 MANUFACTURER'S INSTRUCTIONS**

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions and datasheet.

#### **3.3 FIXTURE ADJUSTMENT**

- .1 Conform to required water conservation requirements.
- .2 Adjustments:
  - .1 Adjust water flow rate to design flow rates.
  - .2 Adjust pressure to fixtures to ensure no splashing at maximum pressures.
  - .3 Adjust flush valves to suit actual site conditions.
  - .4 Adjust urinal flush timing mechanisms.
  - .5 Set controls of automatic flush valves for WCs and urinals to prevent unnecessary flush cycles.
- .3 Checks:
  - .1 Water closets, urinals: flushing action.
  - .2 Aerators: operation, cleanliness.
  - .3 Vacuum breakers, backflow preventers: operation under all conditions.
  - .4 Thermostatic controls: Verify temperature settings, operation of control, limit and safety controls.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 SCOPE DESCRIPTION SUMMARY**

- .1 This section will describe the requirements for testing, adjusting, and balancing of mechanical systems.
- .2 TAB is used throughout this section to describe the process, methods and requirements of testing, adjusting and balancing for HVAC.
- .3 TAB means to test, adjust and balance to perform in accordance with requirements of Contract Documents and to do other work as specified in this section.
- .4 TAB will be performed on all of the following systems:
  - .1 Plumbing (domestic hot water distribution).
  - .2 Heating Piping Systems.
  - .3 Heating Equipment.
  - .4 Cooling Piping Systems.
  - .5 Cooling Equipment.
  - .6 Ventilating and all Air Distribution Systems: Supply, Return, Exhaust, and Outside Air Ventilation Systems.
  - .7 Ventilation Equipment.
  - .8 Special Exhaust Systems and Equipment.

### **1.2 PURPOSE OF TAB**

- .1 Test to verify proper and safe operation, determine actual point of performance, and evaluate qualitative and quantitative performance of equipment, systems and controls at design, average and low loads using actual or simulated loads.
- .2 Adjust and regulate equipment and systems to meet specified performance requirements and to achieve specified interaction with other related systems under normal and emergency loads and operating conditions.
- .3 Balance systems and equipment to regulate flow rates to match load requirements over full operating ranges.

### **1.3 QUALITY ASSURANCE**

- .1 Carry out balancing in accordance with ANSI/ASHRAE Standard 111, Practices for Measurement, Testing, Adjusting, and Balancing of Building, Heating, Ventilation, Air Conditioning, and Refrigeration Systems.
- .2 The contractor performing the work of this section will be a recognized and independent balancing contractor and have a minimum of five (5) years' experience that can be documented and verified.
- .3 The TAB contractor will be recognized and registered with one or more of the following organizations:
  - .1 AABC - Associated Air Balance Council.
  - .2 NEBB - National Environmental Balancing Bureau.
  - .3 TABB - Testing Adjusting and Balancing Bureau.
  - .4 NBC - National Balancing Council.

- .4 TAB: will be performed in accordance with the requirements of the standard under which the TAB firm's qualifications were approved.
- .5 Identify the balancing sub consultant and submit the names of company to the Consultant within 30 days of award of contract. Provide documentation confirming qualifications and successful experience.
- .6 The preceding requirements for regulatory qualifications will only be suspended for the following considerations:
  - .1 It can be shown that there are no balancing companies meeting these requirements within a 150 km (95 mi) distance as measured from the balancing companies address to the construction site via google maps.
  - .2 If the contractor can provide a letter from the qualified companies within the allotted distance, indicating they are unable or otherwise occupied and cannot perform the work.
- .7 Should the regulatory requirement be suspended, the preferred qualifications of the TAB contractor will be, in order of preference:
  - .1 An independent balancing contractor, with the minimum five (5) years' experience.
  - .2 A member of the sheet metal contractor's staff who is familiar with balancing methods and equipment.
- .8 Use TAB Standard provisions, including checklists, and report forms to satisfy Contract requirements.
- .9 Use TAB Standard for TAB, including qualifications for TAB Firm and Specialist for calibration of TAB instruments. Where instrument manufacturer calibration recommendations are more stringent than those listed in TAB Standard, use manufacturer's recommendations.
- .10 TAB Standard quality assurance provisions such as performance guarantees form part of this contract.
- .11 For systems or system components not covered in TAB Standard, use TAB procedures developed by TAB Specialist.
- .12 Where new procedures, and requirements, are applicable to Contract requirements have been published or adopted by body responsible for TAB Standard used (AABC, NEBB, or TABB), requirements and recommendations contained in these procedures and requirements are mandatory.

#### **1.4 REFERENCES**

- .1 Unless dated references are identified below, it will be the latest standard issued by the regulatory agency that will be utilized as the applicable reference.
- .2 Associated Air Balance Council, (AABC) National Standards for Total System Balance, MN-1.
- .3 National Balancing Council, (NBC) Certified Air Balancing Specifications and Certified Hydronic Balancing Specifications.
- .4 National Environmental Balancing Bureau (NEBB) TABES, Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems.
- .5 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA), HVAC TAB HVAC Systems – Testing, Adjusting and Balancing.

## 1.5 INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 01 – Submittals.
- .2 Following the naming of the TAB firm, within 30 days of award of contract. The TAB firm will submit the proposed report documentation standard forms for review and approval to the Consultant.
- .3 General Reporting Requirements:
  - .1 Review specifications and drawings, make site visits, prepare reports and ensure all systems operate to specified requirements.
  - .2 Conduct minimum of two (2) site visits during course of construction and make recommendations to ensure proper provisions are made for testing and balancing. Ensure that modifications are implemented prior to executing work.
  - .3 Undertake start-ups balancing after start-up/operation reports are completed. Submit start-up balancing reports for equipment and system performance, including actions required to conform to contract documents.
  - .4 Undertake preliminary balancing after preliminary verification of controls is completed. Submit preliminary balancing reports for systems and controls, including actions required to conform to contract documents.
  - .5 Undertake final balancing after final verification of controls is completed. Submit final balancing report for systems and controls, including actions required to conform to contract documents. Identify and schedule seasonal balancing work required.
  - .6 Carry out seasonal balancing and provide system performance report.
- .4 Initial Review Report:
  - .1 Initial review report, identifying locations where additional balancing devices will be advantageous to the performance of the TAB work.
- .5 Preliminary Balancing Report:
  - .1 The preliminary balancing report will be provided should rough balancing indicate a problem with equipment and/or site conditions that indicate that the final balancing will be unable to achieve the performance requirements.
- .6 All TAB Reports will be submitted in both Metric and Imperial Units.
- .7 Final TAB Ventilation System Balancing report to include:
  - .1 TAB Ventilation report will include schematic representation of all diffusers within a system, referenced to the individual diffuser / air moving equipment air flow reports.
  - .2 Equipment: Fans / Air Handling Equipment report to include:
    - .1 Manufacturers' Data: manufacturer and model.
    - .2 Size, arrangement discharge and class.
    - .3 Coil types, row and fin quantity.
    - .4 Filters: quantity, type.
    - .5 Design Data:
      - .1 Airflow.
      - .2 Static pressure (suction, discharge, total).
      - .3 Fan RPM.
      - .4 Motor size, RPM, voltage, phase and FLA.

- .6 Measured Data:
  - .1 Airflow.
  - .2 Static pressure.
  - .3 Fan RPM.
  - .4 Pulley sizes.
  - .5 Belt size and quantity and condition.
  - .6 Motor size, RPM.
  - .7 Motor manufacturer and type.
  - .8 Motor operating amps, voltage, phase.
- .7 Static pressure reading between all components of Air Handling Units:
  - .1 Upstream and downstream of coils and heat exchangers.
  - .2 Upstream and downstream of filters.
  - .3 Upstream and downstream of dampers and air mixing devices.
- .8 Filters: condition at the time of balancing.
- .9 Positions of dampers at the time of balancing.
- .10 Recorded duct air flows for return and outside air quantities at mixing boxes.
- .11 Verify and report on performance minimum and maximum volume conditions under variable volume control and at minimum and maximum outside air condition under economizer control.
- .12 Minimum air flow damper setting and air flows.
- .13 Inlet and outlet temperatures for air handling units, including return and outside air temperatures.
- .14 Inlet and outlet temperatures across coils and heat exchangers.
- .3 Duct Air Quantities: Mains, Branches, Fresh Air and Exhaust Identification:
  - .1 Duct sizes.
  - .2 Number of pressure readings.
  - .3 Sum of velocity measurements.
  - .4 Average velocity.
  - .5 Duct recorded air flow.
  - .6 Duct design air flow.
- .4 Air Inlets and Outlets: Supply, Return or Exhaust Outlet:
  - .1 Identification (location and number designation).
  - .2 Design and measured velocities.
  - .3 Design and measured air flows.
  - .4 Deflector vane or diffusion cone settings.
- .5 Terminal Units:
  - .1 Identification.
  - .2 Design and measured airflow.
  - .3 Design and measured static pressure.
  - .4 Minimum and maximum recorded airflow and static pressure.
  - .5 Position of controlling devices and applied set points to achieve minimum and maximum settings.

- .8 Final TAB Hydronic System Balancing Report to include:
  - .1 Hydronic System report will include schematic representation of all devices within a system, referenced to the individual coils / equipment fluid flow reports.
  - .2 Equipment: Pump Report to include:
    - .1 Manufacturer Data: manufacturer and model.
    - .2 Size, arrangement inlet and discharge pipe sizes.
    - .3 Maximum pump impellor size and machine impellor size supplied with pump.
    - .4 Design Data:
      - .1 Pump Flow.
      - .2 Pump Head.
      - .3 Pump RPM.
      - .4 Motor Size, RPM, Voltage, Phase, and FLA.
    - .5 Measured Data:
      - .1 Pump Flow.
      - .2 Pump Head.
      - .3 Pump RPM.
      - .4 Motor Size, RPM.
      - .5 Motor Manufacturer and Type.
      - .6 Motor Operating Amps, Voltage, Phase.
    - .6 Suction and discharge pressures of pump assembly including isolation valves, check valves, suction diffusers, triple duty valves, and strainers.
    - .7 Suction and discharge pressure of strainers at inlet of pump.
  - .3 Equipment: Heat Exchanger:
    - .1 Manufacturer Data: manufacturer and model.
    - .2 Report to include Design Data, Manufacturer Design Data, and Measured Data for the following:
      - .1 Fluid Flow.
      - .2 Inlet and Outlet Fluid Pressure.
      - .3 Pressure Drop across Equipment.
      - .4 Entering and Leaving Fluid Temperatures.
    - .3 Equipment Electrical Data both design and measured, including amp reading on all phases.
    - .4 Steam Heat Exchangers to include steam inlet pressure.
  - .4 Forced Air Coils:
    - .1 Coil Type, Rows and Fins.
    - .2 Fluid Flow.
    - .3 Fluid Pressure Drop across Coil.
    - .4 Entering and Leaving Fluid Temperatures.
    - .5 Coil Airflow.
    - .6 Entering and Leaving Air Temperatures (dry bulb and wet bulb).
    - .7 Coil Control Valve Type (2 Way, 3 Way).
    - .8 Balancing Circuit Setter Position Setting.
    - .9 Bypass Balance Set Point.
  - .5 Convectors and Radiators:
    - .1 Fluid Flow.
    - .2 Balancing Circuit Setter Position Setting.

- .9 Domestic Water Recirculation Distribution Balancing Report to include (for all balancing valves):
  - .1 Fluid Flow.
  - .2 Balancing Circuit Setter Position Setting.

## **1.6 DOCUMENT REQUIREMENTS**

- .1 The contractor will provide the TAB firm a full copy of the contract drawings and specifications, including all addenda and change orders.
- .2 Contractor to provide TAB firm with 1 set of shop drawings for all equipment supplied.
- .3 The TAB firm will submit the proposed report documentation standard forms for review and approval to the Consultant and the commissioning agent.

## **1.7 COMMISSIONING**

- .1 Refer to Section 01 91 01 - Commissioning.

## **1.8 COORDINATION**

- .1 Coordinate the efforts and requirements of TAB with the commissioning agent. Be aware of the commissioning schedule and participate in the commissioning process.
- .2 TAB will be performed in conjunction with the Division 25 activities. Provide all required control set point for inclusion in the controlled programming.
- .3 During the course of completion of TAB work, identify and include in reports construction variances such as:
  - .1 Piping or conduit penetrating ducts.
  - .2 Open holes in ductwork.
  - .3 Collapsed ductwork.
  - .4 Leaks in hydronic systems.
  - .5 Inaccessible valves and dampers.
- .4 Schedule time required for TAB (including repairs, re-testing) into project construction and completion schedule to ensure completion before acceptance of project.
- .5 Do TAB of each system independently and subsequently, where interlocked with other systems, in unison with those systems.

## **1.9 MEASUREMENT TOLERANCES**

- .1 Measured values accurate to within plus or minus 2% of actual values
- .2 Do TAB to following tolerances of design values:
  - .1 Ventilation Systems: plus 5%, minus 5%.
  - .2 Hydronic systems: plus or minus 10%.
  - .3 Supply and Exhaust systems: plus 5%, minus 5%.

#### **1.10 VERIFICATION**

- .1 Reported results subject to verification by the commissioning agent and/or Consultant.
- .2 Provide personnel and instrumentation to verify up to 30% of reported results.
- .3 The Consultant will identify the number and location of measurements to be verified. They or their agents will be present and witness the verification of results.
- .4 Costs incurred due to the failure and of the verification of results and subsequent re balancing of systems will not be reimbursed.
- .5 Failure to verify the reported results will NOT be included as part of the required number of verifications to be performed.

### **PART 2 – PRODUCTS**

#### **2.1 GENERAL**

- .1 The TAB firm / Contractor will use the recognized industry standard for measuring equipment available.
- .2 The equipment utilized will provide measured reading meeting the required accuracy.
- .3 The utilization of outdated or non-calibrated equipment for the performance of TAB will result in the recommencement and rejection of all reports and measurements made. The contractor will then provide verification that the equipment has been replaced and / or calibrated prior to proceeding with the re-starting and performance of TAB activities.

#### **2.2 INSTRUMENTS**

- .1 Prior to TAB, submit a list of instruments used together with serial numbers.
- .2 Calibrate in accordance with requirements of most stringent of referenced standard for either applicable system or HVAC system.
- .3 Calibrate within three (3) months of site work commencement of TAB. Calibrate every six (6) months thereafter. Have Calibration Certificates available and presentable while performing TAB.

#### **2.3 SHIMS AND PULLEYS**

- .1 The contractor will provide all shims and pulleys required to achieve the standards of TAB.

### **PART 3 - EXECUTION**

#### **3.1 GENERAL**

- .1 Adjust fan speeds and modify pumps or controls as required to produce design flow.
- .2 Adjust air systems for design outside air quantity, design recirculating air quantity and design exhaust air quantity.

- .3 Test and record heating and cooling apparatus entering and leaving air, water and refrigerant temperatures.
- .4 Adjust flow patterns from air distribution devices to minimize drafts.
- .5 Verify that all controls are functioning as intended.
- .6 Conduct capacity tests on all equipment. Tests to be made during a period of stable operation and minimal load fluctuation. Submit performance report for each item tested. Reports to include comparison of design capacity, installed capacity and actual operating capacity.
- .7 Provide schematics with each test report identifying all components within system and position of controlling devices.
- .8 Carry out final balancing under peak load conditions to suit system and outdoor conditions. Where loads cannot be simulated, final tests to be carried out at time of peak condition.
- .9 Verify variable volume system/equipment performance under minimum and maximum conditions. Final tests to be carried out with controls operating.

### **3.2 MANUFACTURER'S INSTRUCTIONS**

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

### **3.3 PRE-TAB REVIEW**

- .1 Review contract documents before project construction is started submit report on the adequacy of provisions for TAB and other aspects of design and installation pertinent to success of TAB.
- .2 Review specified standards and report proposed procedures which vary from standard.
- .3 During construction have a minimum of 1 site visit, or 1 site visit every 40 working days to coordinate location and installation of TAB devices, equipment, accessories, measurement ports and fittings.

### **3.4 OPERATION OF SYSTEMS DURING TAB**

- .1 Operate systems for length of time required for TAB and as required by for verification of TAB reports.
- .2 Identify and report failures of equipment that occur during this time.

### **3.5 TAB COMMENCEMENT OF SITE ACTIVITIES – ADJUSTING AND BALANCING**

- .1 Notify Consultant 10 working days prior to start of TAB.
- .2 Start TAB when building is essentially completed, including:
  - .1 Installation of ceilings, doors, windows, other construction affecting TAB.
  - .2 Application of weather-stripping, sealing, and caulking.
  - .3 Pressure, leakage, other tests specified elsewhere Division 23.
  - .4 Provisions for TAB installed and operational.

- .3 Start-up, verification for proper, normal and safe operation of mechanical and associated electrical and control systems affecting TAB including but not limited to:
  - .1 Proper thermal overload protection in place for electrical equipment.
  - .2 Air Systems:
    - .1 Filters in place, clean.
    - .2 Duct systems clean.
    - .3 Ducts, air shafts, ceiling plenums are airtight to within specified tolerances.
    - .4 Equipment commissioning complete.
    - .5 Fire, smoke, volume control dampers installed and open.
    - .6 Coil fins combed, clean.
    - .7 Access doors, installed, closed.
    - .8 Outlets installed volume control dampers open.
  - .3 Liquid Systems:
    - .1 Flushed, filled, vented.
    - .2 Equipment commissioning complete.
    - .3 Strainers in place, baskets clean.
    - .4 Isolating and balancing valves installed, open.
    - .5 Calibrated balancing valves installed, at factory settings.
    - .6 Chemical treatment systems complete, operational.
  - .4 Control Systems:
    - .1 Complete and Verified.

### **3.6 TAB – TESTING AND PERFORMANCE VERIFICATION**

- .1 Perform all performance verification testing following the completion and acceptance of the balancing reports.
- .2 Hydronic Systems Capacity Tests: perform hydronic system capacity tests after:
  - .1 TAB has been completed.
  - .2 Verification of operating, limit, safety controls.
  - .3 Verification of primary and secondary pump flow rates.
  - .4 Verification of accuracy of temperature and pressure sensors and gauges.
- .3 Calculate System Capacity at Test Conditions:
  - .1 Using manufacturer's published data and calculated capacity at test conditions, extrapolate system capacity at design conditions.
  - .2 When capacity test is completed, return controls and equipment status to normal operating conditions.
  - .3 Submit sample of system water to approved testing agency to determine if chemical treatment is correct. Include cost.
- .4 Heating System Capacity Test:
  - .1 Perform capacity test when ambient temperature is within 10% of design conditions. Simulate design conditions by:
    - .1 Increasing OA flow rates through heating coils (in this case, monitor heating coil discharge temperatures to ensure that coils are not subjected to freezing conditions) or

- .2 Reducing space temperature by turning of heating system for sufficient period of time before starting testing.
- .2 Test Procedures:
  - .1 Open fully heat exchanger, heating coil and radiation control valves.
  - .2 Record flow rates and supply and return temperatures simultaneously.
  - .3 Perform tests at full load and partial load conditions.
- .5 Chilled Water System Capacity Test:
  - .1 Perform capacity test when ambient temperature is within 10% of design conditions. Simulate design conditions by:
    - .2 Adding heat from building heating system or.
    - .3 Raising space temperature by turning off cooling and air systems for sufficient period of time before starting testing and pre-heating building to summer design space temperature (occupied) or above. Set OAD and RAD for minimum outside air if OAT is near outside design temperature or to maximum recirculation if RAT is greater than OAT. RAT to be at least 23 degrees C minimum.
  - .4 Test Procedures:
    - .1 Open fully cooling coil control valves.
    - .2 Set thermostats on associated AHUs for maximum cooling.
    - .3 Set AHUs for design maximum air flow rates.
    - .4 Set load or demand limiters on chillers to 100%.
    - .5 After system has stabilized, record chilled water, and condenser water flow rates and supply and return temperatures simultaneously.
- .6 Steam System Capacity Tests and Performance Verification:
  - .1 When systems are operational, perform relevant tests of steam and condensate return piping systems as specified under hydronic systems.
  - .2 Verify operation of components of steam system including:
    - .1 Steam traps by:
      - .1 Measuring temperature of condensate return and/or using audio-sensing devices.
    - .2 Flash tanks.
    - .3 Thermostatic vents.
    - .4 Controls.
    - .5 Verify performance of condensation units, including:
      - .1 Pump capacity at design temperature.
      - .2 Controls.
  - .3 Verify performance of condensate return system to ensure return of maximum quantity of condensate return water at with minimum temperature drop.

### 3.7 COMPLETION OF TAB

- .1 After TAB is completed, replace drive guards, close access doors, lock devices in set positions, and ensure sensors are at required settings.
- .2 Permanently mark settings to allow restoration at any time during life of facility. Do not eradicate or cover markings.
- .3 TAB is considered complete when final TAB Report received and approved by Consultant.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 REFERENCE STANDARDS**

- .1 American Society for Testing and Materials International (ASTM)
  - .1 ASTM E 202-04, Standard Test Methods for Analysis of Ethylene Glycols and Propylene Glycols.

### **1.2 CLEANING AND START-UP OF MECHANICAL PIPING SYSTEMS**

- .1 In accordance with Section 20 08 02 – Commissioning, Cleaning and Start-up of Mechanical Systems.

### **1.3 HYDRONIC SYSTEMS - PERFORMANCE VERIFICATION (PV)**

- .1 Perform hydronic systems performance verification after cleaning is completed and system is in full operation.
- .2 When systems are operational, perform following tests:
  - .1 Conduct full scale tests at maximum design flow rates, temperatures and pressures for continuous consecutive period of 48 hours to demonstrate compliance with design criteria.
  - .2 Verify performance of hydronic system circulating pumps as specified, recording system pressures, temperatures, fluctuations by simulating maximum design conditions and varying.
    - .1 Pump operation.
    - .2 Heat exchanger operation.
    - .3 Pressure bypass open/closed.
    - .4 Control pressure failure.
    - .5 Maximum heating demand.
    - .6 Maximum cooling demand.
    - .7 Heat exchanger failure.
    - .8 Outdoor reset. Re-check heat exchanger output supply temperature at 100% and 50% reset, maximum water temperature.

### **1.4 HYDRONIC SYSTEM CAPACITY TEST**

- .1 Perform hydronic system capacity tests after:
  - .1 TAB has been completed
  - .2 Verification of operating, limit, safety controls.
  - .3 Verification of primary and secondary pump flow rates.
  - .4 Verification of accuracy of temperature and pressure sensors and gauges.
- .2 Calculate system capacity at test conditions.
- .3 Using manufacturer's published data and calculated capacity at test conditions, extrapolate system capacity at design conditions.
- .4 When capacity test is completed, return controls and equipment status to normal operating conditions.

- .5 Submit sample of system water to approved testing agency to determine if chemical treatment is correct. Include cost.
- .6 Heating system capacity test:
  - .1 Perform capacity test when ambient temperature is within 10% of design conditions. Simulate design conditions by:
    - .1 Increasing OA flow rates through heating coils (in this case, monitor heating coil discharge temperatures to ensure that coils are not subjected to freezing conditions) or
    - .2 Reducing space temperature by turning of heating system for sufficient period of time before starting testing.
  - .2 Test procedures:
    - .1 Open fully heat exchanger, heating coil and radiation control valves.
    - .2 Record flow rates and supply and return temperatures simultaneously.
    - .3 Perform tests at full load and partial load conditions.
- .7 Chilled water system capacity test:
  - .1 Perform capacity test when ambient temperature is within 10% of design conditions. Simulate design conditions by:
    - .1 Adding heat from building heating system or;
    - .2 Raising space temperature by turning off cooling and air systems for sufficient period of time before starting testing and pre-heating building to summer design space temperature (occupied) or above. Set OAD and RAD for minimum outside air if OAT is near outside design temperature or to maximum recirculation if RAT is greater that OAT. RAT to be at least 23 degrees C minimum.
  - .2 Test procedures:
    - .1 Open fully cooling coil control valves.
    - .2 Set thermostats on associated AHU's for maximum cooling.
    - .3 Set AHU's for design maximum air flow rates.
    - .4 Set load or demand limiters on chillers to 100%.
    - .5 After system has stabilized, record chilled water, and condenser water flow rates and supply and return temperatures simultaneously.

## **1.5 HUMIDIFICATION SYSTEMS**

- .1 In addition to procedures specified above, perform following:
  - .1 Perform TAB as specified Section 23 05 93 - Testing, Adjusting and Balancing of Mechanical HVAC.
  - .2 Verify performance of controls to provide steam quantities as indicated.

## **1.6 GLYCOL SYSTEMS**

- .1 Test to prove concentration will prevent freezing to minus 40 degrees C. Test inhibitor strength and include in procedural report. Refer to ASTM E 202.

## **1.7 STEAM SYSTEMS**

- .1 Performance verification:
  - .1 When systems are operational, perform relevant tests of steam and condensate return piping systems as specified under hydronic systems.
  - .2 Verify operation of components of steam system including:
    - .1 Steam traps by:
      - .1 Measuring temperature of condensate return and/or
      - .2 Using audio-sensing devices.
      - .3 Use of other approved methods.
    - .2 Flash tanks.
    - .3 Thermostatic vents.
  - .3 Verify performance of condensation units, including:
    - .1 Pump capacity at design temperature.
    - .2 Controls.
  - .4 Verify performance of condensate return system to ensure return of maximum quantity of condensate return water at with minimum temperature drop.
  - .5 Adjust piping system as required to eliminate water hammer.
- .2 Monitor system continuously until acceptance for proper operation of components including steam traps, thermostatic vents, flash tanks and condensate pumping units.

## **1.8 POTABLE WATER SYSTEMS**

- .1 When cleaning is completed and system filled:
  - .1 Verify performance of equipment and systems as specified elsewhere in Division 23.
  - .2 Check for proper operation of water hammer arrestors. Run one outlet for 10 seconds, then shut off water immediately. If water hammer occurs, replace water hammer arrestor or recharge air chambers. Repeat for each outlet and flush valve.
  - .3 Confirm water quality consistent with supply standards, verifying that no residuals remain resulting from flushing and/or cleaning.

## **1.9 COMPRESSED AIR SYSTEMS**

- .1 Verification of existing and new compressed air system to ensure capacities, pressures and functionality of system are consistent with operational requirements.
- .2 Commissioning Agency: installing Contractor.
- .3 Design Criteria, Design Intent: refer to Performance Verification (PV) Report Forms.

## **1.10 WET AND DRY PIPE SPRINKLER SYSTEM, STANDPIPE AND HOSE SYSTEMS**

- .1 Cleaning, testing, start-up, performance verification of equipment, systems, components, and devices are specified in Division 20 and Division 23.
- .2 Verification of controls, detection devices, alarm devices is specified Division 26.

- .3 Demonstrate that fire hose will reach to most remote location regardless of partitions, and obstructions.
- .4 Verify operation of interlocks between HVAC systems and fire alarm systems.

#### **1.11 SANITARY AND STORM DRAINAGE SYSTEMS**

- .1 Buried systems: perform tests prior to back-filling. Perform hydraulic tests to verify grades and freedom from obstructions.
- .2 Ensure that traps are fully and permanently primed.
- .3 Ensure that fixtures are properly anchored, connected to system.
- .4 Operate flush valves, tank and operate each fixture to verify drainage and no leakage.
- .5 Cleanouts: refer to Section 22 13 19 – Storm – Sanitary Waste Piping Specialties.
- .6 Roof drains:
  - .1 Refer to Section 22 13 19 – Storm – Sanitary Waste Piping Specialties.
  - .2 Remove caps as required.

#### **1.12 REPORTS**

- .1 In accordance with Section 01 91 01 - Commissioning: Reports, supplemented as specified herein.

#### **1.13 TRAINING**

- .1 In accordance with Section 01 91 01 - Commissioning: Training of O&M Personnel, supplemented as specified herein.

### **PART 2 - PRODUCTS**

#### **2.1 NOT USED**

- .1 Not Used.

### **PART 3 - EXECUTION**

#### **3.1 NOT USED**

- .1 Not Used.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 SCOPE DESCRIPTION SUMMARY**

- .1 This section will describe the requirements of the ductwork installer to test the installed ductwork for leakage and system performance.

### **1.2 REFERENCES**

- .1 Unless dated references are identified below, it will be the latest standard issued by the regulatory agency that will be utilized as the applicable reference.
- .2 Sheet Metal and Air Conditioning Contractor's National Association (SMACNA)
  - .1 SMACNA HVAC Air Duct Leakage Test Manual.

### **1.3 INFORMATIONAL SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 01 –Submittals.
- .2 Test Reports: submit certified test reports indicating compliance with specifications for specified performance characteristics and physical properties.
- .3 Prepare report of results and submit to Consultant within 24 hours of completion of tests. Include:
  - .1 Schematic of entire system.
  - .2 Schematic of section under test showing test site.
  - .3 Required and achieved static pressures.
  - .4 Orifice differential pressure at test sites.
  - .5 Permissible and actual leakage flow rate (L/s) (Cfm) for test sites.
  - .6 Witnessed certification of results.
- .4 Include test reports in final TAB report.

### **1.4 QUALITY ASSURANCE**

- .1 The contractor performing the work of this section will understand the requirements of and understand the use of equipment to perform the tests.
- .2 Pre-Test Meeting:
  - .1 Convene pre-installation meeting prior to beginning work of this Section with Consultant.
  - .2 Verify project requirements and testing objectives.
  - .3 Determine the extent and expectations of when tests will be conducted during construction.

## **1.5 COMMISSIONING**

- .1 Refer to Section 01 91 01 - Commissioning.

## **PART 2 - PRODUCTS**

### **2.1 GENERAL**

- .1 The test apparatus will be a manufactured item, capable of performing the required tests.

### **2.2 TEST INSTRUMENTATION**

- .1 Test apparatus to include:
  - .1 Fan capable of producing required static pressure.
  - .2 Duct section with calibrated orifice plate mounted and accurately located pressure taps.
  - .3 Flow measuring instrument compatible with the orifice plate.
  - .4 Calibration curves for orifice plates used.
  - .5 Flexible duct for connecting to ductwork under test.
  - .6 Smoke bombs for visual inspections.
- .2 Test apparatus: accurate to within +/- 3 % of flow rate and pressure.
- .3 Test instruments: calibrated and certificate of calibration available during the testing procedure. Calibration certificate will be dated no more than 6 months prior to the date of testing.

## **PART 3 - EXECUTION**

### **3.1 GENERAL**

- .1 Perform ductwork pressure testing, progressively as construction advances. Verify construction standards are adhered to as duct sections are installed.
- .2 Test ducts before installation of insulation or other forms of concealment.
- .3 Test after seals have cured.
- .4 Test when ambient temperature will not affect, effectiveness of seals and gaskets.
- .5 Flexible connections to VAV boxes.

### **3.2 MANUFACTURER'S INSTRUCTIONS**

- .1 Compliance: comply with manufacturer's written recommendations and instructions on the use of the testing apparatus. Including product technical bulletins, handling and storage installations.

### 3.3 TESTING PROCEDURES

- .1 Refer to Section 23 31 00 – HVAC Ducts and Casings for duct construction standards and maximum test pressures. Perform tests at those test pressures and determine the resultant leakage. Verify the duct construction meets the duct construction seal standards specified.
- .2 Base partial system leakage calculations on SMACNA HVAC Air Duct Leakage Test Manual.
- .3 Testing will commence when sufficient ductwork has been installed for the requirements of the testing apparatus. Testing will continue as construction progresses. Continuous failure of testing will result in back charging of the contractor for the commissioning agents labour for witnessing of the testing.
- .4 The Consultant will determine the extent and ductwork sections to be tested. Once testing requirements have been determined, that test will be conducted within 24 hours of the request for tests.
- .5 Be prepared and include costs for testing a minimum of 25% of all installed horizontal ductwork and a minimum of 50% of all installed risers (to be concealed). Failure of any testing will not constitute part of the testing percentages required herein.
- .6 Maximum lengths of ducts to be tested consistent with capacity of test equipment. Section of duct to be tested to include:
  - .1 Fittings, branch ducts, tap-ins.
- .7 Repeat tests until specified pressures are attained. Bear costs for repairs and repetition to tests.
- .8 Seal leaks that can be heard or felt, regardless of their contribution to total leakage.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 SCOPE DESCRIPTION SUMMARY**

- .1 This section describes the materials and methods for the installation of hydronic HVAC distribution piping within the building, operating to 99°C (210°F) and 861 KPa (125PSI).
- .2 Systems to be installed to this specification:
  - .1 Hydronic Heating Piping Systems.
  - .2 Hydronic Chilled Water Piping Systems.
  - .3 Hydronic Glycol Heating Piping Systems.

### **1.2 REFERENCES**

- .1 Unless dated references are identified below, it shall be the latest standard issued by the regulatory agency that shall be utilized as the applicable reference.
- .2 CSA (Canadian Standards Association):
  - .1 CSA B51 – Boiler and Pressure Vessel Code.
- .3 ASME / ANSI (American Society of Mechanical Engineers) / (American National Standards Institute):
  - .1 ASME - Boiler and Pressure Vessel Code.
  - .2 ASME/ANSI B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300.
  - .3 ASME/ANSI B16.5 - Pipe Flanges and Flanged Fittings.
  - .4 ASME/ANSI B16.9 - Factory-Made Wrought Butt welding Fittings.
  - .5 ASME/ANSI B16.10 - Face-to-Face and End-to-End Dimensions of Valves.
  - .6 ASME/ANSI B16.15 - Cast Bronze Threaded Fittings.
  - .7 ASME/ANSI B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.
  - .8 ASME/ANSI B16.21 – Non-metallic Flat Gaskets for Pipe Flanges.
  - .9 ASME/ANSI B16.25 – Butt Welding Ends.
  - .10 ASME/ANSI B16.34 - Valves - Flanged, Threaded, and Welding End.
  - .11 ASME/ANSI B16.39 - Malleable Iron Threaded Pipe Unions.
- .4 ASTM International:
  - .1 ASTM A53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
  - .2 ASTM A106 - Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service.
  - .3 ASTM A 47/A 47M - Standard Specification for Ferritic Malleable Iron Castings.
  - .4 B42 - Standard Specification for Seamless Copper Pipe, Standard Sizes.
  - .5 ASTM E 202 - Standard Test Method for Analysis of Ethylene Glycols and Propylene Glycols.
- .5 CSA International:
  - .1 CSA B242 - Groove and Shoulder Type Mechanical Pipe Couplings.
  - .2 CSA W48 - Filler Metals and Allied Materials for Metal Arc Welding.

- .6 Manufacturer's Standardization of the Valve and Fittings Industry (MSS):
  - Ball Valves:
  - .1 MSS-SP-110, Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.
  - Butterfly Valves:
  - .2 MSS-SP-67, Butterfly Valves.
  - Globe Valves:
  - .3 MSS-SP-80, Bronze Gate, Globe, Angle and Check Valves.
  - .4 MSS-SP-78, Grey Iron Plug Valves, Flanged and Threaded Ends.
  - Check Valves:
  - .5 MSS-SP-80, Bronze Gate, Globe, Angle and Check Valves.
  - .6 MSS-SP-71, Grey Iron Swing Check Valves Flanged and Threaded Ends.
- .7 American Welding Society (AWS):
  - .1 AWS C1.1M/C1.1 - Recommended Practices for Resistance Welding.
  - .2 AWS Z49.1 - Safety in Welding, Cutting and Allied Process.
  - .3 AWS W1 - Welding Inspection Handbook.

### 1.3 INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 01 - Submittals.
- .2 Product Data:
  - .1 Product data shall be submitted for the following:
    - .1 Valves.
    - .2 Check Valves.
    - .3 Strainers.
    - .4 Balancing Valves.
    - .5 Suction Diffusers.
    - .6 Glycol.
  - .2 Provide manufacturer's printed product literature and datasheets for material specified, and include product characteristics, performance criteria, physical size, finish and limitations.
  - .3 Product data shall include all relevant information to confirm the specifications have been met.
- .3 Shop Drawings:
  - .1 Submit drawings stamped and signed by professional engineer licensed in Province of Ontario, Canada.

### 1.4 MAINTENANCE REQUIREMENTS

- .1 The contractor shall verify and demonstrate that proper maintenance can be performed on equipment and material installed.

## 1.5 QUALITY ASSURANCE

- .1 Performance Requirements Defined: catalogued or published ratings for manufactured items obtained from tests carried out by manufacturer or those ordered by manufacturer from an independent testing agency signifying adherence to codes and standard and standardized testing of performance criteria.
- .2 The contractor performing the work of this section shall be a recognized installer of hydronic piping systems and have a minimum of five (5) years' experience which can be documented and verified.
- .3 Grooved Piping System Installer: all mechanics responsible for installing grooved joint piping system to have been trained by manufacturer and retain certificate of training.
- .4 Welder Qualifications:
  - .1 Perform welding only with certified welders suitable for class of welding required. Use welders qualified and licensed by Provincial authorities.
  - .2 Welders to qualify in accordance with ASTM, ANSI B31.1 and Governmental Regulations. Welder's certificate of qualification, not older than 6 months, to be on file at work site.
  - .3 Welding installation to be to CSA W59, latest edition.
  - .4 Welder to mark each weld with personal steel pencil for individual work identification. Mark each joint with stencil before radiographs are taken.

## **PART 2 – PRODUCTS**

### 2.1 GENERAL

- .1 The hydronic distribution system, including piping, joints, fittings, and valves shall meet or exceed the following performance characteristics:
  - .1 Temperature Range: -25°C to 99°C (-15°F to 210°F).
  - .2 Pressure Range: Maximum 690 kPa (100 PSI).
- .2 Minimum services rating to be 1034 kPa (150 PSI) or system pressure, whichever is greater.

### 2.2 PIPE

- .1 Steel Pipe:
  - .1 Black Steel Pipe: to ASTM A53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless, Type E, Grade B Electric Resistance Weld.
  - .2 Black Steel Pipe: to ASTM A106 Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service, Type S, Grade B Seamless.
  - .3 NPS ½ (1/2"Ø) thru NPS 2 (2"Ø): Minimum Schedule 40/STD. Maximum Working Pressure of 2585 kPa (375 PSI) for Threaded Pipe with a Safety Factor of 8 or 0.50.
  - .4 NPS 2 ½ (2 ½"Ø) thru NPS 6 (6"Ø): Minimum Schedule 40/STD. Maximum Working Pressure of 3275 kPa (475 PSI) for Plain End Pipe with a Safety Factor of 8 or 0.50.
- .2 Copper Tube:
  - .1 Copper Tubing: to ASTM B88 & B88M - Standard Specification for Seamless Copper Water Tube & Metric Version.
  - .2 All tubing shall be Type "K", hard drawn.
  - .3 NPS ½ (1/2"Ø) thru NPS 2 (2"Ø): Maximum Working Pressure of 2825 KPa (410 PSI) for Plain End Pipe with a Safety Factor of 0.50.

## 2.3 FITTINGS AND JOINTS

- .1 Threaded Fittings – Steel Pipe:
  - .1 Screwed Fittings: malleable iron, Class 150.
  - .2 PTFE tape.
  - .3 Conforming to ASME/ANSI B16.3 - Malleable Iron Threaded Fittings.
- .2 Welded Fittings – Steel Pipe Butt Weld:
  - .1 Butt-welding fittings: factory manufactured carbon steel.
  - .2 Conforming to ASTM A234 / A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
  - .3 Conforming to ASME/ANSI B16.9 - Factory-Made Wrought Steel Butt Welding Fittings.
- .3 Flanged Fittings – Steel Pipe:
  - .1 Forged Steel, Butt Weld Welding Neck Flanges Class 150: fittings shall be factory manufactured carbon steel, with raised serrated face and pre drilled to American Steel Flange Standard B16.5
  - .2 Conforming to ASTM A234 / A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
  - .3 Conforming to ASME/ANSI B16.5 - Pipe Flanges and Flanged Fittings.
  - .4 Flange Gaskets: 1.6 mm (1/16") thick preformed high temperature graphite sheet gasket, carbon fiber / nitrile composition. Conforming to ASME B16.21 – Non-metallic Flat Gaskets for Pipe Flanges.
  - .5 Bolts / Nuts: heat treated carbon steel, hexagonal to ASTM A307.
- .4 Grooved Rigid Coupling / Zero Flex – Steel Pipe:
  - .1 Coupling to be grooved, mechanical type which engages grooved or shouldered pipe ends, encasing an internal, fully encased, gasket which bridges pipe ends to create the seal. Coupling to be cast in two or more parts secured together during assembly by nuts and bolts. Couplings to be designed with angle bolt pads to provide a rigid non flexible joint. Rolled grooved couplings (cut joints will not be permitted).
  - .2 Coupling shall be constructed from cast ductile iron, conforming to ASTM A 536. Coupling shall have painted enamel, corrosion resistant finish.
  - .3 Gaskets: shall be rated for applicable service and minimum 110°C (230°F). Gasket to be grooved mechanical type, pressure responsive to internal pressure increasing the seal tightness.
    - .1 EPDM Gaskets for Water Service.
    - .2 EPDM Gaskets for Ethylene or Propylene Glycol Service.
  - .4 Bolts / Nuts: heat treated carbon steel, hexagonal to ASTM A307.
- .5 Soldered Fittings – Copper Pipe NPS 2 (2"Ø) and Under:
  - .1 Soldered or brazed joints utilizing filler material and flux.
  - .2 Wrought copper and copper alloy solder joint pressure fittings conforming to ANSI/ASME B16.22.
  - .3 Cast copper alloy solder joint pressure fittings conforming to ANSI B16.18.
  - .4 Cast bronze threaded fittings conforming to ANSI/ASME B16.15.
  - .5 Solder Filler Material: tin-antimony, 95:5: to ASME B16.18.
  - .6 Brazing Filler Material: Copper / Phosphorous / Silver Solder to ANSI/AWS A5.8.

## 2.4 DIELECTRIC UNIONS

- .1 Isolate system components from galvanic currents with dielectric fittings to suit dissimilar metals.
- .2 Provide isolating bronze unions for pipe sizes NPS 2 (2"Ø) and smaller, flanges with gaskets for pipe sizes NPS 2½ (2½"Ø) and larger.
- .3 Unions to withstand minimum 600 V on a dry line without flashover. Dielectric fittings shall meet or exceed the operating and test pressure of the system.

## 2.5 VALVES GENERAL

- .1 Valves: except for specialty valves, to be of single manufacturer.
- .2 All gaskets and packing shall be non-asbestos.

## 2.6 BALL VALVES

- .1 Ball Valve, Soldered End / Screwed End:
  - .1 NPS 2 ½ (2 ½"Ø) and under, soldered or screwed.
  - .2 Two piece forged brass body, full port, stainless steel ball, PTFE adjustable packing, brass gland and PTFE seat.
  - .3 Extended brass stem for handle operation outside insulation.
  - .4 Steel lever handle, with plastic coated contact surface. Provide locking handle type for lock shield service.
  - .5 Class 150 WSP. With CSA and UL approval. Conforming to MSS-SP-110.
- .2 Ball Valve, Grooved End:
  - .1 NPS 3 (3"Ø) and over, grooved end.
  - .2 Two piece forged brass body, full port, stainless steel ball, PTFE adjustable packing, brass gland and PTFE seat.
  - .3 Extended brass stem for handle operation outside insulation.
  - .4 Steel lever handle, with plastic coated contact surface. Provide locking handle type for lock shield service.
  - .5 Class 150 WSP. With CSA and UL approval. Conforming to MSS-SP-110.

## 2.7 BUTTERFLY VALVES

- .1 Butterfly Valves, Grooved End:
  - .1 NPS 3 (3"Ø) and over, grooved end.
  - .2 Cast brass body, bronze disk with elastomer seal, and stainless steel stem with EPDM seal. Steel plate drive adaptor.
  - .3 Manual gear operator with round ridged handle, with PVC coated contact surface. Zinc plated nut.
  - .4 Class 150 WSP. With CSA and UL approval. Conforming to MSS-SP-67.

## 2.8 SWING CHECK VALVES

- .1 Swing Check Valve, Soldered End / Screwed End:
  - .1 NPS 2 ½ (2 ½"Ø) and under, soldered.
  - .2 Y-pattern body, all bronze construction. Cast bronze body, screw in access cap, bronze swing disk, bronze hinge and stainless steel pin.
  - .3 Class 150 WSP. Conforming to MSS-SP-80.
- .2 Swing Check Valve, Flanged End:
  - .1 NPS 2 ½ (2 ½"Ø) and over, flanged.
  - .2 Y-pattern body, cast iron body and bolted cast iron access cap, bronze swing disk, bronze hinge and stainless steel pin. Replaceable bronze seat rings.
  - .3 Class 125 WSP, conforming to MSS-SP-71.

## 2.9 STRAINERS

- .1 Y-Pattern Strainer, Soldered End / Screwed End:
  - .1 NPS 2 ½ (2 ½"Ø) and under, soldered or screwed.
  - .2 Y-pattern body, cast bronze body, screw in access cap, stainless steel removable and cleanable 20 mesh strainer. Strainer to be non-ferrous.
- .2 Y-Pattern Strainer, Flanged End / Grooved End:
  - .1 NPS 2 ½ (2 ½"Ø) and over, flanged or grooved.
  - .2 Y-pattern body, cast iron body, bolted or grooved steel access cap.
  - .3 Stainless steel removable and cleanable 20 mesh strainer. Strainer to be non-ferrous. Free screen area not to be less than double the internal cross-sectional area of pipe.
  - .4 NPS ¾ (¾"Ø) plug for blow down connection.
- .3 Strainers NPS 4 (4"Ø) and greater shall be equipped with a blowdown connection. NPS ¾ (¾"Ø) blow down pipe with ball valve and hose end connection.
- .4 Strainers at pumps to be provided with magnetic screen assembly.

## 2.10 SUCTION DIFFUSERS

- .1 Engineered flow, suction diffuser of angle body type with straightening vanes and combination diffuser-strainer-orifice cylinder.
- .2 All screwed connections or flanged outlet and flanged or grooved inlet connection.
- .3 Cast ductile iron body, carbon steel or cast iron flow straitening vanes. Stainless steel 3 mm (0.125") perforated strainer, with fine mesh removable start-up strainer. Bolted strainer access plate with reusable EPDM gasket. Permanent magnet in flow stream, removable for cleaning. Working Pressure: 1206 kPa (175 psi). Equipped with adjustable support foot, strainer blow down connection, pressure gauge tapings at inlet and discharge of strainer screen.

## 2.11 PRESSURE INDEPENDENT CONTROL VALVES

- .1 All devices requiring control and / or balancing shall be complete with a pressure independent control valve supplied by Tour and Anderson or Siemens
- .2 General
  - .1 All control valves shall be sized and provided by the controls vendor. All control valve bodies shall be suitable for the static and dynamic pressures of the system. Control valve operators shall be sized to close against a differential pressure equal to the design pump head plus 10 percent.
  - .2 Body pressure rating and connection type construction shall conform to fitting and valve schedules. The valve seat differential pressure rating shall exceed the pump dynamic head design pressure.
  - .3 All automatic control valves shall be installed by the mechanical trade.
- .3 The controls contractor shall provide wiring as follows:
  - .1 All line voltage power for electric valve actuators shall be wired by the controls contractor from the nearest available power provided.
  - .2 All low voltage wiring between the controller and the valve actuator shall be wired by the controls contractor.
- .4 General Construction Materials
  - .1 Control valve bodies shall be constructed of cast iron and shall meet requirements of ANSI 125 or ANSI 250 pressure classes
  - .2 Valves shall be constructed with a single chamber and multiple seats to provide flow limiting, pressure compensation and flow control.
  - .3 Valves shall contain a mechanical, spring-loaded pressure independent regulator to maintain a consistent differential pressure across the control port of the valve
  - .4 Valves shall contain an actuated flow control portion that responds to the modulating signal from the controller. This control valve portion shall have a linear flow characteristic.
  - .5 Valves shall contain a field adjustable flow limiter. The flow limiter shall be easily adjustable in the field without the use of special tools. The adjustment dial shall be set for and indicate maximum flow. It shall be possible to manually limit the flow to the required value with the flow limiter and then modulate the flow with the control valve and actuator.
  - .6 A table shall be attached to each valve indicating GPM corresponding to each setting on the dial.
  - .7 The valve shall always maintain full nominal stroke regardless of the maximum flow setting of the flow limiter.
  - .8 The flow limiter shall be lockable and tamper resistant when the actuator is installed.
  - .9 At any given actuator setting the flow accuracy across the entire pressure independent operating range of the automatic differential pressure regulator shall be  $\pm 10\%$  or less
  - .10 Pressure ports shall be standard in the body of the valve for all flanged valves. Pressure ports shall provide a means for a balancer to test the differential pressure across the valve control port to ensure the PICV is operating within the pressure independent range.
  - .11 Valves 2-1/2 inch and larger line size shall meet or exceed ANSI Class IV (0 to 0.01% of nominal maximum) leakage rating at 100 psi close off.
  - .12 The differential pressure range for effective pressure independent operation shall be 3.6 – 90 psi or 8 – 90.

- .5 Valve materials:
  - .1 Valve body: Cast iron
  - .2 Stem, spring: Stainless steel
  - .3 Seat: Stainless steel
  - .4 Plug: Brass and EPDM
  - .5 Seals: EPDM
  - .6 Valves 2 inch and below shall be screwed connection.
  - .7 Valves 2-1/2 inch and larger shall be provided with ANSI 125 or ANSI 250 flanged connections.
  - .8 Actuators shall be UL and CSA listed.
- .6 Failure conditions:
  - .1 Heating Valves shall fail open.
  - .2 Chilled Water Coils shall fail closed.
  - .3 Reheat Coils shall fail closed.
  - .4 Perimeter Heating Units and fan coils shall fail open.

## 2.12 TRIPLE DUTY VALVES

- .1 All triple duty valves shall provide three functions:
  - .1 Isolation: Positive drip-tight shut-off.
  - .2 Backflow: Spring-closure type silent non-slam check valve.
  - .3 Balancing: flow reduction thru a throttling capability.
- .2 The valve shall have four, NPS ¼ (¼"Ø) threaded brass ports with check valves and caps located two each, inlet and outlet.
- .3 NPS 3 (3"Ø) and over, Flanged / Grooved End:
  - .1 Valve shall be straight or angle pattern.
  - .2 Ductile iron body, brass stem and bronze disc, EPDM seals. Brass fittings for metering ports.
  - .3 Extended stainless steel stem for handle operation outside insulation.
  - .4 Rated for a working pressure of 2068 kPa (300 psi).
- .4 Valve shall be complete with preformed fiberglass insulation housing with PVC jacket.

## 2.13 GLYCOL FLUID

- .1 Fill Glycol Systems with a glycol solution of 40% (by volume) propylene glycol complete with ortho-phosphate inhibitor and 60% (by volume) de-mineralized water.
- .2 Fill system and glycol mixing tank with solution and provide spare capacity for one fill of glycol mixing tank.

## **2.14 PIPE EXPANSION PROVISIONS**

- .1 The system will be free floating system.
- .2 Expansion joint consisting of series of grooved end pipe nipples joined in tandem with flexible couplings. Total joint movement xx mm (xx") utilizing x number of couplings and nipples.
- .3 Guides and Anchors: Locations as indicated and detailed or as proposed by contractor.
  - .1 Anchors: Attachment to structure to be reviewed with and approved by the structural engineer.
  - .2 Alignment guides: To accommodate specified thickness of insulation.
- .4 Expansion loops: Utilize expansion loops as indicated. Where Z-bends, U-bends or pipe loop expansion arrangements are used, provide anchors and guides to direct movement along axis of joint. Guide spacing to take into consideration the column buckling strength of the pipe
- .5 Bellows type expansion joints:
  - .1 For axial, lateral or angular movements, as indicated.
  - .2 Bellows: multiple bellows, hydraulically formed, two ply, stainless steel.
  - .3 Reinforcing or control rings: 2 piece nickel iron.
  - .4 Ends: flanged.
  - .5 Liner: austenitic stainless steel in direction of flow.
  - .6 Shroud: carbon steel, painted.

## **2.15 PIPE WELDING**

- .1 Pipe welding shall be in conformance with the AWA (American Welding association) standards.
- .2 Steel Butt Weld Fittings: to ANSI B16.9, latest edition.
- .3 Steel Socket Weld Fittings: to ANSI B16.11, latest edition.
- .4 Electrodes: Certified by Canadian Welding Bureau to appropriate CSA W48 standard.

## **2.16 DRAIN VALVES AND AIR VENTS**

- .1 Provide drain valves at low points in system piping and manual air vents at high points in system piping. Provide automatic air vents at top of system and at point of controlled air / water separation.
- .2 Drain Valves: NPS ¾ (3/4"Ø) ball valves with hose end connection.
- .3 Manual Air Vents: NPS ¼ (1/4"Ø) plug valves.
- .4 Automatic Air Vents: standard float type vent: brass body and NPS [1/8] connection and rated at 690 kPa (100 psi) working pressure. Equip automatic air vents with isolation valves to permit servicing without draining the system.

## 2.17 JLR AND OWNER SPECIFIED PRODUCTS

- .1 Refer to Division 00 and 01 for requirements for alternate manufacturer's to those listed below:
- .2 The following are Owner acceptable manufacturers, all others will be rejected unless pre-approved during tender:
  - .1 All Valves Kitz, Nibco
  - .2 Backflow Preventors Zurn, Conbraco
  - .3 Vacuum Breakers Watts, Zurn
  - .4 T&P Relief Valves Watts, Conbraco
  - .5 Hose Bibb Zurn, Watts
  - .6 Pressure Reducing Regulators Zurn, Watts
  - .7 Thermometers and Pressure Gauges Winters, Wika, Weiss
  - .8 Suction Diffusers / Triple Duty Valves Armstrong, B&G, Emmerson
  - .9 Air Vents Maid o Mist, Sarco
  - .10 Pressure Independent Control Valves Tour and Anderson, Siemens
  - .11 JLR Specified Products and bases of design: Nil

## PART 3 - EXECUTION

### 3.1 GENERAL

- .1 Comply with piping installation requirements of Section 23 05 05 – Installation of Pipe.
- .2 Ream pipes, clean scale and dirt, inside and out, before and after assembly. Cap open ends of piping during installation.
- .3 Grade horizontal water piping down minimum 1:700 (1" in 40'-0"). Install drain valves at all low points, manual air vents at high points.
- .4 Provide screwed or flanged joints in accessible locations. Provide access doors as required.
- .5 Install flanges or unions at connections to all equipment.
- .6 Reduce fittings to be eccentric and installed so as not to trap air.
- .7 Provide dielectric couplings for joining dissimilar metals.
- .8 Use valves and strainers of same size as pipe to which they are connected, unless otherwise indicated.
- .9 Valves to be accessible. Make valves removable without dismantling adjoining pipe.
- .10 Provide clearance for installation of insulation and access for maintenance of equipment, valves and fittings.
- .11 Make provision for thermal expansion of piping system and building structure through use of expansion joints, expansion loops and bends and appropriate supports, anchors and guides. .

### 3.2 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

### 3.3 PIPE SYSTEM APPLICATION

- .1 Utilize the following table to determine design operating conditions, acceptable materials and methods for different hydronic piping applications.
- .2 Ensure that all personnel involved in the installation of manufacturer's products are fully conversant with the pipe end preparation, tools and requirements.
  - .1 Correct coupling and / or fitting selection to suit the application.
  - .2 Proper assembly of joints to accommodate expansion, contraction and/or flexibility as required.
  - .3 Adherence to specifications and/or recommendations with respect to support, anchoring and guiding of piping systems.

Piping System Application Guide					
Piping Service	Operating Temperature	Maximum Operating Pressure	Pipe Size	Acceptable Pipe Material	Acceptable Pipe Joints
Chilled Water or Chilled Glycol Supply and Return (Insulated)	0 °C – 24 °C (32°F – 75°F)	861 kPa (125 PSI)	≤ NPS 2 ½ (2 ½"Ø)	Copper Steel SCH 40	Soldered, Screwed, Welded, Flanged,
			NPS 2 ½ (2 ½"Ø) to NPS 6 (6"Ø)	Steel SCH 40	Welded, Flanged (Victaulic Coupling within Mechanical Rooms)
Low Temp Heating Water or Heating Glycol Supply and Return (Insulated)	38 °C – 60 °C (100°F-140°F)	861 kPa (125 PSI)	≤ NPS 2 ½ (2 ½"Ø)	Copper Steel SCH 40	Soldered, Screwed, Welded, Flanged,
			NPS 2 ½ (2 ½"Ø) to NPS 6 (6"Ø)	Steel SCH 40	Welded, Flanged (Victaulic Coupling within Mechanical Rooms)
High Temp Heating Water or Heating Glycol Supply and Return (Insulated)	61 °C – 99 °C (140°F-210°F)	861 kPa (125 PSI)	≤ NPS 2 ½ (2 ½"Ø)	Copper Steel SCH 40	Soldered, Screwed, Welded, Flanged
			NPS 2 ½ (2 ½"Ø) to NPS 6 (6"Ø)	Steel SCH 40	Welded, Flanged, ((Victaulic Coupling within Mechanical Rooms)

### 3.4 PIPE SUPPORT

- .1 Support and install piping in accordance with Section 23 05 05 – Installation of Pipe.
- .2 Provide proper alignment and grade to ensure that the piping system and pipe-supporting elements are protected from excessive stress and distortion from all concurrently acting static and dynamic loads.

- .3 Vertical piping: Support or anchor vertical piping at its base and provide a minimum of one intermediate clamp for every other length of pipe except on hot water risers. Clamp every length of pipe with clamps that prevent angular movement on hot water risers where tee fittings are used. Where pipe is installed with fewer or no intermediate clamps supports or anchor the base of the piping and provide sufficient guides to prevent buckling of the pipe.
- .4 Provide independent support at equipment connections, concentrated equipment loads (fittings, valves, accessories, etc.), and changes in pipe direction. For grooved joint piping systems support within 600 mm (2') either side of joining coupling.
- .5 In addition to the pipe supports identified above, refer to the following schedule for minimum hanger spacing for straight length of piping.

Pipe Size	Maximum Support Spacing Copper Piping	Maximum Support Spacing Sch 40 Steel Piping
NPS ½ (1/2"Ø) - NPS ¾ (3/4"Ø)	1.5 M (5')	2.1 M (7')
NPS 1 (1"Ø) - NPS 1 ½ (1 1/2"Ø)	1.8 M (6')	2.1 M (7')
NPS 2 (2"Ø)	2.4 M (8')	3.0 M (10')
NPS 2 ½ (2 ½"Ø)	2.7 M (9')	3.3 M (11')
NPS 3 (3"Ø)	3.0 M (10')	3.6 M (12')
NPS 4 (4"Ø)	3.6 M (12')	4.2 M (14')
NPS 6 (6"Ø)		4.8 M (16')
NPS 8 (8"Ø)		5.5 M (18')
NPS 10 (10"Ø)		6.7 M (22')
NPS 12 (12"Ø)		6.7 M (22')

### 3.5 VALVING

- .1 Provide valve type as indicated on drawings. Where not indicated, provide valving in accordance with the following where "R" refers to Required / Recommended and "A" refers to Acceptable Alternate:

Piping Valve Application Guide												
Service / Application		Isolation		Balancing & Isolation		Check Valve	Strainer	Suction Diffuser	Balancing		Triple Duty Valve	Notes:
		Ball Valve	Butterfly Valve	PIC Valve					Balancing Globe Valve	Calibrated Globe Valve		
Heating Pump <NPS 3 (3"Ø) Line Size	Inlet	R						R				
	Outlet	R									R	
Heating Pump ≥NPS 3 (3"Ø) Line Size	Inlet		R					R				
	Outlet		R								R	
AHU Coils	Inlet	A	A	R			R					
	Outlet	A	A									
Equipment	Inlet	A	A	R								
	Outlet	A	A									
Fan Coils Baseboard Htr Convectors Unit Heaters <NPS 2 (2"Ø) Line Size	Inlet	R		R								
	Outlet	R										
Control Valves with Bypass	Inlet	A	A	R			R					
	Outlet	A	A									
Control Valve Bypass		A	A									
Branch Piping / Risers		A	A									
Flow Maintenance, End of Line Bypass										R		

### 3.6 SPECIFIC INSTALLATION REQUIREMENTS

- .1 Valve Installation:
  - .1 Install isolation valves at branch take-offs and to isolate each piece of equipment, and as indicated.
  - .2 Install swing check valves in horizontal lines or provide spring operated check valves where flow direction is down.
  - .3 Install chain operators on valves NPS 4 (4"Ø) and over where installed more than 2400 mm above floor in Mechanical Equipment Rooms.

.2 Circuit Setter Valves:

- .1 The valve shall be installed with flow in the direction of the arrow on the valve body and installed at least five pipe diameters downstream from any fitting, and at least ten pipe diameters downstream from any pump. When installed, easy and unobstructed access to the valve handwheel and metering ports for adjustment and measurement are to be provided.
- .2 Remove handwheel after installation and when TAB is complete.
- .3 Install Manufacturer's pre formed insulation and secure and tape joints in prefabricated insulation.

### 3.7 PIPE WELDING

.1 General:

- .1 Identify each weld with welder's identification symbol.
- .2 Equip welders with fire extinguishers. Observe necessary fire prevention precautions such as shields to minimize fire risk.

.2 Welding:

- .1 Use only piping with machine bevelled ends for welded runs. Machine bevel pipe and fitting ends. If machining is impractical, prepare ends by grinding or by flame cutting and subsequent grinding back 3 mm (1/8") prior to welding. Clean each joint internally, swab and remove scale, surface cracks, oil, grease, oxides or other foreign matter.
- .2 Make welds full penetration, continuous and without defects. Clean each layer of weld to remove slag and scale by wire brushing or grinding. Chip where necessary to prepare for proper deposition of next layer. Weld reinforcement to be not less than 1.6 mm (1/6") and not more than 3 mm (1/8") above normal surface of jointed sections. Crown reinforcement at centre and merge into base material without excessive shoulder on undercut.

.3 Welding Inspection:

- .1 Make work available at any time for inspection. Cover or insulate welds only after inspection carried out.
- .2 Contractor shall engage an experienced firm specialized in radiography to Gamma-ray radiograph and perform these inspections on 5% of welded joints in low pressure hot and cold water systems. Radiograph welded joints over full circumference. The selection of the welds to be inspected shall be done by the Consultant.
- .3 Perform radiography in accordance with Article 3 of Section 5 of the ASME Boiler and Pressure Vessel Code and CGSB-48-CP-2. Include all costs in this contract.
- .4 Cut out and replace welds of poor or doubtful quality with satisfactory welds.
- .5 One or more of the following defects to cause rejection of weld:
  - .1 Failure to meet radiographic requirements or other code tests.
  - .2 Welding performed by unqualified personnel.
  - .3 Welds not reasonably uniform in appearance.
  - .4 Evidence of peening.
  - .5 Cracks.
  - .6 Oxidation around welds.
  - .7 Lack of fusion.
  - .8 Presence of porosity, slag inclusion or overlaps.
  - .9 Undercutting adjacent to completed welds or evidence of undercutting by grinding.

### 3.8 PIPING SYSTEM TESTING

- .1 Piping systems may be tested in whole or partial systems; however, all piping systems shall be subjected to testing.
- .2 Contractor to complete installation inspection, integrity (pressure, leak) tests and support system inspection before system is insulated, concealed, or covered in any way. Piping not to be covered until all inspection and testing deficiencies have been corrected and successful re-testing has been complete.
- .3 Coordinate with authority having jurisdiction the requirement of the authority to witness tests and inspect piping system.
- .4 Isolate any equipment not capable of withstanding test pressure. Equipment shall be isolated from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against the test pressure without damage to valve. Blind flanges shall be installed to isolate equipment.
- .5 Safety valves shall be set at a pressure no more than one-third higher than the test pressure to protect against damage by expanding liquid or other source of overpressure during test.
- .6 During testing, expansion tanks shall be isolated from the system.
- .7 Verify that hydronic system is full of water before starting the test. Allow water to reach ambient temperature prior to initiating the test procedures.
- .8 The hydronic piping system shall be subjected to hydrostatic test pressure that is not less than 1.5 times the system's working pressure or 861 kPa (125 PSI) whichever is greater. The test pressure shall not exceed the maximum pressure for any vessel, pump, valve, or other component in system under test.
- .9 After hydrostatic test pressure has been applied for at least 10 minutes, the piping, joints, and connections shall be examined for leakage. Leaks shall be eliminated by tightening, repairing, or replacing components. The hydrostatic test shall be repeated until there are no leaks.
- .10 Maintain test pressure for four (4) hours without drop in pressure.
- .11 Contractor to complete installation inspection, integrity (pressure, leak) tests and support system inspection before system is insulated or enclosed. Piping not to be covered until all inspection and testing deficiencies have been corrected and successful retesting has been completed.

### 3.9 FLUSHING AND CLEANING

- .1 All heating and cooling piping systems shall be cleaned and flushed in accordance with the procedures provided by the University's approved water treatment supplier prior to operation, and before being connected to the University's distribution system.
- .2 Provide temporary pump and all necessary equipment for flushing system.
- .3 Flush out after pressure test for a minimum of four (4) hours.
- .4 Fill with solution of water and non-foaming, phosphate-free detergent 3% solution by weight. Circulate for minimum of 8 hours.

- .5 Drain and flush for two (2) hours. Remove and clean strainers.
- .6 Provided all work is complete, remove construction strainer baskets and replace with operational strainer baskets.
- .7 Refill system with glycol or clean water adding water treatment as specified.

### **3.10 FLOW BALANCING**

- .1 In accordance with Section 23 05 93 – Testing, Adjusting and Balancing for HVAC for applicable procedures.
- .2 Balance water systems to within plus or minus 5 % of design flow.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 SCOPE DESCRIPTION SUMMARY**

- .1 This section describes the specialties to be installed with the installation of the hydronic HVAC distribution piping within the building.

### **1.2 REFERENCES**

- .1 Unless dated references are identified below, it shall be the latest standard issued by the regulatory agency that shall be utilized as the applicable reference.
- .2 Canadian Standards Association (CSA International):
  - .1 CSA B51 - Boiler, Pressure Vessel, and Pressure Piping Code.
- .3 American Society of Mechanical Engineers (ASME):
  - .1 ASME B40.100 - Pressure Gauges and Gauge Attachments.
  - .2 ASME B40.200 - Thermometers, Direct Reading and Remote Reading.
- .4 Canadian General Standards Board (CGSB):
  - .1 CAN/CGSB-14.4 - Thermometers, Liquid-in-Glass, Self-Indicating, Commercial/Industrial Type.
- .5 University of Guelph Metering Standard (15930).

### **1.3 INFORMATIONAL SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 01 - Submittals.
- .2 Product Data:
  - .1 Product data shall be submitted for all PART 2 – PRODUCTS specified herein.
  - .2 Provide manufacturer's printed product literature and datasheets for material specified, and include product characteristics, performance criteria, physical size, finish and limitations.
  - .3 Product data shall include all maintenance access points and dimensional clearances, such that the contractor can properly layout the equipment to ensure proper access.
  - .4 Product data shall include all relevant information to confirm the specifications have been met.
  - .5 Product data shall provide all relevant data and operational points that verify the engineered criteria have been met and that field operational tolerances can be accommodated, i.e.; equipment are not supplied, which are operating at their upper and lower limits for their design duty performance.
  - .6 Product data shall identify all ancillary field installed devices and provide all information required for the coordination of the installation with other trades.
  - .7 Product data shall include information as specified in Section 20 01 01 - Common Work Results – Mechanical Submittals unless modified with additional information required below.
- .3 Maintenance Data:
  - .1 Provide maintenance data including certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties, for incorporation into manuals specified in Section 01 77 00– Closeout Procedures.

- .2 Maintenance data shall include but not be limited to:
  - .1 Certificates, signed by the manufacturer or their representative, certifying that the materials have been installed as per their installation instructions.
  - .2 The manufacturer's maintenance and installation data.
  - .3 Safety informational data for maintenance staff prior to performing maintenance requirements.
  - .4 List of all routine maintenance requirements as well as monthly, annual or other periodical maintenance recommendations from the manufacturer.

#### **1.4 MAINTENANCE REQUIREMENTS**

- .1 The Contractor shall verify and demonstrate that proper maintenance can be performed on equipment and material installed.

#### **1.5 QUALITY ASSURANCE**

- .1 Performance Requirements Defined: catalogued or published ratings for manufactured items obtained from tests carried out by manufacturer or those ordered by manufacturer from an independent testing agency signifying adherence to codes and standard and standardized testing of performance criteria.
- .2 Where applicable equipment shall bear a ULC or UL label.

### **PART 2 – PRODUCTS**

#### **2.1 GENERAL**

- .1 The hydronic distribution system, including specialties shall meet or exceed the following performance characteristics:
  - .1 Temperature Range: -25°C to 99°C (-15°F to 210°F).
  - .2 Pressure Range: Maximum 690 kPa (100 PSI).
- .2 Minimum services rating to be 1034 kPa (150 PSI) or system pressure, whichever is greater.

#### **2.2 EXPANSION TANKS**

- .1 Expansion Tanks – Replaceable Diaphragm Type:
  - .1 Provide steel pressurized diaphragm type expansion tank with diaphragm compatible with operating fluid. Tank to be ASME certified. Provide vertical tanks as indicated and/or scheduled.
  - .2 Pre-charge tank to 83 kPa (12 PSI).
  - .3 Elastomer Butyl / EPDM diaphragm to be replaceable and suitable for 116°C (240°F) operating temperature.
  - .4 Provide all saddles and/or straps as required to meet the installation requirements.
  - .5 Provide pressure gauge, air-loading Schrader valve with stop, and bottom drain connection.

## **2.3 AIR SEPARATORS**

- .1 Cyclonic Air Separator:
  - .1 Provide centrifugal type air separator with strainer.
  - .2 Unit to be fabricated of steel to ASME ratings for 860 KPa (125 PSI).
  - .3 Unit to have flanged or grooved inlet and outlet connections and separate top connection for venting and bottom connection for blowdown.

## **2.4 MAKE-UP WATER AND WATER FILL ASSEMBLY**

- .1 Make up water assembly shall consist of a NPS 1 ¼ (1 1/4"Ø) main water line with isolation ball valve and NPS 1 ¼ (1 1/4"Ø) reduced pressure principle backwater valve. Downstream will be a tee connection to a NPS 1 ¼ (1 1/4"Ø) bypass around a pressure reducing valve. The bypass will be equipped with an isolation lock shield ball valve with the handle removed. The pressure reducing valve shall be NPS ¾ (3/4"Ø) with isolation ball valves on the inlet and outlet. The discharge of the assembly shall be equipped with a pressure gauge and a temperature and pressure relief valve.

## **2.5 REDUCED PRESSURE PRINCIPLE BACKFLOW PREVENTERS**

- .1 General: Backflow Preventers shall comply with CSA B64 SERIES-11 - Backflow Preventers and Vacuum Breakers.
- .2 The assembly shall also include two quarter turn ball vales for isolation at the inlet and outlet, one strainer downstream of inlet ball valve, two in-line independent check valves with an intermediate relief valve, four test cocks and an air gap drain fitting.
- .3 Construction:
  - .1 All components shall be lead free cast copper or cast bronze body construction.
  - .2 Silicone rubber disc material in the first and second check plus the relief valve. Replaceable polymer check seats for first and second checks. Removable stainless steel relief valve seat. Stainless steel cover bolts.
  - .3 Air gap drain fitting shall be cast bronze.

## **2.6 PRESSURE REDUCING REGULATORS**

- .1 General: domestic water pressure reducing regulators shall comply with CSA B356 Water pressure reducing valves for domestic water supply systems.
- .2 Capacity: maximum inlet pressure: 1034 kPa (150 PSI), outlet pressure of 172 kPa (25 PSI) to 518 kPa (75 PSI) field adjustable.
- .3 Construction: lead free, cast bronze body and bell, stainless steel seat, stem, and sleeve, stainless steel strainer screen, EPDM seals. Soldered inlet and outlet connections.
- .4 Pressure gauges on inlet and discharge.

## **2.7 TEMPERATURE AND PRESSURE RELIEF VALVES**

- .1 General: valve shall be ASME rated and CSA listed.
- .2 Pressure relief valves shall be selected for the appropriate application and exceed the required relief flow capacity. Pressure relief valves shall be provided as indicated and specified, and as required protecting the system from excessive pressure. Valves shall be complete with an extension thermostat for temperature monitoring and a test lever for periodic testing.
- .3 Construction: main valve body cast brass or bronze, stainless steel internal components, silicone seals, stainless steel springs, copper encased thermostat probe.
- .4 Pressure – Temperature Settings:
  - .1 Temperature relief 99°C (210°F);
  - .2 Pressure range 517 – 1034 kPa (75 – 150 PSI);
  - .3 Determine application pressure relief setting prior to installation.

## **2.8 GLYCOL MAKE-UP / FILL SYSTEM**

- .1 Provide prefabricated, automatic standalone glycol make-up package, including glycol tank, stand, pump, wiring, piping, valves and controls.
- .2 Glycol tank to be of 190 L (50 Gal) constructed from stainless steel, capable of operating with 115 °C (240 °F) internal fluid temperature without leaking or deforming. Tank shall be complete with lid with hinged access.
- .3 Pumping assembly to consist of a positive displacement gear pump capable of 13 Lit/m (3.6 gpm) at 690 kPa (100 PSI) discharge pressure, with a 1/2 hp, 120V / 1 Phase electric pump. Inlet to pump shall be equipped with an isolation valve and strainer on inlet connection to tank. Discharge to be equipped with check valve, pressure switch, pressure relief valve (piped back to tank), pressure gauge, and an isolation valve. All components to be metal and rated for high temperature fluid.
- .4 Unit to be complete all piping and fittings to provide a complete system. Unit to be pre wired and complete with a magnetic starter with indicator lights for running and powered.
- .5 Controls to consist of high-pressure cut-off alarm, low level alarm and automatic fill system based on pressure switch.
- .6 Complete unit shall be factory assembled and mounted on a steel support legs with an exterior red primer finish.

## **2.9 PUMP FLEXIBLE CONNECTION**

- .1 Application: to suit motion.
- .2 Minimum Length: 150 mm (6") or in accordance with manufacturer's recommendations to suit offset. Inner hose: bronze corrugated. Braided wire mesh bronze outer jacket. Flanged connections.
- .3 Operating Conditions: To match system requirements.

## **2.10 VACCUUM BREAKERS**

- .1 Vacuum Breaker: brass vacuum breaker adjustable to control induced vacuum with range of 62 to 4980 Pa ( $\frac{1}{4}$ " to 20" w.g.) vacuum complete with swing check valves. Factory preset at 500 Pa (2" w.g.).

## **2.11 PRESSURE GAUGES**

- .1 Pressure Gauges: 112 mm (4  $\frac{1}{2}$ ") round dial type, stainless steel bourdon tube having 0.5% accuracy, black aluminum case with glass dial cover. Movement to be brass rotary type with bronze bushings. Equip gauges with dial face zero reset screw.
- .2 Scale: black embossed figures on white background indicating dual kPa and PSI pressures. Providing a 0 to 700 kPa (0 to 100 PSI) range with 50 kPa (1 PSI) increments.
- .3 Provide bronze needle valve for isolation.

## **2.12 THERMOMETERS**

- .1 Thermometers: industrial type, adjustable angle, with 225 mm (9") molded polyester case and brass stem, non-mercury filled with coloured indication.
- .2 Scale: black embossed figures on white background indicating dual Fahrenheit and Celsius temperatures. Providing a -1 to 115 °C (30 to 240 °F) range with 1°C (2°F) increments.
- .3 Provide stainless steel thermometer wells filled with heat conductive paste.

## **2.13 ENERGY METER**

- .1 Chilled water meter electrode shall be constructed of stainless steel.
- .2 Units provided with a local digital display with tonnes and digital 4-20mA output to tie into the University of Guelph building automation system.
- .3 Provide inline electronic magnetic meter, complete with proper grounding, temperature sensors, metering flow computer with display, and warranty.
- .4 To use polyurethane sensor liner.
- .5 The temperature sensors must be supplied on both supply and return lines, supplying a 4-20mA output signal. Temperature sensors must be properly orientated and verified for accuracy. Output of temperature and meter must be combined to display units required. The meter body shall include grounding and empty pipe electrodes of the same material as the measuring electrodes.
- .6 Meter must be H.A.R.T. compatible.
- .7 The magnetic flowmeter shall be microprocessor based with integral electronics.
- .8 LCD display shall enable the operator to monitor flow rate in clear text messages.

- .9 The meter shall have field replaceable sensors and coils
- .10 The magnetic flowmeter shall provide an accuracy of +/- 0.5% of flow rate.
- .11 It should be possible to check the functionality and verify deviation of the flow meter without needing to dismantle the device by using an external device. This Verification of transmitter electronics should be traceable to NIST or equivalent standards.

## 2.14 JLR AND OWNER SPECIFIED PRODUCTS

- .1 Refer to Division 00 and 01 for requirements for alternate manufacturer's to those listed below:
- .2 The following are Owner acceptable manufacturers, all others will be rejected unless pre-approved during tender:
  - .1 All Valves Kitz, Nibco
  - .2 Expansion Tanks Amtrol, B&G, Armstrong
  - .3 Air Separators Amtrol, B&G, Armstrong
  - .4 Backflow Preventors Zurn, Conbraco
  - .5 Pressure Reducing Regulators Zurn, Watts
  - .6 Vacuum Breakers B&G, Spirax Sarco, Cashamce
  - .7 T&P Relief Valves Watts, Conbraco
  - .8 Glycol make up / fill systems Suez
  - .9 Thermometers and Pressure Gauges Winters, Wika, Weiss
  - .10 Energy Meters Endress & Hauser, Rosemount, Spirax Sarco
  - .11 Air Vents Maid o Mist, Sarco
  - .12 Pressure Independent Control Valves Tour and Anderson, Siemens
- .3 JLR Specified Products and bases of design:
  - .1 Flexible Connections Flexonics

## **PART 3 - EXECUTION**

### 3.1 GENERAL

- .1 Comply with piping installation requirements of Section 20 05 05 – Installation of Pipe.
- .2 Provide screwed or flanged joints in accessible locations. Provide access doors as required.
- .3 Install flanges or unions at connections to all equipment.
- .4 Provide clearance for installation of insulation and access for maintenance of equipment, valves, fittings.
- .5 Run drain lines and blow off connections to terminate above nearest drain.
- .6 Check shop drawings for conformance of tappings for ancillaries and for equipment operating weights.

### **3.2 MANUFACTURER'S INSTRUCTIONS**

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

### **3.3 EQUIPMENT SPECIFIC INSTALLATION REQUIREMENTS**

- .1 Expansion Tanks:
  - .1 Floor mounted vertical expansion tanks shall be mounted on a housekeeping pad.
  - .2 Provide saddles as required for horizontal expansion tank mounting.
  - .3 Adjust expansion tank pressure to suit design criteria.
  - .4 Install lock shield type ball valve at inlet to tank.
- .2 Backflow Preventers:
  - .1 Pipe overpressure discharge thru indirect drain connection to drain.
- .3 Pressure Relief Valves:
  - .1 Pipe discharge to drain. Piping not to rise to create liquid pockets.
- .4 Glycol Fill System:
  - .1 Fill system with specified glycol, and leave tank  $\frac{3}{4}$  full following commissioning.
  - .2 Adjust operating pressure set points and safety relief valve set points.

### **3.4 PRESSURE GAUGE INSTALLATIONS**

- .1 Install so they can be easily read from floor or platform.
- .2 Install between equipment and first fitting or valve.
- .3 Use extensions where pressure gauges are installed through insulation.
- .4 Provide isolation needle valves to isolate pressure gauge for servicing.
- .5 Install single gauge on pipe manifold, serving the following functions:
  - .1 Suction and discharge of pumps and strainers.
- .6 Install single gauges in following locations:
  - .1 Upstream and downstream of PRV's.
  - .2 Upstream and downstream of primary control valves.
  - .3 Inlet and outlet of heat exchangers.
  - .4 Outlet of expansion tank
  - .5 In other locations as indicated.

### **3.5 THERMOMETER INSTALLATIONS**

- .1 Install so they can be easily read from floor or platform.
- .2 Install between equipment and first fitting or valve.
- .3 Use extensions where thermometers are installed through insulation.
- .4 Install in wells on piping. Provide heat conductive material inside well.
- .5 Install in the following locations:
  - .1 Inlet and outlet of heat exchangers.
  - .2 Inlet and outlet of water heating and cooling coils.
  - .3 In other locations as indicated.
- .6 Install wells as indicated only, for balancing purposes.

### **3.6 ENERGY METER INSTALLATION**

- .1 Install as per University Metering Standard and instructions and guidelines
- .2 Install Steam Meter and Chilled Water Energy Meter as indicated..
- .3 All meter location must be accessible and located in a position that allows ease of maintenance and removal without interfering with the meter accuracy or installation practices.
- .4 Meter shall be installed with proper orientation, up and down stream distances and proper grounding as per manufacturer.
- .5 Provide all upstream and downstream minimum distances as specified by supplier.
- .6 To make good on all surroundings after completion of installation of meter.
- .7 Provide insulation by approved sub-contractor to include meter body, surrounding flanges and unions.
- .8 Meters, valves, and bypasses should be supported with appropriate adjustable pipe stands. bricks, concrete or wood blocking are not acceptable means of support.
- .9 Meter installations must be checked for leakage or contaminants at completion of the installation, the proper operation of the meter should be established.
- .10 All flange connections must be supplied with an asbestos-free gasket material to meet temperature and pressure for service.
- .11 All documentation and related work shall be provided for the flow rate specified, commissioning, calibration, verification, performance specification and warranty related to the metering device.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 SCOPE DESCRIPTION SUMMARY**

- .1 This section describes the pumps required for the operation of hydronic HVAC piping systems within the building, operating to 121°C (250°F) and 1207 kPa (175 psi).
- .2 Pumping applicable to:
  - .1 Hydronic Heating Piping Systems.
  - .2 Hydronic Glycol Piping Systems.

### **1.2 REFERENCES**

- .1 Unless dated references are identified below, it will be the latest standard issued by the regulatory agency that will be utilized as the applicable reference.
- .2 American Society of Heating Refrigeration and Air-Conditioning Engineers (ASHRAE):
  - .1 Standard 90.1 - Energy Standard for Buildings except Low-Rise Residential Buildings.
- .3 Canadian Standards Association (CSA International):
  - .1 CSA-B214 - Installation Code for Hydronic Heating Systems.
- .4 National Electrical Manufacturers' Association (NEMA):
  - .1 NEMA MG 1 - Motors and Generators.

### **1.3 INFORMATIONAL SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 01 – Submittals.
- .2 Product Data:
  - .1 Product data will be submitted for all PART 2 – PRODUCTS specified herein.
  - .2 Provide manufacturer's printed product literature and datasheets for material specified, and include product characteristics, performance criteria, physical size, finish and limitations.
  - .3 Product data will include all maintenance access points and dimensional clearances, such that the contractor can properly layout the equipment to ensure proper access.
  - .4 Product data will include all relevant information to confirm the specifications have been met.
  - .5 Product data will provide all relevant data and operational points that verify the engineered criteria have been met and that field operational tolerances can be accommodated, i.e., equipment are not supplied, which are operating at their upper and lower limits for their design duty performance.
  - .6 Product data will identify all ancillary field installed devices and provide all information required for the coordination of the installation with other trades.
  - .7 Product data will include any relevant information that Division 25 requires for a properly functioning building automation system.
  - .8 Product data will include information as specified in Section 20 01 01 – Common Work Results for Mechanical unless modified with additional information required below.

.3 Maintenance Data:

- .1 Provide maintenance data including certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties, for incorporation into manuals specified in Section 01 77 01 – Closeout Procedures.
- .2 Maintenance data will include but not be limited to:
  - .1 Certificates, signed by the manufacturer or their representative, certifying that the materials have been installed as per their installation instructions.
  - .2 The approved shop drawings with performance criteria edited with field observations and commissioned operational set points and adjustments.
  - .3 The manufacturer's maintenance and installation data.
  - .4 Safety informational data for maintenance staff prior to performing maintenance requirements.
  - .5 List of all routine maintenance requirements as well as monthly, annual or other periodical maintenance recommendations from the manufacturer.
  - .6 Any maintenance requirements that may affect the warranty periods of the associated equipment.

**1.4 MAINTENANCE REQUIREMENTS**

- .1 Contractor will verify and demonstrate that proper maintenance can be performed on equipment and material installed.
- .2 Contractor will supply the following materials to site just prior to substantial being awarded.
  - .1 Provide one replacement filter for each installed filter.

**1.5 QUALITY ASSURANCE**

- .1 Performance Requirements Defined: catalogued or published ratings for manufactured items obtained from tests carried out by manufacturer or those ordered by manufacturer from an independent testing agency signifying adherence to codes and standard and standardized testing of performance criteria.
- .2 Electrical equipment will bear a CSA label or have an ESA certification.
- .3 Where applicable equipment will bear a ULC or UL label.
- .4 Provide and construct mock-ups in accordance with Section 01 45 01 – Quality Control.

**1.6 COMMISSIONING**

- .1 General: in accordance with Sections 01 91 01 – Commissioning, 20 08 02 – Commissioning – Cleaning and Start-up of Mechanical Systems.
- .2 In accordance with manufacturer's recommendations.

## **PART 2 - PRODUCTS**

### **2.1 GENERAL**

- .1 The hydronic pumping system, will meet or exceed the following performance characteristics:
  - .1 Temperature Range: -25°C to 121°C (-15°F to 250°F).
  - .2 Pressure Range: maximum 690 KPa (100 psi).
- .2 Minimum services rating to be 1207 kPa (175 psi) or system pressure, whichever is greater.
- .3 All pumps will be equipped with metal impellers. Non-metal impellers will not be acceptable.
- .4 Distribution pumps will be duplex, arranged in parallel and each pump capable of 100% of the system capacity.

### **2.2 IN-LINE CENTRIFUGAL PUMPS**

- .1 The pump (s) will be in line type, close coupled, single stage design. Pumps will be capable of mounting in the vertical position. Provide pumps in accordance with scheduled performance criteria.
- .2 Pump will be rated for a minimum of 1207 kPa (175 PSI) working pressure. The housing will be hydrostatically tested to 150% maximum working pressure.
- .3 Construction:
  - .1 Volute and Frame Casing: cast ductile iron construction, with flanged inlet and discharge with integrally cast support. Suction and discharge will be provided with drilled and tapped seal vent and pressure gauge connections. Casing will be radially split to allow for removal of the rotating element without disturbing pipe connections.
  - .2 Impeller: impeller will be machined cast bronze, enclosed type, statically and hydraulically balanced. Impeller will be keyed to the shaft and secured by a hex head impeller nut and washer.
  - .3 Pump Shaft: alloy steel shaft with bronze sleeve bearing.
  - .4 Seals: mechanical shaft seals for leak less operation. Seal will be internally flushed and a portion of the pumped liquid will be utilized to lubricate and cool the seal faces.
  - .5 Fittings: provide vent, and gauge connections.
- .4 Motor: motor will be premium-efficiency squirrel cage induction type motors and suitable for across-the-line (wye-delta, part wind) starting. Motors will also be capable of inverter duty and variable speed operation. The motor will be TEFC (totally enclosed, fan cooled), meet NEMA specifications and will be the RPM, size (HP), and voltage as indicated. Pump and motor will be factory aligned, and verified by the contractor following installation and realigned if required.
- .5 Variable Frequency Drive (VFD) to be provided by the manufacturer listed in Section 2.3 of this specification.
- .6 Each pump will be factory tested and painted with at least one coat of high-grade machinery enamel prior to shipment.

## **2.3 JLR AND OWNER SPECIFIED PRODUCTS**

- .1 Refer to Division 00 and 01 for requirements for alternate manufacturer's to those listed below:
- .2 The following are Owner acceptable manufacturers, all others will be rejected unless pre-approved during tender:
  - .1 In-line Pumps Armstrong
  - .2 Variable Frequency Drives ABB or Danfoss
  - .3 JLR Specified Products and bases of design: Nil

## **PART 3 - EXECUTION**

### **3.1 GENERAL**

- .1 Install hydronic pumps to CSA-B214.
- .2 Pumps will be fed from the building's dedicated Essential Power System.
- .3 In-line Circulators:
  - .1 Support at inlet and outlet flanges or unions.
  - .2 Install with bearing lubrication points accessible.
- .4 Ensure that pump body does not support piping or equipment. Provide stanchions or hangers for this purpose.

### **3.2 MANUFACTURER'S INSTRUCTIONS**

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

### **3.3 PUMP START-UP**

- .1 Procedures:
  - .1 Before starting pump, check that hydronic system over-temperature and other protective devices are installed and operative.
  - .2 After starting pump, check for proper, rotation and safe operation.
  - .3 Check installation, operation of mechanical seals, packing gland type seals. Adjust as necessary.
  - .4 Check base for free-floating, no obstructions under base.
  - .5 Run-in pumps for 12 continuous hours minimum.
  - .6 Verify operation of over-temperature and other protective devices under low- and no-flow condition.
  - .7 Eliminate air from scroll casing.
  - .8 Adjust water flow rate through water-cooled bearings.
  - .9 Adjust flow rate from pump shaft stuffing boxes to manufacturer's recommendation.
  - .10 Adjust alignment of piping and conduit to ensure true flexibility.
  - .11 Eliminate cavitation, flashing and air entrainment.
  - .12 Adjust pump shaft seals, stuffing boxes, glands.
  - .13 Measure pressure drop across strainer when clean and with flow rates as finally set.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 SCOPE DESCRIPTION SUMMARY**

- .1 This section describes the materials and methods for the installation of steam heating and steam process piping within the building for operating pressures up to 865 KPa (125 PSI).

### **1.2 REFERENCES**

- .1 Unless dated references are identified below, it shall be the latest standard issued by the regulatory agency that shall be utilized as the applicable reference.
- .2 CSA (Canadian Standards Association)
  - .1 CSA B51 – Boiler and Pressure Vessel Code.
- .3 ASME / ANSI (American Society of Mechanical Engineers) / (American National Standards Institute)
  - .1 ASME, Boiler and Pressure Vessel Code.
  - .2 ASME/ANSI B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300.
  - .3 ASME/ANSI B16.5 - Pipe Flanges and Flanged Fittings.
  - .4 ASME/ANSI B16.9 - Factory-Made Wrought Butt welding Fittings.
  - .5 ASME/ANSI B16.10 - Face-to-Face and End-to-End Dimensions of Valves.
  - .6 ASME/ANSI B16.15 - Cast Bronze Threaded Fittings.
  - .7 ASME/ANSI B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.
  - .8 ASME/ANSI B16.21 - Nonmetallic Flat Gaskets for Pipe Flanges.
  - .9 ASME/ANSI B16.25 - Butt welding Ends.
  - .10 ASME/ANSI B16.34 - Valves - Flanged, Threaded, and Welding End.
  - .11 ASME/ANSI B16.39 - Malleable Iron Threaded Pipe Unions.
- .4 ASTM International
  - .1 ASTM A53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
  - .2 ASTM A106 - Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service.
  - .3 ASTM A 47/A 47M - Standard Specification for Ferritic Malleable Iron Castings.
  - .4 B42 - Standard Specification for Seamless Copper Pipe, Standard Sizes.
  - .5 ASTM E 202 - Standard Test Method for Analysis of Ethylene Glycols and Propylene Glycols.
- .5 CSA International
  - .1 CSA B242 - Groove and Shoulder Type Mechanical Pipe Couplings.
  - .2 CSA W48 - Filler Metals and Allied Materials for Metal Arc Welding.
- .6 Manufacturer's Standardization of the Valve and Fittings Industry (MSS)
  - .1 MSS SP-92 - MSS Valve User Guide
  - .2 Gate Valves:
    - .1 MSS-SP-80, Bronze Gate, Globe, Angle and Check Valves.
    - .2 MSS-SP-70, Gray Iron Gate Valves, Flanged and Threaded Ends.

- .3 Ball Valves:
  - .1 MSS-SP-110, Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.
- .4 Butterfly Valves
  - .1 MSS-SP-67, Butterfly Valves.
- .5 Globe Valves
  - .1 MSS-SP-80, Bronze Gate, Globe, Angle and Check Valves.
  - .2 MSS-SP-85, Gray Iron Globe & Angle Valves Flanged and Threaded Ends
- .6 Plug Valves
  - .1 MSS-SP-78, Gray Iron Plug Valves, Flanged and Threaded Ends
- .7 Check Valves
  - .1 MSS-SP-80, Bronze Gate, Globe, Angle and Check Valves.
  - .2 MSS-SP-71, Gray Iron Swing Check Valves Flanged and Threaded Ends.
- .7 American Welding Society (AWS)
  - .1 AWS C1.1M/C1.1 - Recommended Practices for Resistance Welding.
  - .2 AWS Z49.1 - Safety in Welding, Cutting and Allied Process.
  - .3 AWS W1 - Welding Inspection Handbook.
- .8 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
- .9 Material Safety Data Sheets (MSDS).
- .10 20 05 06 – Valves.
- .11 University of Guelph Metering Standard (15930).

### 1.3 INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 01 —Submittals.
- .2 Product Data:
  - .1 Product data shall be submitted for all PART 2 – PRODUCTS specified herein.
  - .2 Provide manufacturer's printed product literature and datasheets for material specified, and include product characteristics, performance criteria, physical size, finish and limitations.
  - .3 Product data shall include all maintenance access points and dimensional clearances, such that the contractor can properly layout the equipment to ensure proper access.
  - .4 Product data shall include all relevant information to confirm the specifications have been met.
  - .5 Product data shall provide all relevant data and operational points that verify the engineered criteria have been met and that field operational tolerances can be accommodated, i.e.; equipment are not supplied, which are operating at their upper and lower limits for their design duty performance.
  - .6 Product data shall identify all ancillary field installed devices and provide all information required for the co-ordination of the installation with other trades.
  - .7 Product data shall include any relevant information which Div 25 requires for a properly functioning building automation system.
  - .8 Product data shall include information as specified in 20 01 01 -Common Work Results Mechanical unless modified with additional information required below.

- .3 Maintenance Data:
  - .1 Provide maintenance data including certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties, for incorporation into manuals specified in Section 01 77 00 – Closeout Procedures.
  - .2 Maintenance data shall include but not be limited to;
    - .1 Certificates, signed by the manufacturer or their representative, certifying that the materials have been installed as per their installation instructions.
    - .2 The approved shop drawings with performance criteria, edited with field observations and commissioned operational set points and adjustments.
    - .3 The manufacturer's maintenance and installation data.
    - .4 Safety informational data for maintenance staff prior to performing maintenance requirements.
    - .5 List of all routine maintenance requirements as well as monthly, annual or other periodical maintenance recommendations from the manufacturer.
    - .6 Any maintenance requirements that may affect the warranty periods of the associated equipment.

#### **1.4 MAINTENANCE REQUIREMENTS**

- .1 The contractor shall verify and demonstrate that proper maintenance can be performed on equipment and material installed.
- .2 The contractor shall supply the following materials to site just prior to substantial being awarded.
  - .1 Provide ten replacement cover gaskets for each type and size of installed steam trap.

#### **1.5 QUALITY ASSURANCE**

- .1 Performance Requirements defined: Catalogued or published ratings for manufactured items obtained from tests carried out by manufacturer or those ordered by manufacturer from an independent testing agency signifying adherence to codes and standard and standardized testing of performance criteria.
- .2 Electrical Equipment shall bear a CSA label or have an ESA certification.
- .3 Welder Qualifications
  - .1 Perform welding only with certified welders suitable for class of welding required. Use welders qualified and licensed by Provincial authorities.
  - .2 Welders to qualify in accordance with ASTM, ANSI B31.1 and Governmental Regulations. Welder's certificate of qualification, not older than 6 months, to be on file at work site.
  - .3 Welding installation to be to CSA W59, latest edition.
  - .4 Welder to mark each weld with personal steel pencil for individual work identification. Mark each joint with stencil before radiographs are taken.
  - .5 Radiography to be provided by experienced specialist approved by Consultant.
- .4 Provide and construct mock-ups in accordance with Section 01 45 01 – Quality Control.

## **1.6 COMMISSIONING**

- .1 Refer to 01 91 01- Commissioning for requirements.
- .2 Refer to 20 08 02 – Commissioning – Cleaning and Start-up of Mechanical Systems.
- .3 The manufacturer and/or their factory representative shall participate in the commissioning process. The manufacturer shall inspect the final installation and verify that the product has been installed as per the manufacturer's instructions. The manufacturer shall report compliance or discrepancies directly to the Consultant.

## **1.7 TRAINING**

- .1 The manufacturer and/or their factory representative shall participate in the training process. The manufacturer shall provide factory trained and approved instructional personnel for both classroom and on-site training as indicated.

## **PART 2 – PRODUCTS**

### **2.1 GENERAL**

- .1 Select all components for 1035 KPa (150 PSI) system rating.

### **2.2 PIPE**

- .1 Steam and Condensate Piping - Steel Pipe
  - .1 Black Steel pipe: to ASTM A53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless, Type E, Grade B electric resistance weld
  - .2 Black Steel pipe: to ASTM A106 Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service, Type S, Grade B seamless.
  - .3 Steam Piping: Minimum Schedule 40/STD. Maximum working Pressure of 2585 KPa (375 PSI) for threaded pipe with a safety factor of 8 or 0.50.
  - .4 Condensate Piping: Minimum Schedule 80/STD.

### **2.3 FITTINGS AND JOINTS**

- .1 Threaded Fittings – Steel Pipe
  - .1 Screwed fittings: malleable iron, Class 150.
  - .2 PTFE tape.
  - .3 Conforming to ASME/ANSI B16.3 - Malleable Iron Threaded Fittings
- .2 Welded Fittings – Steel Pipe Butt Weld
  - .1 Butt-welding fittings: factory manufactured carbon steel.
  - .2 Conforming to ASTM A234 / A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
  - .3 Conforming to ASME/ANSI B16.9 - Factory-Made Wrought Steel Butt-welding Fittings

- .3 Flanged Fittings – Steel Pipe
  - .1 Forged Steel, Butt Weld Welding Neck Flanges Class 150. Fittings shall be factory manufactured carbon steel, with raised serrated face and pre drilled to American Steel Flange Standard B16.5
  - .2 Conforming to ASTM A234 / A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
  - .3 Conforming to ASME/ANSI B16.5 - Pipe Flanges and Flanged Fittings.
  - .4 Flange Gaskets: 1.6 mm (1/16") thick preformed high temperature graphite sheet gasket, carbon fiber / nitrile composition. Conforming to ASME B16.21 - Nonmetallic Flat Gaskets for Pipe Flanges.
  - .5 Bolts / Nuts: Heat treated carbon steel, hexagonal to ASTM A307.

## **2.4 PIPE WELDING**

- .1 Pipe welding shall be in conformance with the AWA (American Welding association) standards.
- .2 Steel butt weld fittings: to ANSI B16.9, latest edition.
- .3 Steel socket weld fittings: to ANSI B16.11, latest edition.
- .4 Electrodes: Certified by Canadian Welding Bureau to appropriate CSA W48 standard.

## **2.5 EXPANSION PROVISIONS**

- .1 The system will be free floating system.
- .2 Guides and Anchors: Locations as indicated and detailed or as proposed by contractor.
  - .1 Anchors: Attachment to structure to be reviewed with and approved by the structural engineer.
  - .2 Alignment guides: To accommodate specified thickness of insulation.
- .3 Expansion loops: Utilize expansion loops as indicated. Where Z-bends, U-bends or pipe loop expansion arrangements are used, provide anchors and guides to direct movement along axis of joint. Guide spacing to take into consideration the column buckling strength of the pipe.

## **2.6 VALVES**

- .1 General
  - .1 Valves: Except for specialty valves, to be of single manufacturer.
  - .2 All gaskets and packing shall be non-asbestos.
  - .3 Refer to 20 04 01 Mechanical Identification for Valve tag and identification requirements
- .2 Gate Valve NRS, Soldered / Screwed End:
  - .1 NPS 2 (2"Ø) and under, soldered / screwed:
  - .2 Non Rising Stem style, full port flow, all bronze construction. Cast bronze body, screw in cast bronze bonnet, bronze stem, and solid bronze wedge disc. Adjustable PTFE packing.
  - .3 Aluminum round ridged handle, with PVC coated contact surface. Zinc plated handle nut.
  - .4 Class 150 WSP. Conforming to MSS-SP-80.

- .3 Gate Valve NRS, Flanged End:
  - .1 NPS 2 ½ (2 ½"Ø) and over, flanged:
  - .2 Non Rising Stem style, full port flow with full length disc guides. Cast iron body, multiple bolt, bolted cast iron bonnet, bronze stem, and solid cast iron wedge disc with renewable bronze seat rings. Adjustable PTFE packing.
  - .3 Cast Iron round ridged handle. Zinc plated handle nut.
  - .4 Class 125 WSP. Conforming to MSS-SP-70.
- .4 Globe Valve, Soldered End / Screwed End:
  - .1 NPS 2 ½ (2 ½"Ø) and under, soldered or screwed:
  - .2 Rising Stem style, all bronze construction. Cast bronze body, screw in cast bronze bonnet, bronze stem, and bronze disc holder. PTFE disc. Adjustable PTFE packing.
  - .3 Aluminum round ridged handle, with PVC coated contact surface. Zinc plated handle nut.
  - .4 Class 150 WSP. Conforming to MSS-SP-80.
- .5 Globe Valve RS OS&Y (Outside Screw and Yoke), Flanged End:
  - .1 NPS 2 ½ (2 ½"Ø) and over, Flanged:
  - .2 Rising Stem style, cast iron body, multiple bolt, bolted cast iron bonnet, bronze stem, and bronze disk. Renewable bronze seat ring. Adjustable PTFE packing.
  - .3 Cast Iron round ridged handle. Zinc plated handle nut.
  - .4 Class 125 WSP. Conforming to MSS-SP-85.

## 2.7 CHECK VALVES

- .1 Swing Check Valve, Soldered End / Screwed End:
  - .1 NPS 2 ½ (2 ½"Ø) and under, soldered:
  - .2 Y Pattern body, all bronze construction. Cast bronze body, screw in access cap, bronze swing disk, bronze hinge and stainless steel pin.
  - .3 Class 150 WSP. Conforming to MSS-SP-80.
- .2 Swing Check Valve, Flanged End:
  - .1 NPS 2 ½ (2 ½"Ø) and over, flanged:
  - .2 Y Pattern body, cast iron body and bolted cast iron access cap, bronze swing disk, bronze hinge and stainless steel pin. Replaceable bronze seat rings.
  - .3 Class 125 WSP. Conforming to MSS-SP-71.

## 2.8 STRAINERS

- .1 Y-Pattern Strainer, Soldered End / Screwed End:
  - .1 NPS 2 ½ (2 ½"Ø) and under, soldered or screwed:
  - .2 Y Pattern body, cast bronze body, screw in access cap, stainless steel removable and cleanable 20 mesh strainer. Strainer to be non-ferrous.
- .2 Y-Pattern Strainer, Flanged End / Grooved End:
  - .1 NPS 2 ½ (2 ½"Ø) and over, flanged or grooved:
  - .2 Y Pattern body, cast iron body, bolted or grooved steel access cap.

- .3 Stainless steel removable and cleanable 20 mesh strainer. Strainer to be non-ferrous. Free screen area not to be less than double the internal cross-sectional area of pipe.
- .4 NPS  $\frac{3}{4}$  (3/4"Ø) plug for blow down connection.
- .3 Strainers NPS 4 (4"Ø) and greater shall be equipped with a blowdown connection. NPS  $\frac{3}{4}$  (3/4"Ø) blow down pipe with ball valve and hose end connection.
- .4 Strainers installed within steam systems shall be installed with the strainer up, above the pipe.

## 2.9 STEAM TRAPS

- .1 General:
  - .1 Steam Traps shall meet the steam flow characteristics of the terminal device served with a 2.5X safety factor.
  - .2 Refer to drawings and schematics for steam trap locations and requirements.
- .2 Float and Thermostatic Trap:
  - .1 Application: continuous flow operation and equipment controlled by modulating temperature control valves. (Examples: unit heaters, air heating coils, heat exchangers.)
  - .2 Mechanical Failure Mode: Closed
  - .3 Maximum Allowable Operating Pressure: 861KPa (125 PSI) @ 232 °C (450°F).
  - .4 Steam traps shall be of the mechanical ball float type having cast iron bodies, NPT connections, and all stainless steel internals. Incorporated into the trap body shall be a stainless steel balanced pressure thermostatic air vent capable of withstanding up to 232 °C (450°F) and resisting water hammer without sustaining damage. Internals of the trap shall be completely serviceable without disturbing the piping.
- .3 Inverted Bucket Trap:
  - .1 Application: Intermittent flow operation, outside air coils or equipment requiring fail proof operation. (Examples: Steam main drip stations.)
  - .2 Mechanical Failure Mode: Open Maximum Allowable Operating Pressure: 861KPa (125 PSI) @ 232 °C (450°F).
  - .3 Steam traps shall be of the mechanical inverted bucket type with cast iron bodies, screwed NPT horizontal connections and stainless steel valve head, seat and bucket. Unit shall be complete with an internal bi-metal air vent for rapid air removal on start up. Internals of the trap shall be completely serviceable without disturbing the piping.
- .4 Balanced Pressure Bellows Thermostatic Trap:
  - .1 Application: intermittent flow operation and equipment where cooling of condensate is preferred. (Examples: radiators.)
  - .2 Mechanical Failure Mode: Closed
  - .3 Maximum Allowable Operating Pressure: 861KPa (125 PSI) @ 232 °C (450°F).
  - .4 Steam traps shall be self-adjusting to all pressures within their operating range. Bodies to be of heavy cast iron with NPT connections. Thermostatic elements shall be of precision welded stainless steel construction. All internals to be stainless steel and shall be replaceable without disturbing the piping connections.

## **2.10 VACUUM BREAKERS**

- .1 Application: on inlets to steam coils and heat exchangers after control valve to admit air to steam systems where vacuum formation may inhibit system drainage or operation.
- .2 Hardened ball check valve design with all working parts manufactured from stainless steel, and shall be suitable for operating conditions of 1378 KPa (200 PSI) saturated steam.

## **2.11 PILOT OPERATED PRESSURE REDUCING VALVE**

- .1 Self-operating, external pilot, single seat, diaphragm operated, dead end shutoff, enclosed spring chamber main and pilot valve.
- .2 Connections: Under NPS 2 (2"Ø): screwed ends. NPS 2-1/2 (2 ½"Ø) and over: flanged ends.
- .3 Main valve body: Ductile cast iron. All internal components will be stainless steel.
- .4 Capacity: To meet operational requirements of the system for flow and pressure.
- .5 Discharge pressure setting shall be field adjustable.

## **2.12 STEAM FLOW CONTROL VALVES**

- .1 Plant steam control valve shall be electric with Multi-Function Technology (MFT), NEMA 2 actuator enclosure rating, 24Vac or 24 Vdc power supply, spring return fail closed. Input signal shall be 2-10 Vdc. Control valve body construction shall be carbon steel with flanged connections with an internal valve trim in high quality 316 stainless steel. Valve shall have a shutoff class IV metal seat with a temperature limit of -320 °F to 1000 °F. The control valve shall regulate the steam pressure within the heat exchanger. The control valve shall be CRN registered.

## **2.13 PRESSURE SAFETY RELIEF VALVES**

- .1 For low pressure steam service, 860 KPa (125 PSI) ASTM rated, with cast iron body, bronze disc and seat, steel spindle assembly carbon steel spring equipped with lifting service, with capacity based on 10% accumulation at fired vessels.

## **2.14 DRIP PAN ELBOW**

- .1 Steel or cast iron with screwed inlet and threaded drain connections.
- .2 Threaded outlet with nipple for vent pipe riser.
- .3 Nipple to slide freely into vent pipe riser.
- .4 Maximum 610 mm (24") distance between relief valve centerline and drip pan elbow discharge centerline.

## **2.15 FLASH TANK**

- .1 Tank: vertical horizontal type with threaded drop tube connections. Construction: to ASME code. Maximum working pressure: 860 KPa (125 PSI). Finish: prime coated. Supports: vertical legs for vertical tank.

## **2.16 PACKAGED CONDENSATE PUMPING UNITS**

- .1 Heavy Duty Cast Iron Tank, 150 Lit (40 US Gal) Capacity equipped with duplex condensate pumps mounted directly on tank.
- .2 Pumps: centrifugal type with two-piece enclosed brass impeller, cast iron housing, high temperature (250°F) mechanical seal, and stainless steel motor shaft. Each pump shall have a capacity of 40 Gpm at a discharge pressure of 345 KPa (50 PSI), 3 HP, 3600 RPM, 575V/3Ph Motors: Heavy-duty, ballbearing, close-coupled pump motors with stainless steel shaft.
- .3 The float switch shall be two-pole with plastic case, stainless steel float and shaft, and double-break silver contacts. A flat perforated brass strainer shall be provided at the inlet to the pump from the tank.
- .4 Unit shall be equipped with
  - .1 Gauge glass
  - .2 Thermometer
  - .3 Discharge pressure gauges
  - .4 Isolation valves
  - .5 Magnetic starters with H-O-A selector switches
  - .6 Complete NEMA 12 Control Panel
- .5 Controls:
  - .1 Duplex automatic: supplied as package by pump manufacturer complete with:
    - .1 Level operated controls.
    - .2 Electrical alternator.
    - .3 High water alarm.
    - .4 Controller in EEMAC 1 enclosure complete with:
      - .1 2 circuit breakers.
      - .2 Through-door operating handles.
      - .3 Two across-line magnetic starters.
      - .4 Ambient compensated quick-trip overloads on each line.
      - .5 Door mounted hand-off-auto selector switches for each pump.
    - .5 Type and quality of electrical components as per Division 26.
  - .2 Float switches: quick double break type with silver contacts. Seamless copper float with bronze rod and packed stuffing box.
  - .3 Wiring between pumps and controls.

## **2.17 DRAIN VALVES AND AIR VENTS**

- .1 Provide drain valves at low points in system piping and manual air vents at high points in system piping. Provide automatic air vents at top of system and at point of controlled air / water separation.

- .2 Drain Valves: NPS  $\frac{3}{4}$  (3/4"Ø) ball valves with hose end connection.
- .3 Manual Air Vents: NPS  $\frac{1}{4}$  (1/4"Ø) plug valves.
- .4 Automatic Air vents: Standard float type ven: brass body and NPS [1/8] connection and rated at 690 KPa (100 PSI) working pressure. Equip automatic air vents with isolation valves to permit servicing without draining the system.

## 2.18 STEAM METER

- .1 Steam meter body shall be constructed of stainless steel.
- .2 Units provided with a local digital gauge with kilograms per hour (kg/hr) display with full compensation for temperature and pressure complete with digital 4-20mA output to tie into the University of Guelph building automation system.
- .3 Supplier to indicate permanent pressure losses to quantify effect on the installation.
- .4 Provide inline meter, complete with proper grounding, display, and warranty.
- .5 Meter must be H.A.R.T. compatible.
- .6 The sensor to count the vortices shall be capable of withstanding temperatures ranging from - 40° to 500° F.
- .7 The sensor shall be constructed of 316 L SS.
- .8 Where specified, calibration data shall be supplied which verifies the meter accuracy to be  $\pm 1.0$  percent of actual flow rate for gases and  $\pm 0.75\%$  of flow rate for liquids.
- .9 LCD display shall enable the operator to monitor flow rate in clear text messages.
- .10 It should be possible to check the functionality and verify deviation of the flow meter without needing to dismantle the device by using an external device. This Verification of transmitter electronics should be traceable to NIST or equivalent standards.
- .11 Size meter to meet all present flow rates, as indicated on drawings.

## 2.19 JLR SPECIFIED PRODUCTS

- .1 Refer to Division 00 and 01 for requirements for alternate manufacturers to those listed below:
  - .1 Packaged Condensate Pump Units Armstrong
  - .2 Steam Meter Endress & Hauser  
Emerson Rosemount  
Spirax Sarco

## **PART 3 - EXECUTION**

### **3.1 GENERAL**

- .1 Comply with piping installation requirements of Section 20 05 05 – Installation of Pipe.
- .2 Ream pipes, clean scale and dirt, inside and out, before and after assembly. Cap open ends of piping during installation.
- .3 Install flanges or unions at connections to all equipment.
- .4 Reducing fittings to be eccentric and installed so as not to trap air.
- .5 Provide dielectric couplings for joining dissimilar metals.
- .6 Use valves and strainers of same size as pipe to which they are connected, unless otherwise indicated.
- .7 Valves to be accessible. Make valves removable without dismantling adjoining pipe.
- .8 Provide clearance for installation of insulation and access for maintenance of equipment, valves and fittings.
- .9 Make provision for thermal expansion of piping system and building structure through use of expansion joints, expansion loops and bends and appropriate supports, anchors and guides.
- .10 Drip pocket openings to be line size. Drain to traps by gravity.

### **3.2 MANUFACTURER'S INSTRUCTIONS**

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

### **3.3 PIPE SUPPORT**

- .1 Support and install piping in accordance with Section 20 05 05 – Installation of Pipe.
- .2 Provide proper alignment and grade to ensure that the piping system and pipe-supporting elements are protected from excessive stress and distortion from all concurrently acting static and dynamic loads.
- .3 Slope low pressure steam piping 40mm in 10 m (½" in 10 ft.) in direction of flow and condensate return piping 60mm in 10 m (¾" in 10 ft.). Runouts to be reverse sloped. Provide drip trap assembly at all low points and points where condensate may back up upstream of control valves. Run condensate lines from trap, provide vent loop over the trapped section.
- .4 Vertical piping: Support or anchor vertical piping at its base and provide a minimum of one intermediate clamp for every other length of pipe except on hot water risers. Clamp every length of pipe with clamps that prevent angular movement on hot water risers where tee fittings are used. Where pipe is installed with fewer or no intermediate clamps supports or anchor the base of the piping and provide sufficient guides to prevent buckling of the pipe.

- .5 Provide independent support at equipment connections, concentrated equipment loads (fittings, valves, accessories, etc.), and changes in pipe direction. For grooved joint piping systems support within 600mm (2') either side of joining coupling.
- .6 In addition to the pipe supports identified above, refer to the following schedule for minimum hanger spacing for straight length of piping.

Pipe Size	Maximum Support Spacing Sch 40 Steel Piping
NPS ½ (1/2"Ø) - NPS ¾ (3/4"Ø)	2.1 M (7')
NPS 1 (1"Ø) - NPS 1 ½ (1 1/2"Ø)	2.1 M (7')
NPS 2 (2"Ø)	3.0 M (10')
NPS 2 ½ (2 ½"Ø)	3.3 M (11')
NPS 3 (3"Ø)	3.6 M (12')
NPS 4 (4"Ø)	4.2 M (14')
NPS 6 (6"Ø)	4.8 M (16')
NPS 8 (8"Ø)	5.5 M (18')
NPS 10 (10"Ø)	6.7 M (22')
NPS 12 (12"Ø)	6.7 M (22')

### 3.4 SPECIFIC INSTALLATION REQUIREMENTS

- .1 Steam Piping Valve Installation
  - .1 Install isolation gate valves at branch take-offs and to isolate each piece of equipment, and as indicated.
  - .2 Install chain operators on valves NPS 4 (4"Ø) and over where installed more than 2400 mm above floor in Mechanical Equipment Rooms.
  - .3 Install flow control globe valves where bypass is required around control valves to control the flow of steam to equipment. Control valves requiring bypass failure control to be equipped with isolation valves on the upstream and downstream side to isolate piping from bypass flow.
- .2 Strainers Installation
  - .1 Install as indicated.
  - .2 Ensure clearance for removal of basket.
  - .3 Install valved blow-down as indicated.
- .3 Steam Safety Relief Valve Installation
  - .1 Pipe to atmosphere independent of other vents and in accordance with applicable code.
  - .2 Support discharge pipe against reaction forces and to take up thermal movement.
  - .3 Drain pipe from drip pan elbow to discharge to a floor drain.

- .4 Packaged Condensate Pumping Units Installation
  - .1 Place level, shim unit and grout.
  - .2 Pipe up to system as indicated.
  - .3 Run tank vent separately to exterior of building in location approved by Consultant.
  - .4 Run drain line and overflow to terminate over floor drain.
  - .5 Check rotation prior to start-up.
  - .6 Check bearings for oil level and lubrication.
- .5 Meter Installation
  - .1 Install as per utility and/or University Metering Standard and instructions and guidelines.
  - .2 All meter location must be accessible and located in a position that allows ease of maintenance and removal without interfering with the meter accuracy or installation practices.
  - .3 Meter shall be installed with proper orientation, up and down stream distances and proper grounding as per manufacturer.
  - .4 Provide all upstream and downstream minimum distances as specified by supplier.
  - .5 To make good on all surroundings after completion of installation of meter.
  - .6 Provide insulation by approved sub-contractor to include meter body, surrounding flanges and unions.
  - .7 Meters, valves, and bypasses should be supported with appropriate adjustable pipe stands. bricks, concrete or wood blocking are not acceptable means of support.
  - .8 Meter installations must be checked for leakage or contaminants at completion of the installation, the proper operation of the meter should be established.
  - .9 For meters 2 1/2" diameter and larger provide a mechanical flange adapter on the downstream side of the meter to provide flexibility for meter and strainer case removal.
  - .10 All flange connections must be supplied with an asbestos-free gasket material top meet temperature and pressure for service.
  - .11 All documentation and related work shall be provided for the flow rate specified, commissioning, calibration, verification, performance specification and warranty related to the metering device.

### 3.5 PIPE WELDING

- .1 General:
  - .1 Identify each weld with welder's identification symbol.
  - .2 Equip welders with fire extinguishers. Observe necessary fire prevention precautions such as shields to minimize fire risk.
- .2 Welding
  - .1 Use only piping with machine bevelled ends for welded runs. Machine bevel pipe and fitting ends. If machining is impractical, prepare ends by grinding, or by flame cutting and subsequent grinding back 3 mm (1/8") prior to welding. Clean each joint internally, swab and remove scale, surface cracks, oil, grease, oxides or other foreign matter.
  - .2 Make welds full penetration, continuous and without defects. Clean each layer of weld to remove slag and scale by wire brushing or grinding. Chip where necessary to prepare for proper deposition of next layer. Weld reinforcement to be not less than 1.6 mm (1/6") and not more than 3 mm (1/8") above normal surface of jointed sections. Crown reinforcement at centre and merge into base material without excessive shoulder or undercut.

- .3 Welding Inspection
  - .1 Make work available at any time for inspection. Cover or insulate welds only after inspection carried out.
  - .2 The contractor shall engage an experienced firm specialized in radiography to Gamma-ray radiograph and perform these inspections on 5% of welded joints in low pressure hot and cold water systems. Radiograph welded joints over full circumference. The selection of the welds to be inspected shall be done by the Consultant.
  - .3 Perform radiography in accordance with Article 3 of Section 5 of the ASME Boiler and Pressure Vessel Code and CGSB-48-CP-2. Include all costs in this contract.
  - .4 Cut out and replace welds of poor or doubtful quality with satisfactory welds.
  - .5 One or more of the following defects to cause rejection of weld:
    - .1 Failure to meet radiographic requirements or other code tests.
    - .2 Welding performed by unqualified personnel.
    - .3 Welds not reasonably uniform in appearance.
    - .4 Evidence of peening.
    - .5 Cracks.
    - .6 Oxidation around welds.
    - .7 Lack of fusion.
    - .8 Presence of porosity, slag inclusion or overlaps.
    - .9 Undercutting adjacent to completed welds or evidence of undercutting by grinding.

### 3.6 PIPING SYSTEM TESTING

- .1 Piping systems may be tested in whole or partial systems, however all piping systems shall be subjected to testing.
- .2 Contractor to complete installation inspection, integrity (pressure, leak) tests and support system inspection before system is insulated, concealed, or covered in any way. Piping not to be covered until all inspection and testing deficiencies have been corrected and successful re-testing has been complete.
- .3 Coordinate with authority having jurisdiction the requirement of the authority to witness tests and inspect piping system.
- .4 Isolate any equipment not capable of withstanding test pressure. Equipment shall be isolated from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against the test pressure without damage to valve. Blind flanges shall be installed to isolate equipment.
- .5 Safety valves shall be set at a pressure no more than one-third higher than the test pressure to protect against damage by expanding liquid or other source of overpressure during test.
- .6 Contractor to complete installation inspection, integrity (pressure, leak) tests and support system inspection before system is insulated or enclosed. Piping not to be covered until all inspection and testing deficiencies have been corrected and successful retesting has been completed.

### 3.7 CLEANING

- .1 Not all of the following cleaning procedures are required for any given project. Use the level of cleanliness, type of cleaning procedure and the sequence as specified on the drawings.
  - .1 FLUSHING
    - .1 Following completion of hydrostatic testing, drain the test fluid at a rate of flow sufficient to flush any debris or foreign materials from the system.
  - .2 BLOWING OUT
    - .1 Vent the steam system to atmosphere, in a safe location, by blowing steam at line pressure through the system and venting, either horizontally or vertically downwards, through full line sized vents, until it is visually evident that discharge of foreign particles has stopped.
  - .3 WIRE BRUSHING
    - .1 Prior to blowing out, clean the line by drawing through a wire brush, sized to the full diameter of the line, until no particles remain.
  - .4 ACID CLEANING
    - .1 Mix cleaning solutions on site or deliver premixed. Ensure acid cleaning is done by an approved cleaning contractor. Prior to blowing out, degrease and descale the system as follows:
      - .1 Caustic Flush:
        - .1 Make up the caustic solution in the following proportions:
        - .2 For every 1,000 gallons of water - 125 gallons of liquid caustic or 840 pounds of flake caustic, and 400 pounds of Trisodium Phosphate.
        - .3 When the auxiliary tank is filled with water, add the caustic in the proportions specified, making sure that all solids are dissolved. Trisodium Phosphate has limited solubility in cold water, therefore, in cold weather or in systems with many small bore pipelines, it is advantageous to reduce the amount of this chemical by half. This greatly reduces the amount of Trisodium Phosphate that precipitates and prevents "freeze-ups" in the lines.
        - .4 Heat the caustic solution until a temperature of about 140 F is obtained. Start circulation.
        - .5 Maintaining the temperature of 140 F, circulate for a minimum of 4 hours.
        - .6 Check lines for proper circulation by checking the temperatures.
        - .7 Treat leaks with caution and do not attempt to correct any during circulation.
        - .8 Check high points in the piping during the caustic flush to ensure the system remains full of solution.
        - .9 Water Flush:
          - .1 Use water to flush the solution in the system back into the pickling tank for disposal.
          - .2 Continue to flush the system with water allowing the discharge to collect in a holding tank. Flush for one half to one full hour or until discharge is neutral.
      - .2 Acid flush:
        - .1 Make up the acid solution in the following proportions:
        - .2 For every 1,000 gallons of water - 100 gallons 66 Be Sulphuric acid, 5 gallons of inhibitor such as Houghton "ACITROL", and water soluble foam suppressant as required. Heat the acid solution with live steam till a temperature of 140 F is obtained.
        - .3 Circulate the hot acid solution through lines for a minimum of 4 hours and maintain solution temperature at 140 F.

- .4 Check lines for proper circulation by checking the temperatures.
- .5 Treat leaks with caution and do not attempt to correct any during circulation.
- .6 Check high points in the piping during the acid flush to ensure that the system remains full of solution.
- .7 Immerse a heavily scaled or rusted piece of metal in the pickling tank and use this as a measure of the descaling rate of the solution.
- .8 Water Flush
  - .1 Use water to flush the solution in the system back into the pickling tank and then pump out for disposal.
  - .2 Continue to flush the system with water allowing the discharge to collect in a holding tank. Flush for one half to one full hour or until discharge is neutral. Test with litmus paper.
  - .3 Keep lines full of water to prevent air from contacting the cleaned surfaces until the system is blown out.
- .2 Ensure cleaning takes place immediately prior to line being placed in service so that no corrosion is allowed to take place during this interval.
- .3 All cleaning fluids must be neutralized prior to disposal.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 SCOPE DESCRIPTION SUMMARY**

- .1 This section will define the duct construction standards to be utilized.

### **1.2 REFERENCES**

- .1 Unless dated references are identified below, it shall be the latest standard issued by the regulatory agency that shall be utilized as the applicable reference.
- .2 Sheet Metal Air Conditioning Contractors' National Association (SMACNA):
  - .1 SMACNA HVAC Duct Construction Standards, Metal and Flexible.
  - .2 SMACNA HVAC Air Duct Leakage Test Manual.
  - .3 SMACNA IAQ Guideline for Occupied Buildings under Construction.
- .3 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE).
- .4 American Society for Testing and Materials (ASTM):
  - .1 ASTM A 653/A 653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process. (Metric).
  - .2 ASTM A 635/A 635M - Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Carbon, Hot Rolled.
  - .3 ASTM A 480/A 480M - Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet and Strip.
  - .4 ASTM C 423, Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
  - .5 ASTM C 916, Standard Specification for Adhesives for Duct Thermal Insulation.
  - .6 ASTM C 1071, Standard specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material).
  - .7 ASTM C 1338, Standard Test Method for Determining Fungi Resistance of Insulation Materials and Facings.
  - .8 ASTM G 21, Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.
- .5 National Fire Protection Association (NFPA):
  - .1 NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems.
  - .2 NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems.
  - .3 NFPA 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations
- .6 Underwriters' Laboratories Inc. (UL):
  - .1 UL181, Standard for Factory-Made Air Ducts and Air Connectors.
- .7 Underwriters' Laboratories of Canada (ULC):
  - .1 CAN/ULC-S110, Fire Tests for Air Ducts.
  - .2 CAN/ULC-S102, Methods of Test for Surface Burning Characteristics of Building Materials and Assemblies.

- .8 Health Canada/Workplace Hazardous Materials Information System (WHMIS):
  - .1 Material Safety Data Sheets (MSDS).

### 1.3 INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 01 – Submittals.
- .2 Product Data:
  - .1 Product data shall be submitted for all PART 2 – PRODUCTS specified herein.
  - .2 Provide manufacturer's printed product literature and datasheets for material specified, and include product characteristics, performance criteria, physical size, finish and limitations.
  - .3 Product data shall include all maintenance access points and dimensional clearances, such that the contractor can properly layout the equipment to ensure proper access.
  - .4 Product data shall include all relevant information to confirm the specifications have been met.
  - .5 Product data shall include information as specified in Section 20 01 01 - Common Work Results for Mechanical unless modified with additional information required below.
  - .6 Additional information required.
- .3 Shop Drawings:
  - .1 Submit duct layout and interference drawings to Consultant for review prior to fabrication. Indicate all duct dimensions, grilles, diffusers, access doors and other pertinent items.
  - .2 Submit duct construction details; including longitudinal seams, lateral joints, connections, hanger and support system, sealants.
- .4 Provide copies WHMIS MSDS - Material Safety Data Sheets in accordance with Division 1 where material specified has MSDS Sheets.
- .5 Refer to Section 20 05 48 - Vibration and Seismic Controls For Piping, Ducts and Equipment. When the piping and equipment support system is required to be seismically engineered, all product information and shop drawings related to this section shall be submitted as per the requirements of Section 20 05 48. Submit drawings stamped and signed by professional engineer licensed in Province of Ontario, Canada.

### 1.4 MAINTENANCE REQUIREMENTS

- .1 The contractor shall verify and demonstrate that proper maintenance can be performed on equipment and material installed.
- .2 The contractor shall supply the following materials to site just prior to substantial being awarded.
  - .1 Provide one replacement filter for each installed filter.

### 1.5 QUALITY ASSURANCE

- .1 Performance Requirements Defined: catalogued or published ratings for manufactured items obtained from tests carried out by manufacturer or those ordered by manufacturer from an independent testing agency signifying adherence to codes and standard and standardized testing of performance criteria.

- .2 Contractor performing the work of this section shall be a recognized fabricator and installer of ductwork systems.
- .3 Air moving equipment shall bear an AMCA label.
- .4 Where applicable equipment shall bear a ULC or UL label.
- .5 Provide and construct mock-ups in accordance with Section 01 45 01 - Quality.
- .6 Indoor Air Quality (IAQ) Management Plan:
  - .1 Develop and implement an Indoor Air Quality (IAQ) Management Plan for new construction for construction and preoccupancy phases of building. For occupied buildings, during construction meet or exceed the requirements of SMACNA IAQ Guideline for Occupied Buildings under Construction.
- .7 Supports, anchors and restraints to conform to and be coordinated with the structural requirements of the Ontario Building Code and the requirements of the Structural Engineer responsible for the design of structural support systems for mechanical systems and equipment.

#### **1.6 DUCT PRESSURE CLASIFICATION**

- .1 Shop fabricated ductwork shall be constructed to meet SMACNA Duct Construction Standards, Latest edition.
- .2 Construct all ductwork and fittings to SMACNA Standards for pressures from - 750 Pa to 2500 Pa (- 3" w.g. to +10" w.g.) and velocities up to 1220.0 Mpm (4000 Fpm) and / or in accordance with manufacturer's instructions for the specific duct pressure, to the following requirements unless detailed otherwise.
- .3 Pressure classification to include for fan shut off with fire damper or other damper closure.
- .4 Ducts to withstand 1½ times the lowest possible pressure (fan shutoff pressure) in ductwork which can be isolated by dampers or valves.
- .5 Each duct system shall be constructed for the specific duct pressure classifications shown in table below or on the contract drawings.
- .6 Where no pressure classes are specified below, the complete system shall be constructed to a 500 Pa (2" wog) pressure classification, regardless of velocity in the duct. Except when the duct is variable volume: all variable volume duct downstream of VAV boxes, the ductwork shall be constructed to a 250 Pa (1" wog) pressure classification.

## 1.7 DUCT PRESSURE CLASSIFICATION AND SEAL REQUIREMENTS

	Design Operating Pressure	Minimum Design Test Pressure	Maximum Velocity	Design SMACNA Seal Class
<b>ALL Systems</b>				
Fan Discharge or Suction to the first Fire Damper / Shut Off Damper that experienced the full flow without relief / prior branch ductwork.	The Fan Maximum Pressure Capability + 20%	500 Pa (2"SP)	N/A	A
<b>Supply Air Ductwork</b>				
Supply Air Main or Riser	750 Pa (3"wg)	996 Pa (4"wg)	914 Mpm (3000 Fpm)	A
Branch to Terminal Unit	500 Pa (2"wg)	500 Pa (2"wg)	762 Mpm (2500 Fpm)	A
Terminal Unit to Diffuser	125 Pa (0.5"wg)	N/A	610 Mpm (2000 Fpm)	C
Exposed SA Duct within space served	125 Pa (0.5"wg)	N/A	460 Mpm (1500 Fpm)	Not Required
<b>Return Air Ductwork</b>				
Return Air main or Riser	- 500 Pa (-2"SP)	500 Pa (2"SP)	762 Mpm (2500 Fpm)	B
Return Air Branch to diffuser within space served.	- 250 Pa (-1"SP)	500 Pa (2"SP)	460 Mpm (1500 Fpm)	Not Required
Return Air – Discharge of Fan to Supply Fan Suction	500 Pa (2"SP)	N/A	762 Mpm (2500 Fpm)	A
<b>Outside Air Ductwork</b>				
Outside Air Suction to Unit	- 250 Pa (-1"SP)	N/A	610 Mpm (2000 Fpm)	B
<b>Exhaust Air Ductwork</b>				
Exhaust Air Discharge from Return Fan / AHU	250 Pa (1"SP)	N/A	610 Mpm (2000 Fpm)	B
<b>Process Exhaust</b>				
Exhaust Air Main or Riser Positive Pressure from Fan (Examples, Washroom Exhaust Fan Discharge)	500 Pa (2"SP)	500 Pa (2"SP)	762 Mpm (2500 Fpm)	C

## 1.8 SMACNA SEAL CLASSIFICATION

- .1 Duct sealing classifications to be in accordance with SMACNA and the following:
  - .1 **SMACNA Seal Class A:** seal all transverse joints, longitudinal seams and duct wall penetrations and made airtight with gaskets, grommets, mastics or liquid sealants. Testing of the assembled length of duct only, section must meet or exceed ASHRAE leakage Class 1.5, 1% of airflow at 500 Pa (2" w.g.).

- .2 **SMACNA Seal Class B:** seal all transverse joints and longitudinal seams and made airtight with gaskets, mastics or liquid sealants. Testing of the assembled length of duct only, section must meet or exceed ASHRAE leakage Class 3, 2.4% of airflow at 500 Pa (2" w.g.).
- .3 **SMACNA Seal Class C:** seal all transverse joints and made airtight with gaskets, mastics or liquid sealants. Testing of the assembled length of duct only, section must meet or exceed (ASHRAE leakage Class 6), 4.7% of airflow at 500 Pa (2" w.g.).
- .2 Definitions:
  - .1 Longitudinal seams are joints oriented in the direction of flow.
  - .2 Transverse joints are connections of two duct sections oriented perpendicular to airflow. Spiral lock seams in a round or flat oval duct need not be sealed. All other connections are considered transverse joints, including but not limited to spin-ins, taps, and other branch connections, access door frames and jambs, duct connections to equipment, etc.
  - .3 Duct wall penetrations are openings made by any screw fastener, pipe, rod, or wire.
- .3 Duct leakage not to exceed the lesser of 1.0 L/s per m<sup>2</sup> of duct surface area or 1% of the average airflow in duct or riser at 500 pa 2".

## 1.9 DUCT STRUCTURAL REQUIREMENTS AND REINFORCEMENT

- .1 Duct material to resist deflection caused by internal pressure and vibration due to turbulent airflow. Internal pressure to include for fan shutoff due to fire damper or other damper closure under normal or emergency conditions.
- .2 Maximum deflection of rectangular duct as follows:
  - .1 Up to 305 mm - 10 mm (Up to 12" - .375");
  - .2 330 to 459 mm - 13 mm (13" to 18" - .500");
  - .3 460 to 609 mm - 16 mm (19" to 24" - .625");
  - .4 610 mm and up - 19 mm (24" and up - .750").
- .3 Maximum amplitude of vibration of sheet is 0.4 mm (1/64").
- .4 Reinforcing: maximum allowable deflection of reinforcing at operating pressure is 6 mm (0.25").
- .5 Seams: longitudinal seams to withstand 1½ hours maximum operating pressure without failure or leakage.
- .6 Joints: transverse joints to withstand 1½ times the maximum operating pressure without failure or leakage.
- .7 Individual seams and joints to be airtight at 1½ times system operating pressure.
- .8 Beam Strength of Duct Section: duct section between adjacent hangers to carry its own weight and resist external loads.

## 1.10 SMACNA VARIANCES

- .1 The use of SMACNA Duct Construction Standards – Metal and Flexible (Latest Edition) shall be utilized except where deviations are noted herein.

## **PART 2 - PRODUCTS**

### **2.1 GENERAL**

- .1 Provide ductwork of galvanized steel except where otherwise noted on drawings or specified herein.
- .2 Construct round, rectangular, square, and flat oval duct as specified herein.
- .3 Duct dimensions shown in the contract drawings are for airflow area. When ducts are acoustically lined, their dimensions shall be increased as necessary.

### **2.2 DUCT MATERIAL - METAL**

- .1 Galvanized Steel:
  - .1 Standard duct construction material.
  - .2 Lock forming quality: to ASTM A 653/A 653M, G90 zinc coating.
  - .3 Thickness, Fabrication and Reinforcement: to SMACNA requirements.
  - .4 Joints: to SMACNA construction standards.

### **2.3 DUCT FITTINGS**

- .1 Fabrication: to SMACNA. Application as follows or as indicated on the drawings.
- .2 General:
  - .1 Provide volume control damper in branch duct near connection to main duct. Provide extended shafts for ducts with insulation.
- .3 Duct Transitions: bull nose size transitions will not be accepted. Duct size transitions shall be minimum 30 degrees maximum included angle on any one face.
- .4 Duct fitting for use downstream of VAV boxes, low velocity / pressure applications:
  - .1 Elbows:
    - .1 Rectangular / square radiused elbows: short radius square throat, centerline radius: 0.5 times width of duct.
    - .2 Rectangular / square mitered elbows: single thickness turning vanes.
    - .3 Round / oval radiused elbows: four piece adjustable elbow, centreline radius: 1.0 times diameter.
    - .4 Round / oval mitered elbows are not permitted.
  - .2 Branches:
    - .1 Rectangular / square main – rectangular / square branch: radius on branch 1.0 times width of duct with splitter damper or, if shown, 45 degrees entry on branch.
    - .2 Rectangular / square – round / oval: with conical connection.
    - .3 Round / oval main – round / oval branch: with conical connection.
    - .4 Branch to diffuser / VAV box: spin in collar tee.
  - .3 Duct offsets shall be a combination of 45° radiused elbows with interstitial duct or mitered elbows with turning vanes.

- .5 Duct fitting for use upstream of VAV boxes, medium velocity / pressure applications.
  - .1 Elbows:
    - .1 Rectangular / square radiused elbows: short radius centerline radius: 1.0 times width of duct. If duct is over 800 mm (32") width, provide single thickness turning vanes at each 300 mm in width or centred.
    - .2 Rectangular / square mitered elbows: single thickness turning vanes.
    - .3 Round / oval radiused elbows: five piece elbow, centreline radius: 1.0 times diameter.
    - .4 Round / oval mitered elbows are not permitted.
  - .2 Branches:
    - .1 Rectangular / square main – rectangular / square branch: radius on branch 1.0 times width of duct with splitter damper or, if shown, 45 degrees entry on branch.
    - .2 Rectangular / square main – round / oval branch: 45°/straight backed rectangular connection and round/oval discharge.
    - .3 Round / oval main – round / oval branch: conical connection.
  - .3 Duct offsets shall be a combination of 45° radiused elbows with interstitial duct or mitered elbows with turning vanes.
- .6 Duct fitting for use on high velocity systems and systems limiting static pressure loss.
  - .1 Elbows:
    - .1 Rectangular / square radiused elbows: standard radius centerline radius: 1.5 times width of duct. If duct is over 590 mm (24") width, provide single thickness turning vanes at each 300 mm in width or centred.
    - .2 Rectangular / square mitered elbows: To 300 mm (12") width single thickness turning vanes. Over 300 mm (12") width double thickness turning vanes.
    - .3 Round / oval radiused elbows: smooth radius elbow, centreline radius: 1.5 times diameter.
    - .4 Round / oval mitered elbows are not permitted.
  - .2 Branches:
    - .1 Rectangular / square main – rectangular / square branch: radius on branch 1.5 times width of duct with splitter damper.
    - .2 Rectangular / square main – round / oval branch: 45°/straight backed rectangular connection and round / oval discharge.
    - .3 Round / oval main – round / oval branch: conical connection.

## 2.4 DUCT SUPPORT SYSTEMS AND HANGERS

- .1 Duct supports, hanging shall be in accordance with SMACNA HVAC Duct Construction Standards.
- .2 Coordinate the location, spacing and sizing of hangers with other services to provide a coordinated installation.
- .3 Construction standards and spacing of support systems and hangers for duct distribution systems in accordance with SMACNA HVAC Duct Construction Standards or as modified herein.
- .4 Upper attachment to building to be in accordance with SMACNA HVAC Duct Construction Standards. Or as modified herein.
  - .1 Friction clamps to steel structure will not be acceptable.
  - .2 Attachments to metal roof deck not permitted.
  - .3 Attachments to steel structure to be bolted type connections.
  - .4 Beam attachments to provide concentric support on both sides of beam.

- .5 Hangers and Lower Attachment to ductwork to be in accordance with SMACNA HVAC Duct Construction Standards. Or as modified herein.
  - .1 Wire hangers will not be acceptable.
  - .2 Band / Strap Hangers: of same material as duct and use shall be limited to ductwork which does not exceed 600 mm (24") width or 600 mm (24") diameter.
  - .3 Trapeze Hangers: ducts over 600 mm diameter or longest side, to SMACNA.
  - .4 Hangers: black steel angle with black steel rods to SMACNA.

## **2.5 SEISMIC REQUIREMENTS**

- .1 Refer to 20 05 48 - Vibration and Seismic Controls For Piping, Ducts and Equipment for seismic requirements for this project.

## **2.6 SEALANTS AND TAPES**

- .1 General:
  - .1 All duct sealing products shall be UL181A-M and UL181B-M listed.
  - .2 All duct sealing products shall be tested in accordance with ULC S102, flame spread not to exceed 25, smoke developed not to exceed 50.
  - .3 Products will meet all SMACNA pressure classes up to 10" w.g. and SMACNA seal Classes A, B, and C on ducts constructed to SMACNA standards.
  - .4 Exterior applied products shall be UV resistant.
  - .5 Product stability shall be maintained thru a minimum of 5 freeze / thaw cycles.
- .2 Duct Sealant (Mastic):
  - .1 Description: water based synthetic polymer, oil resistant, flame resistant, fungal resistant duct sealant.
  - .2 Application: painted on with a brush, trowel applied, or applied with a caulking gun.
  - .3 Application Temperature: 4.4°C to 38°C (40°F to 110°F).
- .3 Joint Gaskets:
  - .1 Neoprene gasket tape, self-adhesive closed cell, neoprene blend elastomeric foam.
- .4 Cloth backed – Rubber adhesive Tape:
  - .1 Tapes to be used only in conjunction with a sealant on flat surfaces. Do not apply tape to bare metal or dry sealant.
  - .2 Polyvinyl treated, open weave fiberglass tape, 50 mm (2") wide.

## **2.7 FLEXIBLE DUCTWORK**

- .1 General:
  - .1 All flexible ductwork products shall meet UL Standard 181 as a Class 1 flexible air duct.
  - .2 All products shall have flame spread and smoke development ratings in accordance with CAN/ULC S102-M88:
    - .1 Maximum flame spread rating: 25.
    - .2 Maximum smoke developed rating: 50.
  - .3 Flexible ductwork shall comply with NFPA 90A and 90B.
  - .4 Flexible ductwork shall not be installed in exposed applications.

- .2 Insulated Acoustic Flexible Ductwork (Metal):
  - .1 Application: supply air connections to diffusers.
  - .2 Spiral wound, mechanically bonded, flexible perforated (25%) aluminum inner core. Wrapped with 25 mm (1") thick flexible mineral fiber thermal insulation and factory jacketed with spiral wound aluminum vapor barrier.
  - .3 Maximum Bend Radius: 2.5 x inside diameter.
  - .4 Acoustical Performance:

Acoustic Flexible Duct Attenuation Performance (Db / Metre) @ Frequency (Hz) Indicated				
250	500	1K	2K	4K
8	13	23	23	20

- .3 Flexible Ductwork (Metal):
  - .1 Application: Un-insulated Supply and Return Air connections to diffusers.
  - .2 Spiral wound, mechanically bonded, flexible aluminum.
  - .3 Maximum Bend Radius: 2.5 x inside diameter.
- .4 Insulated Acoustic Flexible Ductwork (Fabric):
  - .1 Application: Supply Air connections to diffusers.
  - .2 Nylon fabric attached to aluminum helix inner core. Wrapped with 25 mm (1") thick flexible mineral fibre thermal insulation and factory jacketed with scrim foil mylar vapor barrier.
  - .3 Maximum Bend Radius: 0.5 x inside diameter.

## 2.8 FLEXIBLE CONNECTIONS

- .1 Neoprene coated glass fabric, coated both sides, minimum mass 1.32 kg/m<sup>2</sup> (39 oz/yd<sup>2</sup>), secured to ducts and fans with 38 mm x 3 mm (1½" x 1/8") galvanized steel flat bars using galvanized steel screws at 100 mm (4") intervals.
- .2 Flexible connections will not be more than 150 mm (6") long between metal parts and with sufficient slack to prevent vibration transmission and allow for movement of equipment.

## 2.9 ACCOUSTIC INSULATION

- .1 General: Long textile type fibre, Mineral fibre, acoustic rigid duct liner: air surface coated mat polymer spray applied facing. 25 mm (1") thick, to ASTM C 1071, fibrous glass rigid board duct liner.
- .2 Flame spread rating shall not exceed 25. Smoke development rating shall not exceed 50 when tested in accordance with CAN/ULC-S102.
- .3 Recycled Content: minimum 35% by weight recycled content. Binder shall contain no phenol, formaldehyde or acrylics.
- .4 Fungi Resistance: to ASTM C 1338.
- .5 Maximum velocity on faced air side: 1220 Mpm (4000 Fpm).
- .6 Acoustical performance:

<b>Acoustic Rigid Duct Liner Attenuation Performance</b> <b>(Db / Metre) @ Frequency (Hz) Indicated.</b> <b>25 mm (1") Thick Board</b>						
P/A	125	250	500	1K	2K	4K
6	1.6 (0.5)	3.9 (1.2)	7.5 (2.3)	16.4 (5.0)	19.0 (5.8)	11.8 (3.6)
4	1.3 (0.4)	2.6 (0.8)	6.2 (1.9)	13.1 (4.0)	13.5 (4.1)	9.2 (2.8)
1	0.4 (0.1)	1.0 (0.3)	3.8 (1.0)	6.6 (2.0)	3.9 (1.2)	3.9 (1.2)
P/A = duct perimeter (ft) / duct cross sectional area (ft <sup>2</sup> )						

- .7 Fasteners:
- .1 Adhesive: Water-based fire retardant type adhesive: to ASTM C 916. Flame spread rating shall not exceed 25. Smoke development rating shall not exceed 50.
  - .2 Weld pins, length to suit thickness of insulation. Metal retaining clips, 32 mm (1 ¼ ") round / square.
- .8 Unless otherwise noted, ALL duct dimensions on the plans / drawings shall be Net, Inside Dimensions. The installing contractor shall construct the sheet metal ductwork with additional width and height to accommodate the internal acoustic insulation as required and identified.

## 2.10 DISSIPATIVE SILENCERS

- .1 Factory manufactured Square / Rectangular / Round and Straight / Elbowed dissipative sound power reducing sheet metal perforated silencers. With bell-mouth entrance and exponential exit.
- .2 All silencers shall be tested in accordance with the ASTM E- 477 silencer test code.
- .3 Construct silencers of minimum 0.8 mm (22 Ga) galvanized steel shells. Provide with unobstructed internal air passages to ensure uniform performance. Internal panels to be 0.8 mm (22 Ga) galvanized and perforated steel, die-stamped in one piece,
- .4 Acoustic medium to be minimum 75 kg/m (4.5 lb/ft.) density glass fibre. Furnish standard modules. Where two or more standard modules are required to compose a silencer, provide galvanized nosing pieces to cover adjacent silencer shell edges.
- .5 Refer to drawings for required dimensions and insertion losses.

## 2.11 FIRE STOPPING

- .1 Retaining angles around duct, on both sides of fire separation in accordance with Section 07 84 00 - Fire stopping.
- .2 Fire stopping material and installation must not distort duct.

## 2.12 AIR HANDLING UNIT CASINGS AND PLENUMS CONSTRUCTION

- .1 Floor mounted air handling unit casings and outside air intake / exhaust plenums shall be constructed in accordance with SMACNA double wall casing construction details and as indicated below.
- .2 Make all fresh air intake ducts watertight. Slope to exterior wall and fit with suitable drain connection at bottom. Coat inside of ductwork on bottom and up sides with waterproof mastic.
- .3 Construct apparatus, sheet metal connections, plenum chambers and casings of 1.2 mm (18 Ga) galvanized metal.
- .4 Fabricate casings and connections to avoid restrictions in air flow. Where changes in shape or cross-sectional area are necessary, slope for airstream to be limited to 45° angle in direction of airflow.
- .5 Form all joints in casings with 38 mm (1½") high standing seams. Reinforce all seams with 38 mm x 38 mm x 4.8 mm (1½" x 1½" x 3/16") steel angles. Place seams perpendicular to airflow and outside of casings on not greater than 900 mm (36") centres. Place supplemental reinforcing angles inside casing, parallel to air flow on 900 mm (36") centres, where span of casing equals or exceeds 2100mm (84").
- .6 Construct access doors and frames of 1.2 mm (18 Ga) galvanized steel of double panel construction with 25 mm (2") rigid insulation between metal panels. Walk-through type access doors to have minimum of two handles for tight closure against continuous neoprene gasket formed into frame and arranged for operation from either side of door. Mount all doors on doorframe with three steel butt hinges. Frame door and brace to nearest bracing angles with galvanized reinforcing angles.
- .7 At floor line and at other points where casings join masonry construction, rivet casing on maximum 300 mm (12") centres to 38 mm x 38 mm x 3.2 mm (1½" x 1½" x 1/8") angle. Secure angles to masonry with expansion or toggle bolts on 300 mm (12") centres and caulk airtight to masonry.

## 2.13 ACCESS DOORS AND TEST PORTS

- .1 Provide for access to fire or other dampers, for service or inspection and for cleaning of turning vanes and ductwork.
- .2 Non-Insulated Ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 1.0 mm (20 Ga) thick complete with sheet metal angle frame.
- .3 Insulated Ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 1.0 mm (20 Ga) thick complete with sheet metal angle frame and 25 mm thick rigid glass fibre insulation.
- .4 Gaskets: neoprene.
- .5 Hardware:
  - .1 Up to 300 x 300 mm (12"x12"): two sash locks.
  - .2 301 to 450 mm (12" – 18"): four sash locks.
  - .3 451 to 900 mm (18" – 36"): piano hinge and minimum two sash locks.
  - .4 Doors over 900 mm (36"): piano hinge and two handles operable from both sides with hold open devices and 250 x 250 mm (10"x10") glass viewing panel.

- .6 Access doors to be sized for application and access requirement. Contractor to verify and demonstrate that the access door provides required space for purpose of installation.
- .7 Duct test ports shall be 28 mm minimum inside diameter. Length to suit insulation thickness. Cam lock handles, with neoprene expansion plug and handle chain. Neoprene mounting gasket.

## 2.14 WATERTIGHT DUCTWORK

- .1 Provide watertight duct for:
  - .1 Dishwasher exhaust.
  - .2 Fresh air intake.
  - .3 Minimum 300 mm (12") upstream and 600 mm (24") downstream from duct mounted humidifier discharge manifold.
  - .4 As indicated.
- .2 Form bottom of horizontal duct without longitudinal seams. Weld joints of bottom and side sheets. Seal other joints with duct sealer. Slope horizontal branch / connecting ductwork down towards sealed section of duct.
- .3 Fit base of riser / plenum / manifold section, with 150 mm (6") deep drain sump and 25 mm (1"Ø) drain connected, with deep seal trap and ball valve, discharging to open funnel drain or as indicated.

## 2.15 JLR SPECIFIED PRODUCTS

- .1 Refer to Division 00 and 01 for requirements of alternate manufacturer's to those listed below:
  - .1 Sealants and Tapes Duro-Dyne
  - .2 Flexible Ductwork Flexmaster
  - .3 Flexible Connections Duro-Dyne
  - .4 Acoustic Insulation Johns Manville
  - .5 Silencers Vibro Acoustics
  - .6 Fire stopping 3M
  - .7 Access Doors Duro-Dyne

## PART 3 - EXECUTION

### 3.1 GENERAL

- .1 Ductwork shall be fabricated / manufactured and installed to meet or exceed the pressure classifications and seal classification, as specified herein.
- .2 Ductwork shall be fabricated / manufactured and installed as indicated on the drawings. Minor variations to location, reduced sizes for short lengths, modified sizes maintaining original area, fitting style, and round vs rectangular may be acceptable to accommodate for site conditions, structural requirements, and space limitations. These revisions should be coordinated with the other trades utilizing / installing within the same space. These revisions to the design of the system should be reviewed with and coordinated with the Consultant.

- .3 Do not break continuity of insulation vapor barrier with hangers or rods. In the case of strap hangers Insulate strap hangers 100 mm (4") beyond insulated duct.
- .4 Install ductwork and accessories to provide a system free from buckling, warping, breathing or vibration.
- .5 Provide dielectric isolation or other method to prevent corrosion due to contact with uncoated steel or copper.
- .6 No pipes, wire, structural member or other obstruction will be allowed in ductwork or to penetrate ductwork unless reviewed with and coordinated with the Consultant.
- .7 Duct routing, connections and take-offs to follow building lines.
- .8 Coordinate duct and supporting elements with building architectural, structural, and electrical systems to ensure proper installation and access for maintenance and service.
- .9 Coordinate duct supporting elements with other mechanical systems.
- .10 Do not conceal duct installation before the completion of the Contractor's quality assurance inspection and testing and approval of local authorities having jurisdiction.
- .11 Protect openings against entry of foreign material.
- .12 Install ductwork to minimize furring space, maximize headroom, and conserve space.
- .13 Install ducts to permit separate thermal insulation of each duct.

### **3.2 MANUFACTURER'S INSTRUCTIONS**

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

### **3.3 DUCT SUPPORT**

- .1 The design of duct supporting elements is dependent on Contractor controlled methods of installation and the physical characteristics, limitations and operating characteristics of the duct distribution system.
- .2 Contractor controlled methods of installation include the physical location of the duct (distance to support structure), method of support (hanger, trapeze, etc.), attachment location (roof structure, column, interior wall, etc.), attachment method (cast in place, expansion inserts, structural bridging, clamping, etc.) and distribution systems being supported (single, multiple, etc.).
- .3 Coordinate support system design with the requirements and constraints of the connected equipment, structure, vibration isolation systems and seismic restraint systems.
- .4 Support risers in accordance with SMACNA.

### **3.4 CONNECTIONS TO BUILDING STRUCTURE**

- .1 Spacing, location and loading of individual attachments and all duct support attachments not to exceed capacity of structure.
- .2 Attachments to concrete floor to be at least 400 mm from edge of slab.
- .3 Attachments to concrete floor to be cast in place inserts or expansion studs and anchors. Explosive actuated fasteners not permitted.
- .4 Attachments to composite metal roof deck not to interfere with composite behaviour of roof deck structure.
- .5 Attachments to metal roof deck not permitted.
- .6 Locate connections to open web steel joists at panel points.
- .7 Attachments to steel structure to be bolted type connections.
- .8 Beam attachments to provide concentric support on both sides of beam.
- .9 Maximum loads on attachments to concrete not to exceed one-fifth of the ultimate strength of the attachment as determined by manufacturer's tests. Install attachments in accordance with manufacturer's requirements.

### **3.5 FIRE STOPPING**

- .1 All fire stopping shall be the work of one contractor. Material and installation within annular space between pipes, ducts, insulation and adjacent fire separation Division 07 Standards.
- .2 Provide fire / smoke dampers where indicated and as specified.
- .3 Install breakaway joints in ductwork on sides of fire separation.

### **3.6 ESCUTCHEONS**

- .1 Install on ductwork passing through walls, partitions, floors, and ceilings in finished areas.
- .2 Sizes: outside diameter to cover opening or sleeve. Inside diameter to fit around duct or outside of insulation if so provided.

### **3.7 CONNECTIONS TO EQUIPMENT**

- .1 Duct support shall be independently supported from equipment. Weight of piping shall not be imposed upon connections to equipment.
- .2 In accordance with manufacturer's instructions unless otherwise indicated.
- .3 Use flanges for isolation and ease of maintenance and assembly.

### **3.8 CLEARANCES**

- .1 Provide clearance around systems, equipment and components for observation of operation, inspection, servicing, maintenance and as recommended by manufacturer.
- .2 Provide space for disassembly, removal of equipment and components as recommended by manufacturer or as indicated (whichever is greater) without interrupting operation of other system, equipment, and components.

### **3.9 SEALANT INSTALLATION**

- .1 Ensure all surfaces where sealant or tape is to be applied have been thoroughly cleaned with soap and water and dried. Surfaces should be free from oils, grease, dust, dirt, rust, moisture, ice crystals, and other substances that inhibit or prevent bonding and contaminations.
- .2 Temperatures should be within application temperature range.
- .3 Tapes to be used only in conjunction with a sealant on flat surfaces. Do not apply tape to bare metal or dry sealant. Ensure tape adhesive backing is compatible with sealant to ensure bonding.

### **3.10 FLEXIBLE DUCTWORK INSTALLATION**

- .1 Connect flexible ducts to other ductwork or equipment with stainless steel gear clamps. Secure joints by minimum three wraps of pressure sensitive, vapor seal adhesive tape or with mastic duct sealant and sheet metal screws.
- .2 Length of flexible ductwork not to exceed 2.0 m (6.5 ft.). Flexible ductwork shall be run minimizing the bends and 90° elbows and limiting the length of flexible duct to that which is required only. Flexible duct sections shall be continuous with no intermediate joints.
- .3 Support flexible ducts by hangers every 1.2 m (4 ft.) unless supported adequately by ceiling construction. Support method to prevent duct damage by vibration or other motion. Do not lay ducts across light fixtures or other hot surfaces.
- .4 Flexible ductwork shall not pass through floors or fire walls.
- .5 Flexible ductwork shall be a single section of duct (no joints).
- .6 Flexible ductwork shall be connected to sheet metal duct and diffusers using duct sealer, minimum of 2 screws (180° apart), and metal draw bands.

### **3.11 FLEXIBLE CONNECTION INSTALLATION**

- .1 Install flexible connections to isolate vibration and provide adequate system performance. Provide for air moving equipment at the following locations:
  - .1 Fans: inlet and discharge.
  - .2 Air handling units: inlet and discharge.

- .2 Install flexible braided copper wire jumper (No. 2/0 copper or heavier) across each flexible connection, fastened to ductwork and unit. Secure lugs with sheet metal screws.
- .3 Install flexible connections not more than 150 mm (6") long between metal parts and with just sufficient slack to prevent vibration transmission. Allow movement of 50 mm (2").
- .4 Flexible connections shall be adjusted such that the material DOES NOT restrict the airflow entering or exiting fans.

### **3.12 INTERIOR ACOUSTIC INSULATION / DUCT LINER**

- .1 Acoustically line ductwork where indicated or noted.
- .2 Secure insulation to duct with fire resistant adhesive, welded pins and clips on 400 mm (16") centres.
- .3 Caulk interior butt joints and edges of insulation with fire resistant mastic.
- .4 Metal nosing shall be used on leading edges of each piece of lined duct when the velocity exceeds 4000 Fpm (20.3 m/s) otherwise, it shall be used on the leading edge of any lined duct section that is preceded by unlined duct.

### **3.13 ACCESS DOOR INSTALLATION**

- .1 Install access doors at all devices requiring service, adjustment and cleaning, including the following:
  - .1 Fire dampers.
  - .2 Control dampers.
  - .3 Drain pans.
  - .4 Humidifier duct grids.
  - .5 Duct mounted coils and filters.
- .2 When acoustically lined duct is cut for access, repair cut edges of acoustic lining using self-adhesive fiberglass tape and water based duct sealer. Adhere new acoustic lining to match existing to inside of access panel or door to ensure continuity of acoustic properties of system.

### **3.14 TESTING**

- .1 In accordance with SMACNA HVAC Duct Leakage Test Manual and as indicated below. Complete test before performance insulation or concealment
- .2 Do leakage tests in sections. Test section minimum of 30 m long with not less than three branch takeoffs and two 90 degrees elbows. Make trial leakage tests as instructed to demonstrate workmanship. Do not install additional ductwork until trial test has been passed
- .3 Test high pressure risers and mains by means of a small pressure blower, with calibrated meter and U-gauge manometer to measure the test static pressure developed in the ductwork.

- .4 Carry out leak tests at test pressure 500 Pa (2" w.g.) above system design pressure and repeat until leakage is proven at less than the following:
  - .1 Seal Class A: 1% of airflow;
  - .2 Seal Class B: 2% of airflow;
  - .3 Seal Class C: to testing required.
- .5 Carry out duct structural test at test pressure 1.5 times the maximum pressure possible (fan shutoff pressure) in ductwork that can be isolated by dampers or valves under normal or emergency conditions.
- .6 Test VAV systems at design pressure that could exist at minimum as well as maximum flow conditions.

### **3.15 DUCT CLEANING**

- .1 Following the complete installation of new systems, vacuum clean interior of all ductwork to insure the removal of all dust, contaminants and trash from the duct distribution system.
- .2 Isolate and clean sections in zones to ensure that dirt deposits and debris from zone being cleaned does not pass through other zones that have already been cleaned.
- .3 Install access doors and panels for equipment where required to facilitate system inspection and cleaning. Remove and reinstall ceilings to gain access to HVAC system as required.
- .4 Ensure vacuum units and evacuation fans are securely in place before starting cleaning operation of isolated section of HVAC air duct system.
- .5 Pass brushes through sections as often as necessary to achieve required cleanliness.
- .6 Change brush sizes as required to ensure positive contact with duct and component interiors.
- .7 Clean corners and pockets where dirt and debris can accumulate.
- .8 Clean equipment, components and other features in isolated zone before moving to next zone of HVAC air duct system.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 SCOPE DESCRIPTION SUMMARY**

- .1 This section defines the accessories required for the installation of a ductwork distribution system.

### **1.2 REFERENCES**

- .1 Unless dated references are identified below, it will be the latest standard issued by the regulatory agency that will be utilized as the applicable reference.
- .2 Sheet Metal Air Conditioning Contractors' National Association (SMACNA):
  - .1 SMACNA HVAC Duct Construction Standards, Metal and Flexible.
  - .2 SMACNA HVAC Air Duct Leakage Test Manual.
  - .3 SMACNA IAQ Guideline for Occupied Buildings under Construction.
- .3 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE).
- .4 National Fire Protection Association (NFPA):
  - .1 NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems.
  - .2 NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems.
  - .3 NFPA 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.
- .5 Underwriters' Laboratories Inc. (UL):
  - .1 UL181, Standard for Factory-Made Air Ducts and Air Connectors.
- .6 Underwriters' Laboratories of Canada (ULC):
  - .1 CAN/ULC-S110, Fire Tests for Air Ducts.
  - .2 CAN/ULC-S102, Methods of Test for Surface Burning Characteristics of Building Materials and Assemblies.
  - .3 CAN4-S112, Fire Test of Fire Damper Assemblies.
  - .4 CAN4-S112.2, Standard Method of Fire Test of Ceiling Firestop Flap Assemblies.
  - .5 ULC-S505, Fusible Links for Fire Protection Service.

### **1.3 INFORMATIONAL SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 01 – Submittals.
- .2 Product Data:
  - .1 Product data will be submitted for all PART 2 – PRODUCTS specified herein.
  - .2 Provide manufacturer's printed product literature and datasheets for material specified, and include product characteristics, performance criteria, physical size, finish and limitations.
  - .3 Product data will include all maintenance access points and dimensional clearances, such that the contractor can properly layout the equipment to ensure proper access.
  - .4 Product data will include all relevant information to confirm the specifications have been met.
  - .5 Product data will provide all relevant data and operational points that verify the engineered criteria have been met and that field operational tolerances can be accommodated, i.e., equipment are not supplied, that are operating at their upper and lower limits for their design duty performance.

- .6 Product data will identify all ancillary field installed devices and provide all information required for the coordination of the installation with other trades.
- .7 Product data will include any relevant information that Division 25 requires for a properly functioning building automation system.
- .8 Product data will include information as specified in Section 20 01 01 – Common Work Results for Mechanical unless modified with additional information required below.
- .9 Additional information required.

#### **1.4 MAINTENANCE REQUIREMENTS**

- .1 The contractor will verify and demonstrate that proper maintenance can be performed on equipment and material installed.
- .2 The contractor will supply the following materials to site just prior to substantial being awarded:
  - .1 Ten (10) fusible links of each type of fire damper.

#### **1.5 QUALITY ASSURANCE**

- .1 Performance Requirements Defined: catalogued or published ratings for manufactured items obtained from tests carried out by manufacturer or those ordered by manufacturer from an independent testing agency signifying adherence to codes and standard and standardized testing of performance criteria.
- .2 Contractor performing the work of this section will be a recognized installer of ductwork distribution systems that can be documented and verified.
- .3 Electrical equipment will bear a CSA label or have an ESA certification.
- .4 Air moving equipment will bear an AMCA label.
- .5 Where applicable equipment will bear a ULC or UL label.
- .6 Once the installation (including ceilings) has been completed, the Contractor will verify that the fusible links for all fire dampers can be replaced.
- .7 Provide and construct mock-ups in accordance with Section 01 45 01 – Quality.

### **PART 2 - PRODUCTS**

#### **2.1 GENERAL**

- .1 The Installation will conform to SMACNA HVAC Duct Construction Standards, Metal and Flexible.
- .2 All dampers will be constructed from the same material as the ductwork in which it is installed.
- .3 Contractor will coordinate the installation of balancing dampers with the TAB (Testing and Balancing) Contractor to ensure that the system can be balanced as per the performance requirements. TAB contractor to provide guidance and advice on the location and type of balancing damper to be employed.

- .4 Contractor will coordinate the installation of control dampers with Division 25, Controls Contractor to ensure that the system can be controlled as per the performance requirements. Controls / EMCS contractor to provide guidance and advice on the location and type of dampers to be employed.
- .5 It is recommended that the contractor mock-up the installation of a fire damper for review with the authority having jurisdiction.

## **2.2 FIRE DAMPERS**

- .1 Fire dampers will be curtain type, Type B (stacked blades outside the air stream) unless otherwise identified or approved:
  - .1 Type A fire dampers (stacked blades restricting airflow, within the air stream) will not be utilized unless approved by the Consultant.
  - .2 Type C fire dampers (stacked blades providing 100% free area), will be utilized for duct distribution systems where the Design Operating Pressure is 100 Pa (4"wg) or greater.
- .2 Fire Dampers will be ULC listed and bear a ULC label. Fire dampers will also meet the requirements, once installed, of the local authority having jurisdiction. Fire damper assemblies will have been fire tested in accordance with CAN4-S112.
- .3 Fire damper will be Dynamic Type.
- .4 Fire dampers will be suitable for maximum air velocity and pressure differential to which it will be subjected.
- .5 Fire dampers will be activated with a fusible link, weighted to close and lock in closed position when released or having negator-spring-closing operator for multi-leaf type or roll door type in horizontal position with vertical air flow. Fusible Links will be rated for 74°C (165°F), unless otherwise indicated.
- .6 Construction:
  - .1 Mild steel, factory fabricated for fire rating requirement to maintain integrity of fire wall and/or fire separation.
  - .2 Top Hinged: round or square, multi-blade hinged, sized to maintain full duct cross sectional area.
  - .3 Equip fire dampers with steel sleeve or frame.
  - .4 45 x 45 x 3 mm (1 ½ x 1 ½ x 1/8") retaining angle iron frame, on full perimeter of fire damper, on both sides of fire separation being pierced.
  - .5 Equip sleeves or frames with perimeter mounting angles attached on both sides of wall or floor opening. Construct ductwork in fire-rated floor-ceiling or roof-ceiling assembly systems with air ducts that pierce ceiling to conform to ULC.

## **2.3 COMBINATION FIRE AND SMOKE DAMPERS**

- .1 Combination Fire / Smoke Dampers: to be ULC or UL listed and labelled.
- .2 Motorized (S/D-M): folding blade type, normally open with power on. When power is interrupted damper will close automatically. Both damper and damper operator will be ULC listed and labelled.
- .3 Electro Thermal Link (S/D-ETL): dual responsive fusible link that melts when subjected to local heat of 74°C (165°F) and from external electrical impulse of low power and short duration; ULC or UL listed and labelled.

- .4 Combined Actuator: electrical control system actuated from smoke sensor or smoke detection system and from fusible link.
- .5 120V / 1Ph power supply from Division 26.

## 2.4 OPERATING / CONTROLLED DAMPERS

- .1 Disc Type Control Dampers:
  - .1 Frame: brake formed, welded, 1.6 mm (16 Ga) thick, galvanized steel to ASTM A 653/A 653M.
  - .2 Disc: spin formed, 1.6 mm (16 Ga) thick, galvanized steel to ASTM A 653/A 653M.
  - .3 Gasket: extruded neoprene, field replaceable.
  - .4 Bearings: roller self-lubricated and sealed.
  - .5 Performance: leakage in closed position, less than 1 % of rated airflow at 500 Pa (2"wg) pressure differential across damper.
- .2 Multi Leaf Control Dampers:
  - .1 Opposed blade type for applications requiring air volume control.
  - .2 Parallel blade dampers will be utilized for two position (Open / Closed) control requirements.
  - .3 Where two dampers are required for mixing control, such as an outside air / return air mixing chamber, outside air will be opposed blade and the return air will be parallel blade.
  - .4 Dampers will be constructed from the same material as the ductwork in which it is installed, interlocking blades, complete with extruded vinyl seals, spring stainless steel side seals, structurally formed and welded frame. Pressure fit self-lubricated bronze bearings.
  - .5 Linkage: plated steel tie rods, brass pivots and plated steel brackets, complete with plated steel control rod.
  - .6 Performance: leakage: in closed position less than 2% of rated air flow at 500 Pa differential across damper.
- .3 Multi Leaf Control Dampers (Insulated):
  - .1 For use on outside air intake control dampers and exhaust isolation dampers and discharge point.
  - .2 Same specification as that indicated above with the following exceptions:
    - .1 Construction material will be aluminum.
    - .2 Frames: insulated with extruded polystyrene foam with RSI 0.88. Frames will be thermally broken.
    - .3 Blades: constructed from aluminum extrusions with internal hollows insulated with polyurethane or polystyrene foam, RSI 0.88.
- .4 Control Damper Operators:
  - .1 Damper operator will be provided and installed by Division 25, if specifications for Division 25 are provided, otherwise.
  - .2 Electronic Damper Operators for Variable Position Control:
    - .1 Direct mount proportional type with spring return for "fail-safe" in Normally Open or Normally Closed position, as indicated.
    - .2 Microprocessor-controlled brushless DC motor operator.
    - .3 Operator torque, sized to control dampers against maximum pressure and dynamic closing/opening pressure, whichever is greater.
    - .4 Actuator will be equipped with a built-in mechanical stop to adjust angle of rotation, and have the damper position viewed easily with clear position indicator.
    - .5 Built-in auxiliary switches providing feedback or signal for additional device.

- .6 Field adjustable rotation direction.
- .7 Housing: aluminum dye cast and plastic casing, NEMA 2 Enclosure Type 2.
- .8 Power Requirements: 24 V AC.
- .9 Operating Range: 0 - 10 V DC or 4 - 20 mA DC.
- .10 Damper actuator to drive damper from full open to fully closed will be field adjustable and variable from 60 – 150 seconds.
- .3 Electric Damper Operators for Open / Closed Position Control:
  - .1 Direct mount proportional type with spring return for "fail-safe" in Normally Open or Normally Closed position as indicated.
  - .2 Operator Torque: size to control dampers against maximum pressure and dynamic closing/opening pressure, whichever is greater.
  - .3 Actuator will be equipped with a built-in mechanical stop to adjust angle of rotation, and have the damper position viewed easily with clear position indicator.
  - .4 Built-in auxiliary switches providing feedback or signal for additional device.
  - .5 Field adjustable rotation direction.
  - .6 Housing: aluminum dye cast and plastic casing, NEMA 2 Enclosure Type 2.
  - .7 Power Requirements: 120 V AC.
  - .8 Damper actuator to drive damper from full open to full closed in less than 80 seconds.
- .4 Control Power Transformers:
  - .1 Control transformers will be 120V - 24V, 60 Hertz transformers, installed to meet the power requirements of the connected devices with an additional 25% spare capacity.
  - .2 Transformers will be ULC listed and CSA certified.
  - .3 Standard design will be single phase, all welded core construction made with high quality, high permeability silicon steel laminations. Coils will be accurately wound with high quality magnetic wire with insulation film. All units from 50VA to 5kVA are encapsulated with electrical grade silica sand and resin compounds. Transformers will be complete with heavy duty NEMA 3 Conduit knockouts on sides and rear of enclosure. Front accessible wiring compartment with high and low voltage copper lead wires or tabs. Ample space for transformer connection for primary and secondary terminations.
  - .4 Insulation: up to 1kVA; Class B, 80°C temperature rise. 1.5 to 5kVA; Class F, 115°C temperature rise.
  - .5 Mounting: designed for vertical or horizontal mounting.

## 2.5 BALANCING DAMPERS

- .1 Splitter Dampers:
  - .1 Construction in accordance with SMACNA guidelines. For use as a rough balancing tool only.
  - .2 Fabricate from same material as duct but one sheet metal thickness heavier, with appropriate stiffening.
  - .3 Control rod with locking device and position indicator with shaft extension to accommodate insulation thickness.
  - .4 Extended Pivot: piano hinge.
  - .5 Folded leading edge.
- .2 Single Blade Balancing Damper:
  - .1 Construction in accordance with SMACNA guidelines.
  - .2 Fabricate from same material as duct, but one sheet metal thickness heavier. V-groove stiffened.
  - .3 Size and configuration to recommendations of SMACNA, except maximum height of the single blade for rectangular duct will be 200 mm (8").
  - .4 Locking quadrant with shaft extension to accommodate insulation thickness.

- .5 Inside and outside nylon end bearings.
- .6 Channel frame of same material as adjacent duct, complete with angle stop.
- .3 Multi Blade Balancing Damper:
  - .1 Factory manufactured of material compatible with duct.
  - .2 Opposed Blade: configuration, metal thickness and construction to recommendations of SMACNA.
  - .3 Maximum Blade Height: 100 mm (4").
  - .4 Bearings: self-lubricating nylon.
  - .5 Linkage: locking quadrant with shaft extension to accommodate insulation thickness.
  - .6 Channel frame of same material as adjacent duct, complete with angle stop.

## **2.6 BACKDRAFT DAMPERS / RELIEF DAMPERS**

- .1 Automatic gravity operated multi leaf construction with nylon bearings, spring assisted or counterweighted, as required. Dampers will be constructed from the same material as the ductwork in which it is installed.
- .2 Backdraft dampers will be designed to operate to the full open position at 50 Pa (0.2"SP).
- .3 Relief Dampers will relief positive pressure of 25 Pa (0.1"SP).

## **2.7 JLR AND OWNER SPECIFIED PRODUCTS**

- .1 Refer to Division 00 and 01 for requirements for alternate manufacturer's to those listed below:
- .2 The following are Owner acceptable manufacturers, all others will be rejected unless pre-approved during tender:
  - .1 Fire Dampers Metalaire, NCA, Ruskin, Ventex
  - .2 Multi leaf Dampers Metalaire, NCA, Ruskin, Ventex
  - .3 Backdraft Dampers Metalaire, NCA, Ruskin, Ventex
  - .4 Insulated Multi Leaf Dampers Tamco, Nailor
  - .5 Actuators Belimo, Siemens
  - .6 JLR Specified Products and bases of design: Nil

## **PART 3 - EXECUTION**

### **3.1 GENERAL**

- .1 Install in accordance with recommendations of SMACNA.
- .2 Seal multiple damper modules with silicon sealant.
- .3 Install access door adjacent to each damper. Ensure dampers are observable and accessible.
- .4 Review installation with relevant sub-contractors to insure the performance requirements can be met.

### **3.2 MANUFACTURER'S INSTRUCTIONS**

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

### **3.3 FIRE DAMPER INSTALLATION**

- .1 Install in accordance with the conditions of ULC listing.
- .2 Maintain integrity of fire separation.
- .3 After completion and prior to concealment obtain approvals of complete installation from authority having jurisdiction.
- .4 Install access door adjacent to each damper.
- .5 Coordinate with installer of fires topping.
- .6 Ensure access doors/panels, fusible links and damper operators are easily observed and accessible.
- .7 Install break-away joints of approved design on each side of fire separation.
- .8 Dampers will be installed so that the centerline of the damper depth or thickness is located in the centerline of the wall, partition of floor slab depth or thickness.

### **3.4 BALANCING DAMPER INSTALLATION**

- .1 Install where indicated and as required for completion of balancing.
- .2 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.
- .3 Locate balancing dampers in each branch duct, for supply, return and exhaust systems.
- .4 Runouts to registers and diffusers: install single blade damper located as close as possible to main ducts.
- .5 Dampers: vibration free.
- .6 Ensure damper shaft extensions/ operators are observable and accessible.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 SCOPE DESCRIPTION SUMMARY**

- .1 This section specifies fans, motors, accessories and hardware for the project.

### **1.2 REFERENCES**

- .1 Unless dated references are identified below, it will be the latest standard issued by the regulatory agency that will be utilized as the applicable reference.
- .2 American National Standards Institute (ANSI)/American Society of Mechanical Engineers (ASME) Testing Standards:
  - .1 ANSI/AMCA Standard 99, Standards Handbook.
  - .2 ANSI/AMCA Standard 204 - Balance Quality and Vibration Levels for Fans.
  - .3 ANSI/AMCA Standard 210 - Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating.
  - .4 ANSI/AMCA Standard 320 - Laboratory Methods of Sound Testing of Fans Using Sound Intensity.
- .3 Air Movement and Control Association International, Inc. (AMCA) Certified Ratings Program:
  - .1 AMCA Publication 111 - Laboratory Accreditation Program Outlines Procedure for Obtaining AMCA International Recognition of a Laboratory.
  - .2 AMCA Publication 11 - Certified Ratings Program Operating Manual.
  - .3 AMCA Publication 211 - Certified Ratings Program - Product Rating Manual for Fan Air Performance.
  - .4 AMCA Publication 212 - Certified Ratings Program - Product Rating Manual for Smoke Management Fan Performance.
  - .5 AMCA Publication 311 - Certified Ratings Program - Product Rating Manual for Fan Sound Performance.
  - .6 AMCA Standard 205, Energy Efficiency Classification for Fans.
  - .7 AMCA 201 - Fans and Systems.

### **1.3 INFORMATIONAL SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 01 – Submittals.
- .2 Product Data:
  - .1 Product data will be submitted for all PART 2 – PRODUCTS specified herein.
  - .2 Provide manufacturer's printed product literature and datasheets for material specified, and include product characteristics, performance criteria, physical size, finish and limitations.
  - .3 Product data will include all maintenance access points and dimensional clearances, such that the contractor can properly layout the equipment to ensure proper access.
  - .4 Product data will include all relevant information to confirm the specifications have been met.
  - .5 Product data will provide all relevant data and operational points that verify the engineered criteria have been met and that field operational tolerances can be accommodated, i.e., equipment are not supplied, which are operating at their upper and lower limits for their design duty performance.
  - .6 Product data will identify all ancillary field installed devices and provide all information required for the coordination of the installation with other trades.

- .7 Product data will include any relevant information which Division 25 requires for a properly functioning building automation system.
- .8 Product data will include information as specified in 20 01 01 Common Work Results – Mechanical unless modified with additional information required below.
- .9 Additional information required.
- .3 Maintenance Data:
  - .1 Provide maintenance data including certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties, for incorporation into manuals specified in Section 01 77 01 – Closeout Procedures.
  - .2 Maintenance data will include but not be limited to:
    - .1 Certificates, signed by the manufacturer or their representative, certifying that the materials have been installed as per their installation instructions.
    - .2 The approved shop drawings with performance criteria, edited with field observations and commissioned operational set points and adjustments.
    - .3 The manufacturer's maintenance and installation data.
    - .4 Safety informational data for maintenance staff prior to performing maintenance requirements.
    - .5 List of all routine maintenance requirements as well as monthly, annual or other periodical maintenance recommendations from the manufacturer.
    - .6 Any maintenance requirements that may affect the warranty periods of the associated equipment.
- .4 Provide copies WHMIS MSDS - Material Safety Data Sheets in accordance with Division 1 where material specified has MSDS Sheets.

#### **1.4 MAINTENANCE REQUIREMENTS**

- .1 Contractor will verify and demonstrate that proper maintenance can be performed on equipment and material installed.
- .2 Contractor will supply the following materials to site just prior to substantial being awarded:
  - .1 Provide one set of V belts for each belt drive fan.

#### **1.5 QUALITY ASSURANCE**

- .1 Performance Requirements Defined: catalogued or published ratings for manufactured items obtained from tests carried out by manufacturer or those ordered by manufacturer from an independent testing agency signifying adherence to codes and standard and standardized testing of performance criteria.
- .2 Electrical equipment will bear a CSA label or have an ESA certification.
- .3 Air moving equipment will bear an AMCA label.
- .4 Where applicable equipment will bear a ULC or UL label.
- .5 All fans prior to shipment will be completely assembled and test run as a unit at operating speed or maximum RPM allowed for the particular construction type. Each wheel will be statically and dynamically balanced. Fans balance readings maintained and a written copy will be available upon request.

## **1.6 COMMISSIONING**

- .1 The manufacturer and/or their factory representative will participate in the commissioning process. The manufacturer will inspect the final installation and verify that the product has been installed as per the manufacturer's instructions. The manufacturer will report compliance or discrepancies directly to the Consultant.

## **PART 2 - PRODUCTS**

### **2.1 GENERAL**

- .1 All fan performance ratings will conform to AMCA Standard 205 (fan efficiency grade) and 211 (air performance). Fans will be tested in accordance with ANSI/AMCA Standard 210 (air performance) and 300 (sound performance) in an AMCA accredited laboratory. Fans will be licensed to bear the AMCA certified ratings seal for air and fan efficiency grade (FEG).
- .2 All fans will bear a permanently attached nameplate displaying model and serial number of the unit for future identification.
- .3 Fans will meet or be lower than maximum sound data as listed on the drawings.
- .4 The contractor will coordinate the installation of fans with Division 25, Controls Contractor to ensure that the system can be controlled as per the performance requirements.

### **2.2 COMMERCIAL CABINET DUCT BLOWER IN-LINE CENTRIFUGAL FANS FORWARD CURVED DWDI**

- .1 Application: Standard supply / return / exhaust air at standard temperature and humidity.
- .2 Description:
  - .1 DWDI (Double Width, Double Inlet) Forward Curved type fan mounted within a cabinet for in line airflow, interior mounting.
  - .2 Performance: as indicated on drawings and schedule.
- .3 Construction:
  - .1 Cabinet assembly will be heavy-gauge galvanized steel, lock seam, construction. Duct collars for duct attachment and removable side panels for service access. Cabinet will be finished with an enamel paint coating.
  - .2 Cabinet will be insulated with 25 mm (1") thick fiberglass foil faced insulation.
  - .3 Fan will be forward curved, galvanized steel, Class 1 construction. Wheel will be statically and dynamically balanced. Fans will be equipped with self-aligning ball bearings, permanently lubricated and sealed.
  - .4 Supply air position will be adjustable from right angle to straight through with interchangeable panels.
  - .5 Motor and Drive: fan will be direct drive or belt drive as indicated. Motor will be permanent split capacitor with built-in thermal overload protection and disconnect plug. Motor will conform to applicable sections of NEMA Standard MG-1. Motors will bear a CSA / UL label. Motors will be capable of adjustable speed and provided with a speed controller if required.
  - .6 Unit will be supplied with integral wiring box and receptacle and disconnect receptacle. Factory mounted and wired NEMA-rated disconnect switch.

- .4 Accessories (supplied by Fan Manufacturer):
  - .1 Internal fan housing mounting with flexible duct connection to cabinet and internal spring or neoprene type vibration isolators.
  - .2 Speed controller.
  - .3 Disconnect switch.

## **2.3 RESIDENTIAL CEILING MOUNTED CENTRIFUGAL FANS FORWARD CURVED**

- .1 Application: standard exhaust air from a single space, at standard temperature and humidity.
- .2 Description:
  - .1 SWSI (Single Width, Single Inlet) Forward Curved type fan mounted within a cabinet for in line airflow, interior ceiling mounting.
  - .2 Performance: as indicated on drawings and schedule.
- .3 Construction:
  - .1 Cabinet assembly will be galvanized steel, lock seam, construction.
  - .2 Fan will be forward curved, galvanized steel. Wheel will be statically and dynamically balanced.
  - .3 Motor and Drive: fan will be direct drive. Motors will be permanently lubricated and mounted with resilient anti-vibration mounts. Motors will be capable of adjustable speed.
  - .4 Field wiring compartment with disconnect receptacle.
  - .5 Adjustable pre-punched mounting bracket to accommodate varying ceiling thickness.
  - .6 Painted white enamel aluminum ceiling mounted exhaust grille.
- .4 Accessories (supplied by Fan Manufacturer):
  - .1 Internal fan housing mounting with flexible duct connection to cabinet and internal spring or neoprene type vibration isolators.
  - .2 Speed controller.
  - .3 Disconnect switch.

## **2.4 COMMERCIAL PROPELLER FANS – WALL MOUNTED**

- .1 Application: standard air at standard temperature and humidity.
- .2 Description:
  - .1 Propeller style axial fan blades mounted on a panel exposed within the space.
  - .2 Performance: as indicated on drawings and schedule.
- .3 Construction:
  - .1 Fan panels and motor mount assemblies will be constructed of heavy gauge steel. Panels will have a deep formed inlet Venturi for aerodynamic airflow into the fan. Motor and bearing supports will be constructed of heavy-gauge steel and will be suitably braced to prevent vibration or pulsation.
  - .2 Fan blades will be of an airfoil shape for higher efficiency. Blades and wheel rotor impellor will be constructed of fabricated steel and blades will be securely attached to the hub. Hub and blades will be statically and dynamically balanced.
  - .3 Shafts will be hot rolled steel, mounted on pillow block bearings, heavy duty, grease lubricated, anti-friction ball, self-aligning type.
  - .4 Finish – enamel corrosion resistant paint finish. Aluminum components will be unpainted.

- .4 Motor and Drive:
  - .1 Fan will be direct drive as shown on the drawings.
  - .2 Motor will conform to applicable sections of NEMA Standard MG-1. Motors will bear a CSA / UL label.
  - .3 Motors will be capable of adjustable speed and provided with a speed controller if required.
  - .4 Motors will be explosion proof where specified.
  - .5 Factory mounted and wired NEMA-rated disconnect switch.
- .5 Accessories (supplied by Fan Manufacturer):
  - .1 Wall mounting collar.
  - .2 Motorized damper and damper guard screen.
  - .3 Wall collar louvers mounted flush with exterior wall.
  - .4 Spiral plated Inlet Motor Guard Screen, OSHA compliant.
  - .5 Speed controller.
  - .6 Disconnect switch.

## **2.5 COMMERCIAL ROOF MTD CENTRIFUGAL SPUN ALUMINIUM EXHAUST FAN**

- .1 Application: standard exhaust air at standard temperature and humidity.
- .2 Description:
  - .1 Plug fan style, backward inclined type fan mounted within a spun aluminum housing, with integral roof curb mounting frame for exterior mounting.
  - .2 Performance: as indicated on drawings and schedule.
- .3 Construction:
  - .1 Housing assembly will be a spun aluminum dome with rolled bead edge for rigidity. Dome will cover aluminum base with a deep Venturi inlet to prevent snow and rain entry into the building. Entire assembly will direct mount to a roof curb, provide roof curb gasket. Lifting lugs will be provided.
  - .2 A two piece top cap will have stainless steel quick release latches to provide access into the motor compartment without the use of tools.
  - .3 Fan will be backward inclined, aluminium, Class 1 construction. Wheel will be statically and dynamically balanced. Fans will be equipped with self-aligning ball bearings, permanently lubricated and sealed.
  - .4 Heavy-duty cast iron adjustable pulleys to permit balancing and speed adjustment.
  - .5 Motor and Drive: fan will be belt drive as indicated. Motors will be TEFC (Totally Enclosed Fan Cooled), squirrel-cage induction motors, premium efficiency severe duty type, NEMA Design B. Having a minimum service factor of 1.15 (continuous). Motor will conform to applicable sections of NEMA Standard MG-1. Motors will bear a CSA / UL label. Motors will be capable of adjustable speed and inverter duty.
  - .6 Power to the fan will be thru the roof curb assembly and a conduit chase constructed of EMT will be provided to the motor compartment. Provide a factory mounted and wired NEMA-rated disconnect switch.
  - .7 Fan will be equipped with backdraft damper to be mounted within curb at inlet to fan. Fan discharge will be equipped with a bird screen.

- .4 Roof curb will be factory supplied for applicable roof construction, roof curb will be minimum 600 mm (24") high and have insulated and weatherproofed walls.
- .5 Accessories (supplied by Fan Manufacturer):
  - .1 Gasketted access door in housing.
  - .2 Weatherproof motor and belt guard.
  - .3 Spark resistant construction.
  - .4 Protective coating.
  - .5 Disconnect switch.

## 2.6 JLR AND OWNER SPECIFIED PRODUCTS

- .1 Refer to Division 00 and 01 for requirements for alternate manufacturer's to those listed below:
- .2 The following are Owner acceptable manufacturers, all others will be rejected unless pre-approved during tender:
  - .1 Commercial Cabinet Centrifugal Blowers Cook, Penn Berry, Greenheck
  - .2 Ceiling Washroom Exhaust Fan Cook, Penn Berry, Greenheck
  - .3 Wall Mounted Propeller Fans Cook, Penn Berry, Greenheck
  - .4 Spun Aluminum Upblast Roof Exhauster Cook, Penn Berry, Greenheck
  - .5 JLR Specified Products and bases of design: Nil

## **PART 3 - EXECUTION**

### 3.1 GENERAL

- .1 Carry out field inspection on arrival at site, check for structural damage and verify that electrical characteristics, unit capacities and options are as specified.
- .2 Coordinate roof, wall and ceiling openings, locations and sizes and positioning of roof curbs with other trades.
- .3 Make all adjustments necessary to meet specified airflow. Provide belts and pulleys required for final balancing. Coordinate with the TAB (Testing Adjusting and Balancing) Contractor.

### 3.2 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 SUMMARY**

- .1 This section describes the minimum performance and build quality of air terminal units.

### **1.2 REFERENCES**

- .1 American National Standards Institute/Air Movement and Control Association (ANSI/AMCA)
  - .1 ANSI/ASHRAE 51-07 (ANSI/AMCA 210-07), Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.
- .2 International Organization of Standardization (ISO)
  - .1 ISO 3741-2010, Acoustics-Determination of Sound Power Levels of Noise Sources Using Sound Pressure - Precision Methods for Reverberation Rooms.
- .3 National Fire Protection Association (NFPA)
  - .1 NFPA 90A-12, Standard for the Installation of Air Conditioning and Ventilating Systems.
- .4 Underwriter's Laboratories (UL)
  - .1 UL 181-2005(R2008), Factory-Made Air Ducts and Air Connectors.

### **1.3 INFORMATIONAL SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 01 – Submittals.
- .2 Product Data:
  - .1 Product data will be submitted for all PART 2 – PRODUCTS specified herein.
  - .2 Provide manufacturer's printed product literature and datasheets for material specified, and include product characteristics, performance criteria, physical size, finish and limitations.
  - .3 Product data will include all maintenance access points and dimensional clearances, such that the contractor can properly layout the equipment to ensure proper access.
  - .4 Product data will include all relevant information to confirm the specifications have been met.
  - .5 Product data will provide all relevant data and operational points that verify the engineered criteria have been met and that field operational tolerances can be accommodated, i.e., equipment are not supplied, which are operating at their upper and lower limits for their design duty performance.
  - .6 Product data will identify all ancillary field installed devices and provide all information required for the coordination of the installation with other trades.
  - .7 Product data will include any relevant information which Division 25 requires for a properly functioning building automation system.
  - .8 Product data will include information as specified in 20 01 01 Common Work Results – Mechanical unless modified with additional information required below.
  - .9 Additional information required.
- .3 Shop Drawings:
  - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Ontario, Canada.
  - .2 Indicate the following:
    - .1 Capacity.
    - .2 Pressure drop.

- .3 Noise rating.
  - .4 Leakage.
  - .5 Control schematics.
- .4 Maintenance Data:
  - .1 Provide maintenance data including certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties, for incorporation into manuals specified in Section 01 77 01 – Close-out.
  - .2 Maintenance data will include but not be limited to:
    - .1 Certificates, signed by the manufacturer or their representative, certifying that the materials have been installed as per their installation instructions.
    - .2 The approved shop drawings with performance criteria, edited with field observations and commissioned operational set points and adjustments.
    - .3 The manufacturer's maintenance and installation data.
    - .4 Safety informational data for maintenance staff prior to performing maintenance requirements.
    - .5 List of all routine maintenance requirements as well as monthly, annual or other periodical maintenance recommendations from the manufacturer.
    - .6 Any maintenance requirements that may affect the warranty periods of the associated equipment.
- .5 Provide copies WHMIS MSDS - Material Safety Data Sheets in accordance with Division 1 where material specified has MSDS Sheets.
- .6 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .7 Test and Evaluation Reports:
  - .1 Test data: to ANSI/AMCA Standard 210.
    - .1 Submit published test data on DIN (Direct Internal Noise), in accordance with ISO 3741 made by independent testing agency for 0, 2.5 and 6 m/s branch velocity or inlet velocity.
    - .2 Sound power level with inlet pressures of up to 0.75 kPa in accordance with ISO 3741 for 2nd through 7th octave band, also made by independent testing agency.

#### **1.4 COMMISSIONING**

- .1 The manufacturer and/or their factory representative will participate in the commissioning process. The manufacturer will inspect the final installation and verify that the product has been installed as per the manufacturer's instructions. The manufacturer will report compliance or discrepancies directly to the Consultant.

### **PART 2 - PRODUCTS**

#### **2.1 SINGLE DUCT AIR TERMINAL UNIT – INTEGRAL ATTENUATOR AND HOT WATER REHEAT**

- .1 Basic unit
  - .1 Furnish and install Single Duct Air Terminal Units. The units will be the size and capacity as outlined in the schedule. Casing dimensions will be checked to ensure the terminals fit the available space.

.2 Quality and Standards

- .1 Air terminals will be certified under the Air Conditioning, Heating and Refrigeration Institute (AHRI) Standard 880-08 Certification Program and carry the AHRI seal. All NC values will be calculated per AHRI Standard 885-08. Units with NC values calculated per AHRI-885-90 or 98 will not be accepted. Terminal units will be either ETL® or UL® listed as a complete assembly. Terminal electrical components, including actuators and low voltage controls will be UL® listed. All electrical components including both line voltage and low voltage will be mounted in a metal control enclosure. Units will have a single point field wiring connection. Units will be manufactured and wired per UL-1995 and in accordance with the National Electric Code.

.3 Shipping

- .1 All terminals will be shipped as a single unit requiring no field assembly. Accessories including hot water coils and electric heaters will be factory mounted.

.4 Casing

- .1 The air terminals will be constructed of galvanized steel. The casing will be a minimum of 22-gauge. The terminal primary air inlet valve will have a round (oval or rectangular for larger sizes) inlet for field duct connection. The terminal unit discharge will allow for a slip and drive duct connection. Units will have a universal control-mounting panel constructed of minimum 22-gauge steel. Control panel will include stand-offs to allow controls to be mounted without penetrating the terminal casing. Control panels without stand-offs are not acceptable.

.5 Primary Inlet Air Valve

.1 Inlet tube:

- .1 Primary inlet air valve assembly will have a seamless butt weld on round inlet tube to minimize leakage and prevent the damper from binding on overlapping seam welds. Inlet tubes with overlapping welds or non-continuous, skipped welds are not acceptable. Inlet air valve will have three structural beads machine formed into the tube. One external bead will be provided for the attachment of flexible duct. Inlet air valves without three structural beads are not acceptable.

.2 Flow sensor:

- .1 Primary inlet air valve flow sensor will be multi-quadrant averaging sensor with flow sampling of both velocity pressure and flow differential pressure from four quadrants, and will contain two control ports and two accessory ports. Flow sensors sampling only velocity pressure in all four quadrants are not acceptable. Sensors reading differential pressure with fewer than 8 measuring points are not acceptable. All piping connections to the flow sensor must be made with external ports that extend through damper tube. Units with piping connections made in the primary air stream are not acceptable. Flow sensors with plastic piping connections of any kind are not acceptable. At an inlet velocity of 2000 fpm, the differential static pressure required to operate any terminal size will not exceed 0.14" wg. for the basic terminal.

- .1 Inlet flow sensing devices will be provided with a gasketed access door to permit removal, inspection and cleaning of the air flow sensor.

.3 Damper assembly

- .1 Damper shaft will rotate in a self-lubricating, long life, low friction thermo-plastic bearing. Damper shaft construction will be one piece, continuous extruded aluminum. Damper shaft end will include a permanent cast damper position indicator. Damper tube will be free of obstructions including damper stops to allow the free rotation of the damper. Mechanical damper stops located in the inlet tube are not acceptable. A flexible gasket-mounted damper blade without adhesives will provide damper seal.

Damper gasket will include slit partitioning around the perimeter to prevent damper noise at low flows near full close off. Damper gaskets without perimeter slit partitioning are not acceptable. Mechanically fastened damper assembly will be double layer, 18 gauge equivalent, galvanized steel with integral blade seal. Leakage through the damper assembly will be less than 1% of maximum CFM at 3" static pressure.

.6 Insulation

- .1 Air Terminals will be internally insulated with or 1" thick, 1.5 lb. /ft<sup>3</sup>, dual density fiberglass. Insulation and edges will be coated to prevent air erosion to 6000FPM surface velocity. Insulation will comply with UL 181 and NFPA 90A.

.7 Hot Water Coils

- .1 Hot Water Coils are to be factory mounted to the discharge outlet of the terminal. The number of rows and circuits will meet the capacities as shown in the schedule. Hot water coils will be enclosed in a minimum 20-gauge coated steel casing allowing attachment to metal ductwork with a slip and drive connection. Fins will be rippled and sine wave type, constructed from heavy gauge aluminum, and mechanically bonded to the tubes. Tubes will be copper with a minimum wall thickness is 0.016" with male sweat header connections.
- .2 Coils will be leak tested to 300 psi with minimum burst of 2000 psi at ambient temperature. Coil performance data will be rated and presented in accordance with AHRI standard 410. Coils must be ARI rated, certified and include an AHRI label. Coils that are not AHRI rated, certified or labeled AHRI are not acceptable.

.8 Access Panels and Mounting

- .1 Provide separate bottom primary inlet access panel
- .2 Terminal will include 3" wide bottom-mounting surfaces on opposite ends designed to accept bottom-mounting hardware including trapeze type. Bottom-mounting surfaces will allow mounting hardware to be installed without interfering with access or removal of the bottom access panels.

.9 Sound

- .1 The terminal manufacturer will provide AHRI certified sound power data for radiated and discharge sound. All NC values will be calculated per AHRI standard 885-98. Verify sound ratings for the terminal do not exceed specified value at scheduled static pressure. Sound performance will be AHRI certified. Each individual terminal unit will bear an AHRI label.
- .2 Sound attenuator will be provided where scheduled to meet acoustical performance requirements. The attenuator and terminal unit will be single piece construction. Attenuator insulation will be the same as the unit casing insulation.

.10 Controls

- .1 Factory mounting and wiring of DDC controls will be as specified in the schedule. Mounting will include manufacturer's flow sensor, transformer, and an enclosure protecting DDC controls and wiring.

## 2.2 JLR AND OWNER SPECIFIED PRODUCTS

- .1 Refer to Division 00 and 01 for requirements for alternate manufacturer's to those listed below:
- .2 The following are Owner acceptable manufacturers, all others will be rejected unless pre-approved during tender:
  - .1 Single Duct Air Terminal Unit Cook, Price, Nailor
  - .2 JLR Specified Products and bases of design: Nil

### **PART 3 - EXECUTION**

#### **3.1 APPLICATION**

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for air terminal units' installation in accordance with manufacturer's written instructions.
  - .1 Visually inspect substrate in the presence of Departmental Representative.
  - .2 Inform Consultant of unacceptable conditions immediately upon discovery.
  - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from the Consultant.

#### **3.2 INSTALLATION**

- .1 Install in accordance with manufacturers recommendations.
- .2 Support independently of ductwork.
- .3 Install with at least a minimum of four duct diameters of straight inlet duct length, the same size as the inlet.
- .4 Locate controls, dampers and access panels for easy access.

#### **3.3 CLEANING**

- .1 Progress Cleaning: seal ends of terminal units to prevent dust from settling inside the terminal unit and on sensors.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 01 – Cleaning.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 REFERENCE STANDARDS**

- .1 ASTM International
  - .1 ASTM E 90-09, Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
- .2 National Research Council Canada (NRC)
  - .1 National Building Code of Canada 2015 (NBC).
- .3 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)

### **1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 01 – Submittal Procedures.
- .1 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for diffusers, registers and grilles and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2 Indicate following:
    - .1 Capacity.
    - .2 Throw and terminal velocity.
    - .3 Noise criteria.
    - .4 Pressure drop.
    - .5 Neck velocity.

### **1.3 MAINTENANCE MATERIAL SUBMITTALS**

- .1 Extra Materials:
- .2 Provide maintenance materials in accordance with Section 01 78 00 – Closeout Submittals.
- .3 Include:
  - .1 Keys for volume control adjustment.
  - .2 Keys for air flow pattern adjustment.

### **1.4 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 —Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

- .3 Storage and Handling Requirements:
  - .1 Store materials off in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect diffuser, registers and grilles from nicks, scratches, and blemishes.

## **PART 2 - PRODUCTS**

### **2.1 SYSTEM DESCRIPTION**

- .1 Performance Requirements:
- .2 Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards.

### **2.2 GENERAL**

- .1 To meet capacity, pressure drop, terminal velocity, throw, noise level, neck velocity as indicated.
- .2 Frames:
  - .1 Full perimeter gaskets.
  - .2 Plaster frames where set into plaster or gypsum board and as specified.
  - .3 Concealed fasteners.
- .3 Concealed manual volume control damper operators.
- .4 Colour/Finish: As indicated on drawings.

### **2.3 MANUFACTURED UNITS**

- .1 Grilles, registers and diffusers of same generic type, products of one manufacturer.

### **2.4 SUPPLY GRILLES AND REGISTERS**

- .1 General: with opposed blade dampers.
- .2 Type E: as indicated on drawings.

### **2.5 RETURN AND EXHAUST GRILLES AND REGISTERS**

- .1 General: with opposed blade dampers.
- .2 Type B: as indicated on drawings.
- .3 Type C: as indicated on drawings.

.4 Type D: as indicated on drawings.

.5 Type F: as indicated on drawings.

## **2.6 DIFFUSERS**

.1 General: volume control dampers with flow straightening devices and gaskets.

.2 Type A: as indicated on drawings.

## **2.7 LINEAR DIFFUSERS**

.1 Air volume control damper with concealed adjustment.

.2 Type G: as indicated on drawings.

## **2.8 JLR AND OWNER SPECIFIED PRODUCTS**

.1 Refer to Division 00 and 01 for requirements for alternate manufacturer's to those listed below:

.2 The following are Owner acceptable manufacturers, all others will be rejected unless pre-approved during tender:

- |  |                            |
|--|----------------------------|
| .1 Supply Grilles and Registers:             | Metalaire, Nailor, Krueger |
| .2 Return and Exhaust Grilles and Registers: | Metalaire, Nailor, Krueger |
| .3 Diffusers:                                | Metalaire, Nailor, Krueger |
| .4 Linear Diffusers:                         | Metalaire, Nailor, Krueger |

.3 JLR Specified Products and bases of design:

.1 Nil

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

.1 Install in accordance with manufacturer's instructions.

.2 Install with flat head screws in countersunk holes where fastenings are visible.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 REFERENCE STANDARDS**

- .1 ASTM International
  - .1 ASTM E 90-09, Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
- .2 National Research Council Canada (NRC)
  - .1 National Building Code of Canada 2015 (NBC).
- .3 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)

### **1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 01 – Submittals.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for louvers, intakes and vents and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2 Indicate following:
    - .1 Pressure drop.
    - .2 Face area.
    - .3 Free area.
- .3 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .4 Test Reports: submit certified data from independent laboratory substantiating acoustic and aerodynamic performance to ASTM E 90.

### **1.3 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 – Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect louvers, intakes and vents from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.

## **PART 2 - PRODUCTS**

### **2.1 SYSTEM DESCRIPTION**

- .1 Performance Requirements:
  - .1 Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards.

### **2.2 GRAVITY ROOF OUTSIDE AIR INTAKES AND RELIEF VENTS**

- .1 Factory manufactured aluminum hinged at curb line.
  - .1 Complete with integral birdscreen.
  - .2 Backdraft damper.
  - .3 Maximum throat velocity: 2.5 m/s.
  - .4 Maximum loss through unit: 15 Pa static pressure.
  - .5 Maximum velocity through damper area: 1.5 m/s.
  - .6 Shape: as indicated.
- .2 Birdscreens:
  - .1 Complete with integral birdscreen of 2.7 mm diameter aluminum wire. Use 12 mm mesh on exhaust and 19 mm mesh on intake.

### **2.3 FIXED LOUVRES - ALUMINUM**

- .1 Construction: welded with exposed joints ground flush and smooth.
- .2 Material: extruded aluminum alloy 6063-T5.
- .3 Blade: stormproof pattern with centre watershed in blade, reinforcing bosses and maximum blade length of 1500 mm.
- .4 Frame, head, sill and jamb: 150 mm deep one piece extruded aluminum, minimum 3 mm thick with approved caulking slot, integral to unit.
- .5 Mullions: at 1500 mm maximum centres.
- .6 Fastenings: stainless steel SAE-194-8F with SAE-194-SFB nuts and resilient neoprene washers between aluminum and head of bolt, or between nut, ss washer and aluminum body.
- .7 Screen: 12 mm exhaust and 19 mm intake mesh, 2 mm diameter wire aluminum birdscreen on inside face of louvres in formed U-frame.
- .8 Finish: factory applied enamel, prime coated. Colour: as indicated or approved by Consultant.

## **2.4 FIXED LOUVRES**

- .1 Refer to Division 9.

## **2.5 JLR AND OWNER SPECIFIED PRODUCTS**

- .1 Refer to Division 00 and 01 for requirements for alternate manufacturer's to those listed below:
- .2 The following are Owner acceptable manufacturers, all others will be rejected unless pre-approved during tender:
  - .1 Fixed Louvres: Ventex, Tamco
  - .2 JLR Specified Products and bases of design: Nil

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- .1 In accordance with manufacturer's and SMACNA recommendations.
- .2 Reinforce and brace as indicated.
- .3 Anchor securely into opening. Seal with caulking to ensure weather tightness.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 SCOPE DESCRIPTION SUMMARY**

- .1 This section describes the pumps requirements for HVAC heat exchangers.

### **1.2 REFERENCES**

- .1 Unless dated references are identified below, it will be the latest standard issued by the regulatory agency that will be utilized as the applicable reference.
- .2 American Society of Heating Refrigeration and Air-Conditioning Engineers (ASHRAE):
  - .1 Standard 90.1 - Energy Standard for Buildings except Low-Rise Residential Buildings.
- .3 American Society of Mechanical Engineers (ASME)
  - .1 ASME Boiler and Pressure Vessel Code, 2010.
- .4 CSA International
  - .1 CSA B51-09, Boiler, Pressure Vessel, and Pressure Piping Code.

### **1.3 INFORMATIONAL SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 01 – Submittals.
- .2 Product Data:
  - .1 Product data will be submitted for all PART 2 – PRODUCTS specified herein.
  - .2 Provide manufacturer's printed product literature and datasheets for material specified, and include product characteristics, performance criteria, physical size, finish and limitations.
  - .3 Product data will include all maintenance access points and dimensional clearances, such that the contractor can properly layout the equipment to ensure proper access.
  - .4 Product data will include all relevant information to confirm the specifications have been met.
  - .5 Product data will provide all relevant data and operational points that verify the engineered criteria have been met and that field operational tolerances can be accommodated, i.e., equipment are not supplied, which are operating at their upper and lower limits for their design duty performance.
  - .6 Product data will identify all ancillary field installed devices and provide all information required for the coordination of the installation with other trades.
  - .7 Product data will include any relevant information that Division 25 requires for a properly functioning building automation system.
  - .8 Product data will include information as specified in Section 20 01 01 – Common Work Results for Mechanical unless modified with additional information required below.
- .3 Maintenance Data:
  - .1 Provide maintenance data including certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties, for incorporation into manuals specified in Section 01 77 00 – Closeout Procedures.

- .2 Maintenance data will include but not be limited to:
  - .1 Certificates, signed by the manufacturer or their representative, certifying that the materials have been installed as per their installation instructions.
  - .2 The approved shop drawings with performance criteria edited with field observations and commissioned operational set points and adjustments.
  - .3 The manufacturer's maintenance and installation data.
  - .4 Safety informational data for maintenance staff prior to performing maintenance requirements.
  - .5 List of all routine maintenance requirements as well as monthly, annual or other periodical maintenance recommendations from the manufacturer.
  - .6 Any maintenance requirements that may affect the warranty periods of the associated equipment.

#### **1.4 MAINTENANCE REQUIREMENTS**

- .1 Contractor will verify and demonstrate that proper maintenance can be performed on equipment and material installed.
- .2 Contractor will supply the following materials to site just prior to substantial being awarded.
  - .1 Provide one replacement filter for each installed filter.

#### **1.5 QUALITY ASSURANCE**

- .1 Performance Requirements Defined: catalogued or published ratings for manufactured items obtained from tests carried out by manufacturer or those ordered by manufacturer from an independent testing agency signifying adherence to codes and standard and standardized testing of performance criteria.
- .2 Electrical equipment will bear a CSA label or have an ESA certification.
- .3 Where applicable equipment will bear a ULC or UL label.
- .4 Provide and construct mock-ups in accordance with Section 01 45 01 – Quality Control.

#### **1.6 COMMISSIONING**

- .1 General: in accordance with Sections 01 91 01 – Commissioning, 23 08 02 – Commissioning – Cleaning and Start-up of Mechanical Systems.
- .2 In accordance with manufacturer's recommendations.

## **PART 2 - PRODUCTS**

### **2.1 FLOODED HEAT EXCHANGER**

- .1 Packaged Unit: complete with heat exchanger, condensate control valves, steam traps, necessary interconnecting piping, fittings and valve for condensate discharge, and necessary interconnecting piping, fittings, isolation valves, gauges and transmitter/switches on hydronic header manifold assemblies all mounted on a steel frame and support base. Package unit shall be constructed to allow disassembly for component delivery to mechanical room.
- .2 Heat exchangers: shell & coil type completely welded with heated liquid medium in shell and steam/condensate through coils, 316L stainless steel shell with hemi-spherical heads, 316L 150# flanged connections, internal 316L helically corrugated coiled bundle tubes welded to 316L tube sheet, oversized to maximize sensible heat extraction, pressure/temperature ratings of 150 psig and 366°F. Designed, tested and manufactured in accordance with ASME Section VIII Div. 1 and from an ISO 9001 manufacturing shop and be CRN registered.
- .3 Condensate Control Valves:
  - .1 Valve: carbon steel body, contour top guided or multi-hole cage guided, stainless steel valve, stainless steel valve seat and stem, V-Teflon gland packing up to 366°F, grafoil gland packing above 366°F, screwed NPT end connections up to size 2" NPS and flanged end connections for sizes 2½" to 6" NPS, 450°F maximum operating temperature, 300 PSIG maximum operating pressure, equal percentage flow, ANSI Class IV leakage, 50:1 rangeability.
  - .2 Electric Actuator: proportional modulation, capability for custom configuration, zinc coated metal and plastic casing NEMA type 2 / IP54 housing mounted in any orientation, painted steel mounting bracket, input 4-20mA 2-10 Vdc signal from BAS, reversibility with built-in switch, visual position indicator, manual override for actuator position, fail-safe Mechanical, spring-return mechanism, 2-10V VDC feedback output, maximum 10 VA at 24-V AC or 8 W at 24-V DC power requirements, ISO 9001, cULus, and CSA C22.2 No. 24-93.
- .4 Main Steam Trap: float and thermostatic steam trap and shall be CRN registered.
- .5 Overflow Steam Trap: thermodynamic trap complete with integral strainer and shall be CRN registered.
- .6 Check Valve: spring-assisted non-slam type in 316 stainless steel construction including valve seat and disc, CRN registered.
- .7 Provide cast iron suction guide at the inlet of each pump complete with fine mesh screen, blow down connection, permanent magnet particle trap, full length straightening vanes and pressure gauge tapings.
- .8 Provide triple-duty balancing, check and isolation valve assembly installed on the discharge of each pump. Body shall be cast iron, bronze disc and EPDM seat, stainless steel stem, two brass body metering ports and two ¼" NPT drain tapings.
- .9 Air separator with integral strainer installed upstream of the pump suction guide. Air separator from size 2" to 3" shall come with threaded NPT tangential connections. Air separator from size 4" to 24" shall come with ANSI 150# RFSO flanged tangential connections. All separator sizes shall be designed and built in accordance with ASME Section VIII, Div. 1. Unit size from 2" to 6" shall be made of cast iron. All size shall come with a blowdown connection provided for routine cleaning of the unit.

- .10 Fixed pivot ball float liquid air vent shall be installed on the air separator. The vent body shall be cast iron, valve, seat, leverage system and float shall all be in stainless steel. Design pressure/temperature shall be 250 psi / 450 °F.
- .11 Manual lugged style resilient seated bi-directional butterfly valve shall be installed at both liquid inlet and liquid outlets of each pump and each heat exchanger. Valve stem construction shall be 416 stainless steel and disc shall be 304 stainless steel. Molded-in resilient seat must provide bubble-tight shutoff up to 250 psi.
- .12 Premium stainless steel liquid filled pressure gauge shall be installed on both liquid inlet and liquid outlets. Gauge must have a 4" dial face, stainless steel case and stainless steel internal, filled with glycerin and provide  $\pm 1\%$  accuracy. Pressure gauge installed on steam shall be protected by a 180 degree coil siphon made of 304 stainless steel seamless schedule 40 good for a working pressure of 500 psi @ 680 °F. Both pressure gauge and siphon shall be CRN registered.
- .13 Bi-metal thermometer shall be installed on both liquid inlet and liquid outlets. Thermometer must have 4" dial stainless steel case and stem, fixed centre back connection, dual scale (°F & °C) and provide  $\pm 1\%$  accuracy. Thermometer shall be connected in either a brass or stainless steel thermowell.
- .14 Piping shall be hydrostatically tested at the factory prior to shipping.
- .15 Piping and frame shall have high heat resistance black paint with temperature capacity to 800 °F.
- .16 Standard material specifications :
  - .1 Steam piping in carbon steel schedule 40 ASTM-A53 grade B ERW
  - .2 Condensate piping in carbon steel schedule 80 ASTM-A53 grade B ERW
  - .3 Water/glycol piping in carbon steel schedule 40 ASTM-A53 grade B ERW
  - .4 Carbon steel flanges ASME B16.5 SA-105
  - .5 Carbon steel threaded fittings ASME B16.11 SA-105 3000#
  - .6 Carbon steel butt weld fittings ASME B16.9 SA-234 WPB
  - .7 Carbon steel union MSS-SP-83 SA-105 3000#
  - .8 Metallic gaskets ASME B16.20 316L (steam/condensate)
  - .9 Non-metallic gaskets PTFE (liquid)
  - .10 Studs black ASME SA-193 B7 / Hex nuts black ASME SA-194 2H
  - .11 Steel structure ANSI I-Beam S 3x7.5 44W and ANSI HSS A-500 C 1/4" tk. rect./square tube
- .17 RTD shall be 3-wire platinum type with 316 stainless steel probe complete with NEMA 4 aluminum head and installed on hydronic supply header outlet assembly complete with 316 stainless steel thermowell.
- .18 Flow switch shall be general purpose duty 120/240VAC for liquid flow installed on hydronic outlet of pumps before heat exchangers complete with single pole, double throw snap switch, stainless steel paddle, hardened stainless steel bearings, sealed monel bellows, sensitivity adjustment screw and 1" NPT connection.
- .19 Provide shop drawings in 3D, including a detailed bill of materials, connections sizes table, operating conditions table and a complete specifications package of every component.

## 2.2 IN-LINE CENTRIFUGAL PUMPS

- .1 The pump (s) will be in line type, close coupled, single stage design. Pumps will be capable of mounting in the vertical position. Provide pumps in accordance with scheduled performance criteria.
- .2 Pump will be rated for a minimum of 1207 kPa (175 PSI) working pressure. The housing will be hydrostatically tested to 150% maximum working pressure.
- .3 Construction:
  - .1 Volute and Frame Casing: cast ductile iron construction, with flanged inlet and discharge with integrally cast support. Suction and discharge will be provided with drilled and tapped seal vent and pressure gauge connections. Casing will be radially split to allow for removal of the rotating element without disturbing pipe connections.
  - .2 Impellor: impeller will be machined cast bronze, enclosed type, statically and hydraulically balanced. Impeller will be keyed to the shaft and secured by a hex head impeller nut and washer.
  - .3 Pump Shaft: alloy steel shaft with bronze sleeve bearing.
  - .4 Seals: mechanical shaft seals for leak less operation. Seal will be internally flushed and a portion of the pumped liquid will be utilized to lubricate and cool the seal faces.
  - .5 Fittings: provide vent, and gauge connections.
- .4 Motor: motor will be premium-efficiency squirrel cage induction type motors and suitable for across-the-line (wye-delta, part wind) starting. Motors will also be capable of inverter duty and variable speed operation. The motor will be TEFC (totally enclosed, fan cooled), meet NEMA specifications and will be the RPM, size (HP), and voltage as indicated. Pump and motor will be factory aligned, and verified by the contractor following installation and realigned if required.
- .5 Variable Frequency Drive (VFD) to be provided by the manufacturer listed in Section 2.3 of this specification.
- .6 Each pump will be factory tested and painted with at least one coat of high-grade machinery enamel prior to shipment.

## 2.3 AIR SEPARATORS

- .1 Cyclonic Air Separator:
  - .1 Provide centrifugal type air separator with strainer.
  - .2 Unit to be fabricated of steel to ASME ratings for 860 KPa (125 PSI).
  - .3 Unit to have flanged or grooved inlet and outlet connections and separate top connection for venting and bottom connection for blowdown

## 2.4 PIPING

- .1 All piping and devices shall meet the requirements
  - .1 23 21 13 Hydronic Piping
  - .2 23 21 19 Hydronic Specialties

## 2.5 WIRING AND CONTROLSCONTROLS

- .1 The supplier shall co ordinate the equipment assembly with Div 25. The assembly shall include thermowells for all devices required for complete control of the package by Div 25.
- .2 The supplier shall not include any controls within the package
- .3 The package shall include power wiring from the VFD and the pump mpotor.

## 2.6 VARIABLE FREQUENCY DRIVES

- .1 Each motor in the package will be equipped with a Variable Frequency Drive, rated for the equipment supply voltage.
- .2 Operating Conditions
  - .1 All VFD's must be suitable for operation within an ambient temperature range of -10 - 50°C (14 - 122°F)
  - .2 Humidity: VFD's must be capable of withstanding operation in environments with humidity of maximum 95% non-condensing.
  - .3 Input Frequency: VFD's shall be capable of operating with a mains supply frequency range of 50 – 60Hz ± 2%.
  - .4 Output Frequency: The VFD shall be capable of variable frequency, variable voltage output in the range 0 – 500Hz and 0 – Supply Voltage. Frequency resolution must be at least 0.1Hz
  - .5 VFD's shall be capable of controlling and correctly protecting the motors throughout the required frequency range.
  - .6 VFD's should include protection features to ensure that the motor may not operate in an overloaded condition which may cause damage to the connected motor.
  - .7 VFD's shall be selected based on the full load operating current of the motor. No under sizing of the VFD is permitted, nor should any over sizing be necessary.
  - .8 VFD's shall be capable of controlling the motor with a constant or variable torque output characteristic in order to operate the desired load. Selection between constant and variable torque operation should be easily selectable by parameters within the VFD.
  - .9 VFD's shall be capable of operating with High Efficiency motors of classes IE2, IE3 and IE4.
  - .10 The product data label will carry the UL/CUL standard logo.
  - .11 Harmonics
    - .1 VFD's shall be of a low harmonic design, and shall provide compliance with EN61000-3-12 for units in the range where input current >16A and ≤75A per phase
    - .2 Inverters up to 45kW for use on 3 Phase supplies shall utilise film capacitors in the DC link, to minimise harmonic distortion without the need for AC or DC chokes
  - .12 EMC: All VFD's will be available with inbuilt EMC filters as standard.
  - .13 Bypass
    - .1 The VFD is required to be supplied with functionality able to control a three contactor bypass circuit / configuration.
    - .2 The VFD will be capable of automatically selecting bypass control in the event of a VFD trip condition.
    - .3 The VFD will be capable of selecting bypass or VFD control based on a digital input to the VFD.
    - .4 The VFD will be serviceable while in Bypass mode.

- .14 Control Functions: All VFD programmable parameters to be adjustable from digital operator keypad located on front door of VFD Parameters to include:
- .15 VFDs to have following system interfaces:
  - .1 Inputs:
    - .1 Process control speed reference interface to receive either a 0-10 Vdc, 4-20 mA dc or speed potentiometer signal.
    - .2 Remote mode start and stop contacts.
    - .3 Remote forward/reverse contacts.
    - .4 Remote preset speed contacts.
    - .5 Remote external trip contact.
    - .6 Remote reset contact.
    - .7 Remote jog contact.
  - .2 Outputs:
    - .1 Programmable digital relays (2), NO contact.
    - .2 Form C contact to indicate protective function trip.
    - .3 Two (2) programmable analog output signals.

## 2.7 JLR AND OWNER SPECIFIED PRODUCTS

- .1 Refer to Division 00 and 01 for requirements for alternate manufacturer's to those listed below:
- .2 The following are Owner acceptable manufacturers, all others will be rejected unless pre-approved during tender:
  - .1 Flooded Heat Exchanger: Preston Phipps, Spirax Sarco
  - .2 Control Valves: Siemens
  - .3 Variable Speed Drives Seimens, ABB
  - .4 JLR Specified Products and bases of design: Nil

## **PART 3 - EXECUTION**

### 3.1 INSTALLATION

- .1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.
- .2 General: install level and firmly anchored to supports as in accordance with manufacturer's recommendations.
- .3 Arrange piping so that tube bundle can be removed after disconnecting two unions or flanges adjacent to head and without disturbing other equipment and systems.

### **3.2 APPURTENANCES**

- .1 Install with safety relief valve piped to drain.
- .2 Install thermometer wells with thermometers on inlet and outlet of primary and secondary side.
- .3 Install pressure gauge on steam inlet.

### **3.3 FIELD QUALITY CONTROL**

- .1 Site Tests and Inspections:
- .2 Perform tests as directed by the Consultant to ensure heat exchangers are functional.
  - .1 Obtain reports within 3 days of review and submit immediately to the Consultant.
- .3 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product.
- .4 Manufacturer's Field Services:
  - .1 Submit manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
  - .2 Ensure manufacturer's representative is present before and during critical periods of installation and testing.
  - .3 Schedule site visits:
    - .1 After delivery and storage of products, and when preparatory Work, or other Work, on which the Work of this Section depends, is complete but before installation begins.
    - .2 Twice during progress of Work at 25% and 60% complete.

### **3.4 SYSTEM START-UP**

- .1 General: perform start-up operations in accordance with Section 01 91 01 - Commissioning : General Requirements, supplemented as specified herein.
- .2 Check heater for cleanliness on primary and secondary sides.
- .3 Check water treatment system is complete, operational and correct treatment is being applied.
- .4 Check installation, settings, operation of relief valves and safety valves.
- .5 Check installation, location, settings and operation of operating, limit and safety controls.
- .6 Check supports.
- .7 Timing: only after TAB of hydronic systems have been successfully completed.

- .8 Primary side:
  - .1 Measure flow rate, pressure drop, and steam pressure and temperature at heater inlet.
    - .1 Verify operation of steam traps. Measure temperature of condensate return at trap outlet.
  - .2 Control valve: verify proper operation without binding, slack in components. Measure steam pressure and temperature at control valve inlet.
  - .3 Secondary side:
    - .1 Measure flow rate, pressure drop and water temperature at heater inlet and outlet.
    - .2 Verify installation and operation of air elimination devices.
  - .4 Calculate heat transfer from primary and secondary sides.
  - .5 Simulate heating water temperature schedule and repeat above procedures.
  - .6 Verify settings, operation, safe discharge from safety valves and relief valves.
  - .7 Verify settings, operation of operating, limit and safety controls and alarms.
  - .8 Reports:
    - .1 In accordance with Section 01 91 01 - Commissioning.

### **3.5 DEMONSTRATION**

- .1 Training: provide training in accordance with Section 01 91 01 - Commissioning.

### **3.6 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by heat exchanger installation.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 SUMMARY**

- .1 This section describes the minimum performance and build quality of air handling units designed and manufactured to the specific requirements of this project.

### **1.2 REFERENCES**

- .1 American National Standards Institute/American Society of Heating, Refrigeration and Air Condition Engineers/Illuminating Engineering Society (ANSI/ASHRAE/IES)
  - .1 ANSI/ASHRAE 52.2-2012, Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.
  - .2 ANSI/ASHRAE/IES 90.1-2010, Energy Standard for Buildings Except Low-Rise Residential Buildings.
- .2 Green Seal (GS)
  - .1 GS-11-11, Standard for Paints and Coatings.
- .3 Master Painters Institute (MPI)
  - .1 Architectural Painting Specification Manual - current edition.
    - .1 MPI #18.
- .4 National Fire Protection Association (NFPA)
  - .1 NFPA 90A-12, Standard for the Installation of Air Conditioning and Ventilating Systems.
- .5 Sheet Metal and Air-Conditioning Contractors' National Association (SMACNA)
- .6 South Coast Air Quality Management District (SCAQMD)
  - .1 SCAQMD Rule 1113-11, Architectural Coatings.

### **1.3 INFORMATIONAL SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 01 – Submittals.
- .2 Product Data:
  - .1 Product data will be submitted for all PART 2 – PRODUCTS specified herein.
  - .2 Provide manufacturer's printed product literature and datasheets for material specified, and include product characteristics, performance criteria, physical size, finish and limitations.
  - .3 Product data will include all maintenance access points and dimensional clearances, such that the contractor can properly layout the equipment to ensure proper access.
  - .4 Product data will include all relevant information to confirm the specifications have been met.
  - .5 Product data will provide all relevant data and operational points that verify the engineered criteria have been met and that field operational tolerances can be accommodated, i.e., equipment are not supplied, which are operating at their upper and lower limits for their design duty performance.
  - .6 Product data will identify all ancillary field installed devices and provide all information required for the coordination of the installation with other trades.

- .7 Product data will include any relevant information which Division 25 requires for a properly functioning building automation system.
  - .8 Product data will include information as specified in 20 01 01 Common Work Results – Mechanical unless modified with additional information required below.
  - .9 Additional information required.
- .3 Shop Drawings:
- .1 Submit drawings stamped and signed by professional engineer registered or licensed in Ontario Canada.
  - .2 Indicate on drawings:
    - .1 Actual cooling and heating fluid entering and leaving conditions for stated air side requirements.
    - .2 Product data shall indicate dimensions, weights, capacities, ratings, fan performance, motor electrical characteristics, metal gauges and finishes of materials.
    - .3 Provide fan curves with specified operating point clearly plotted.
    - .4 Submit sound power levels for both fan inlet and outlet at rated capacity. Provide sound power levels at the inlet and outlet of the unit.
    - .5 Submit product data of filter media, filter performance data, filter assembly, and filter frames.
    - .6 Submit electrical requirements for power supply wiring including wiring diagrams for interlock and control wiring, clearly indicating factory-installed and field-installed wiring.
- .4 Maintenance Data:
- .1 Provide maintenance data including certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties, for incorporation into manuals specified in Section 01 77 01 – Closeout Procedures.
  - .2 Maintenance data will include but not be limited to:
    - .1 Certificates, signed by the manufacturer or their representative, certifying that the materials have been installed as per their installation instructions.
    - .2 The approved shop drawings with performance criteria, edited with field observations and commissioned operational set points and adjustments.
    - .3 The manufacturer's maintenance and installation data.
    - .4 Safety informational data for maintenance staff prior to performing maintenance requirements.
    - .5 List of all routine maintenance requirements as well as monthly, annual or other periodical maintenance recommendations from the manufacturer.
    - .6 Any maintenance requirements that may affect the warranty periods of the associated equipment.
- .5 Furnish list of individual manufacturer's recommended spare parts for equipment such as bearings and seals, and addresses of suppliers, together with list of specialized tools necessary for adjusting, repairing or replacing, for placement into operating manual.
- .6 Contractor will supply the following materials to site just prior to substantial being awarded:
- .1 Provide one set of V belts for each belt drive fan.
- .7 Provide copies WHMIS MSDS - Material Safety Data Sheets in accordance with Division 1 where material specified has MSDS Sheets.

#### 1.4 QUALITY ASSURANCE

- .1 Performance Requirements Defined: catalogued or published ratings for manufactured items obtained from tests carried out by manufacturer or those ordered by manufacturer from an independent testing agency signifying adherence to codes and standard and standardized testing of performance criteria.
- .2 Electrical equipment will bear a CSA label or have an ESA certification.
- .3 Air moving equipment will bear an AMCA label.
- .4 Where applicable equipment will bear a ULC or UL label.
- .5 All fans prior to shipment will be completely assembled and test run as a unit at operating speed or maximum RPM allowed for the particular construction type. Each wheel will be statically and dynamically balanced. Fans balance readings maintained and a written copy will be available upon request.
- .6 The following are to be used as selection criteria and are to be as specified: Air flow rates, external static pressures, water flow rates. The following are to be equaled or bettered: Coil face velocities, filter face velocities, casing leakage rates. The following are to be met within 10% of specified values: Water pressure drops.
- .7 Provide unit produced by a recognized manufacturer who maintains a local service agency and parts stock.
- .8 Air handling units and major components shall be products of the manufacturer regularly engaged in production of such equipment.
- .9 Fans shall conform to AMCA bulletins regarding testing and construction. (Airfoil fans shall bear the AMCA certified rating seal for airflow and sound).
- .10 Coils shall be ARI certified.
- .11 Filter media shall be ULC listed.
- .12 Unit shall be factory CSA approved.
- .13 After construction, units shall be cleaned thoroughly before shipping. All floor surfaces and wall surfaces shall be thoroughly degreased and cleaned. After cleaning, units shall be shrink wrapped using a heavy gauge heat shrinkable plastic wrap.
- .14 During storage, contractor shall store units in a dry heated environment. Fan wheels shall be rotated monthly during storage. Units shall be regularly inspected for moisture and any job site moisture shall be immediately removed.

#### 1.5 COMMISSIONING

- .1 The manufacturer and/or their factory representative will participate in the commissioning process. The manufacturer will inspect the final installation and verify that the product has been installed as per the manufacturer's instructions. The manufacturer will report compliance or discrepancies directly to the Consultant.

## **PART 2 - PRODUCTS**

### **2.1 DESCRIPTION**

- .1 Provide factory assembled air handling unit in configuration as indicated on drawings. Unit shall include all specified components installed at the factory. Field fabrication of units and their components will not be accepted.
- .2 The unit shall be designed to be supported by a house keeping pad.

### **2.2 ACOUSTICAL PERFORMANCE**

- .1 The casing shall have been tested for acoustical performance by an independent laboratory that is accredited. Manufacturers shall submit sound data in compliance with the following:
- .2 Test methods and facilities used to establish sound transmission loss values shall conform explicitly with the ASTM designation E90-85 and E413-73.

- .3 Sound Transmission Loss DB ASTM E-90 & E413-73

	1	2	3	4	5	6	7	8	
2" wall	18	19	27	33	43	52	52	52	STC=37

- .4 Test methods and facilities used to establish sound absorption values shall conform explicitly with the requirements of the ASTM Standard Test Method for Sound Absorption Coefficients by the Reverberation Method: ASTM C423-84A and E795-83.

#### Sound Absorption ASTM C423-84A & E795-83

	1	2	3	4	5	6	7	8	
2" wall	.10	.23	.75	1.08	1.05	.99	.97	.95	STC=37

### **2.3 CASING**

- .1 Walls and roofs shall be constructed of satin coated 16 gauge galvanized steel, G90, with minimum 100mm thick double walled insulated construction. The inner liner shall be 22 gauge solid galvanized steel galvanized steel. Insulation shall be 4.0 lb. density mineral fiber.
- .2 All permanently joined flanged panel surfaces shall be sealed with an individual strip of 1/8" X 3/8" tape sealer. Wall and roof seams shall be turned inward to provide a clean flush exterior finish. All panel seams shall be sealed during assembly to produce an airtight unit.
- .3 Cabinet shall be pressures tested.

## 2.4 INSULATION

- .1 All insulation used in air handling unit walls, roof and base shall have a Flame spread rating of less than 25 and a Smoke Developed rating of less than 50 per ASTM E84 and UL 723 and Can/ULC S102-M88.
- .2 Insulation shall meet NFPA 90A and 90B.

## 2.5 STRUCTURAL BASE CONSTRUCTION

- .1 Units shall be constructed from a minimum C6x8.2 lb./sq.ft. channel structural steel perimeter base, with 2x2x1/4 intermediate structural steel channel and angle iron supports. Perimeter structural steel base shall be designed to directly support the weight of the walls. Intermediate structural steel and angle iron shall support the weight of all internal components (i.e. fans, coils, etc.). Maximum base deflection shall be 1/4 inch on unsupported spans of 12 ft. Structural steel base shall be designed so that it can be point loaded or set on an unlevel surface and shimmed by the contractor within 12 foot spans without deflecting more than 1/4 inch. The structural steel base shall be either I-beam construction or C-channel (not box channel) so that the base will shed all water. Base shall be provided with lifting lugs, minimum four (4) per shipping split. Formed metal bases formed from sheet metal will not be acceptable. Base shall prevent wall panel joints from separating during lifting, transportation and rigging.
- .2 Lifting lugs shall be located and engineered to properly support the loads within. Manufacturers shall provide a load point calculation along with detailed lifting lug information as part of the shop drawing package.
- .3 A 0.12" thick aluminum checker plate floor shall be installed on the base. Floor seams shall be continuously welded providing a completely flat unit floor. Standing seams will not be accepted in any section. Steel checker plate floor shall be coated with grey epoxy paint. A 1-1/2" perimeter collar shall be provided to ensure the unit is internally watertight. The collar shall be alternately screwed down and tack welded to the unit base on one (1) foot centres. Caulk joint to be watertight.
- .4 The base shall be insulated with 100mm thick, 1-1/2 lb. density fibreglass insulation and sheeted with a 22 gauge galvanized steel liner. The base liner shall be broken, tack welded and sealed for rigidity and vapour barrier integrity.

## 2.6 ACCESS DOORS

- .1 Access door construction and width shall match the rest of the unit casing. Corners shall be welded for rigidity. Spot welding of corner seems will not be accepted. 4.0 lb. density insulation shall be sandwiched between the outer and inner skins. A 10" x 10" (double pane) tempered glass window shall be provided in each door.
- .2 Provide two chrome plated high pressure latches operable from either side of the door. Hinges shall be continuous piano type stainless steel. Door openings shall be fully gasketed with continuous 1/2" closed cell hollow round black gasket with a metal encapsulated reinforced backing that mechanically fastens to the door opening perimeter. Door frames shall be framed from 16 gauge galvanized steel with the outside of the door flush to the unit. Minimum door width shall be as shown on the plans but in no case shall an access door be less than 18". Door height shall be the maximum permitted by the height of the unit up to 72".
- .3 Doors shall open against positive pressure.

## 2.7 FANS

- .1 All fans shall be tested in accordance with AMCA Standards 210-70 and 310 Test Codes for Air Moving Devices. Backward inclined fans shall bear the AMCA sticker for both air and sound performance.
- .2 Fan Wheels and Shafts: Provide air foil blades on all fans wheels. Provide solid shafts keyed to the fan wheel. Coat fan shaft with rust inhibitor. Hollow shafts will not be acceptable.
- .3 Fan bearings shall be self aligning pillow block, grease lubricated, extra heavy duty anti-friction ball or spherical roller type selected for an L10 life of 200,000 hours at design operating conditions. Bearings are to be mounted on the integral fan scroll bracing.
- .4 Fan and motor shall be mounted on an all welded, structural steel, prime coated and internal isolation base. The outlet of the fan shall be separated from the unit casing by means of a factory installed flexible connection. The internally mounted motor shall be provided on a slide rail base to allow proper adjustment of belt tension.
- .5 Provide an OSHA approved fully enclosed metal belt guard having side of galvanized steel and expanded metal face. Belt guard shall be sized to allow either sheave to be increased by two sizes.
- .6 Provide fixed pitch sheaves rated at 150% of motor nameplate H.P. Allow for one (1) drive change for air balancing purposes (parts only, labour by air balancer).
- .7 On air handling units with ABB variable speed drives, mount the VSD on the unit. Factory wire between the VSD and fan motors. Ensure all casing penetrations are sealed to be air tight. Provide a terminal block within the VSD for field termination of line side wiring.

## 2.8 MOTORS

- .1 Motors shall be designed for severe duty in accordance with IEEE 841 standards and shall meet NEMA MG1 Part 31. Motors shall be operable at 600 Volts, 60 Hz, 3-phase.
- .2 Motor enclosure shall be totally enclosed fan cooled and rated to IP55. A non metallic cooling fan shall be provided. Frame, end bells and fan cowl shall be manufactured of heavy duty cast iron. The end plates shall be sealed to the frame joints. Enclosure shall be epoxy coated and rated for ASTM B117-90 96 hour salt spray test.
- .3 Motor windings shall have class F insulation with class B temperature rise ratings. Windings shall be 200C inverter spike resistant wire. Motor windings shall withstand 2000V transients. Motor service factor shall be 1.15 on sine wave power and 1.0 on VFD power.
- .4 Bearings shall be regreasable without disassembly and provide for the elimination of purged grease. Bearing life shall be a minimum of L10 at 50000 hours. Bearing seals shall be Inpro or equivalent.
- .5 Motors shall be balanced to less than 0.08 inches per second (filter out) and the vibration test data shall be shipped with the motor.
- .6 Nameplates shall be stainless steel and contain both NEMA data and bearing data.
- .7 Motors used with variable frequency drives shall be provided with a brush system to electrically ground the shaft and discharge any induced voltage on the motor shaft, with a direct path to ground.

- .8 Motor shall be provided with a 3 year warranty.
- .9 Acceptable motor manufacturers are Reliance-Baldor, US Motors, and TECO-Westinghouse.

## **2.9 VIBRATION ISOLATION**

- .1 An integral all weld steel vibration isolation base shall be provided for the fan and motor.
- .2 Provide open spring mounts with iso stiff springs, sound deadening pads and leveling bolts.
- .3 Horizontal stiffness shall be equal to vertical stiffness.
- .4 Spring deflection shall be 2".
- .5 Isolators shall have earthquake restraints. Upon request, the unit manufacturer shall submit a restraint detail certified by a professional engineer.

## **2.10 HEATING AND COOLING COILS**

- .1 Coils shall be fully enclosed within casing and mounted on angle frames manufactured to allow coils to be individually removed. Cooling coil racks and coil casings shall be 12 Ga. 304 stainless steel. Heating coils shall be mounted on galvanized angle racks. Coils shall be bottom drainage and be provided with an air-blowout connection. Means shall also be provided to continually circulate supply air from the unit through the coil.
- .2 Removable coil access panels shall be provided to remove coils through casing wall. Coil covers shall be double wall construction with all exposed edges of insulation covered with sheet metal including holes through the cover for coil header stub outs. Coils shall be individually removable towards the access side.
- .3 All drain pans shall be double wall continuously welded 304 stainless steel. Intermediate drain pans shall be interconnected with stainless steel 1" down pipes. Condensate drain shall be a minimum 1-1/4" diameter stainless steel tube extending 1" out from unit for solder connection to trap. Drain pans shall be sloped within unit and fully drainable.
- .4 Coils shall be certified in accordance with ARI Standard 410.
- .5 Cooling coils shall be supplied with moisture eliminators in the leaving air side of the coils to collect any water carryover. Eliminators shall be 304 SS construction and drain all collected moisture into drain pan.
- .6 Construction:
  - .1 Tubes: Horizontal, copper 0.035" tube thickness.
  - .2 Fins: Aluminum mechanically bonded to tubes.
  - .3 Headers: Seamless copper with vent and drain connections.
  - .4 Casing: 16 gauge, galvanized steel for heating and stainless steel for cooling, channels with 16 gauge center and end supports.
  - .5 Connections: Same end, counterflow, with vent, drain, supply and return stubs extended to outside of unit casing with grommets for airtight casing. Roof mounted units shall have the centre of the bottom coil connections located 10" off the unit floor.

## **2.11 PREFILTERS**

- .1 Prefilters shall be (2"-50mm) AM-AIR 300, medium efficiency (at least 35%), pleated, disposable type, MERV 8. The filter shall be listed by Underwriters Laboratories as Class 2.
- .2 Prefilters shall be installed in a prefabricated channel rack.
- .3 Prefilters shall be lift out from upstream access section.

## **2.12 FINAL FILTERS**

- .1 Final filters shall be high performance, AAF deep pleated 12" long cartridge disposable type, MERV 14. Each filter shall consist of glass fibre media, media support grid, contour stabilizer and enclosing frame.
- .2 Final filter media shall be of high density microfine glass fibers laminated to a non-woven synthetic backing to form a lofted filter blanket. The filter media shall have an average efficiency of 95% on the ASHRAE Test Standard 52. The filter shall be listed by Underwriters Laboratories as Class 2.
- .3 Holding frames shall be factory fabricated of 16 gauge galvanized steel and shall be equipped with gaskets and 2 heavy duty positive sealing fasteners. Each fastener shall be capable of withstanding 25 lb. pressure without deflection. They will be capable of being attached or removed without the use of tools.
- .4 Final filters shall be lift out from upstream access section.

## **2.13 DRAINS**

- .1 Provide 1 1/4" capped floor drain connections on the side of the unit for complete drainability of the base pan for the following sections:
  - .1 Fresh Air Plenums
  - .2 Humidifier Sections
  - .3 Service Corridors
  - .4 Fan Sections
  - .5 Sections upstream and downstream of coils
  - .6 All sections if unit has washdown liner
- .2 Depth of trap for drains shall be equal to total static pressure of the unit + 50%.

## **2.14 LIGHTS**

- .1 Four (4) foot long, vapour proof fluorescent ceiling mounted marine lights with wall mounted duplex receptacles shall be provided in each access section. One (1) switch with an indicator light shall be installed on the exterior of the unit. Factory wire from switch to all lights in EMT conduit with liquid tight connections. Electrical power shall be 120V/1/60.

## **2.15 FILTER GAUGES**

- .1 Provide electronic filter gauges which have a digital display and a 4-20mA or 0-10VDC signal to indicate air pressure drop. Power the gauges from the lighting circuit.
- .2 Magnehelic gauges shall be accurate to +/- 2% of full range.
- .3 Provide sensing probes and shut off valves for each gauge.
- .4 Provide one gauge flush mounted into the casing for each filter bank.

## **2.16 ALUMINUM AIRFOIL DAMPERS**

- .1 Aluminum airfoil frames and blades shall be a minimum of 12 gauge extruded aluminum. Blades to be 6" wide single air foil design.
- .2 Frames shall be extruded aluminum channel with grooved inserts for vinyl seals. Standard frames 2" x 4" x 5/8" on linkage side, 1" x 4" x 1" on the other sides.
- .3 Pivot rods shall be 7/16" hexagon extruded aluminum interlocking into blade section. Bearings to be double sealed type with a Celcon inner bearing on a rod within a Polycarbonate outer bearing inserted into frame so that the outer bearing cannot rotate.
- .4 Bearing shall be designed so that there are no metal-to-metal or metal-to-bearing riding surfaces. Interconnecting linkage shall have a separate Celcon bearing to eliminate friction in linkage.
- .5 Blade linkage hardware is to be installed in frame out of airstream. All hardware to be on non-corrosive reinforced material or cadmium plated steel.
- .6 Damper seals shall be designed for minimum air leakage by means of overlapping seals.
- .7 Outdoor air dampers shall be Internal hollows shall be insulated with 7/8" thick polyurethane foam with R factor of 5.0 per inch. Blades shall be 100% thermally broken. Frame shall be insulated with polystyrene, R factor of 5.0 per inch.
- .8 Damper blades shall be maximum 40" long per section.
- .9 Dampers greater than 2 sections wide shall be provided with a jackshaft.
- .10 Acceptable dampers are: T.A. Morrison "TAMCO series 1000 and 9000" and "RUSKIN

## **2.17 TEST PORTS**

- .1 Provide 1" diameter test ports for unit air stream testing in each plenum section between each component within the AHU. Test ports shall have a tube that extends between the inside and outside of the unit and a screwed cap on the exterior to allow access. The test ports shall have been flanged on the exterior to allow air seal and shall be flanged on the interior to cover the penetration of the casing

## **2.18 ELECTRICAL**

- .1 Factory wire and test all air handling units. Have units approved by CSA or ETLc.
- .2 Supply one @ 600 V/60 Hz/3 Ph power connection for motors and other large electrical devices and one @ 120 V/208V/60 Hz/1 Ph power connection for lights, controls, heaters, etc.
- .3 A bonding wire shall be provided between the motor loads and the electrical panel. Use of the air handling unit casing for a bond will not be accepted.
- .4 Label and number code all wiring and electrical devices in accordance with the unit electrical diagram. Mount the devices in a control panel inside the unit's service enclosure or on the outside. Ensure the control panel meets the CSA or Canadian Electrical Code (CEC) standard for the specific installation.
- .5 Provide a system of motor control including all necessary terminal blocks, motor contactors, motor overload protection, grounding lugs, auxiliary contactors and terminals for the connection of external control devices or relays. Individually fuse all fan and branch circuits.
- .6 Wire from the motors to the motor control in accordance with the local electrical code and contained by EMT conduit with liquid tight connections. Seal the casing penetrations in a manner that eliminates air leaks. At all split sections, provide a 1 foot long piece of flexible conduit, with the extra wire spooled, for reconnection on site by the installing contractor.

## **2.19 FINISH**

- .1 Unit shall be finished painted with two components, each bond primer and finish painted with alkyd enamel, colour as selected by Owner. All uncoated steel shall be painted with grey enamel. All metal surfaces shall be prepainted with vinyl wash primer to ensure paint bonds to metal.

## **2.20 AIR LEAKAGE TESTING**

- .1 Unit manufacturer shall factory pressure test each air handling unit to ensure the leakage rate of the casing does not exceed 1.0% of the unit air flow at 1.5 times the rated static pressure. Leakage test shall be performed with VFD panels installed.
- .2 Test shall be conducted in accordance with SMACNA duct construction manual. A calibrated orifice shall be used to measure leakage airflow.
- .3 An officer of the air handling unit company shall certify test results. Forward copies of certified test results to the consultant. The consultant and owner shall witness the pressure test on the first two units. Provide for all transportation for the consultant and owner to the factory.

## **2.21 FLOOD TESTING**

- .1 All unit bases shall be flooded to a level of 1.25" after manufacturing to assure no leakage through the floor and the perimeter water barrier. The results of the flood test shall be certified by the manufacturer.

## **2.22 JLR AND OWNER SPECIFIED PRODUCTS**

- .1 Refer to Division 00 and 01 for requirements for alternate manufacturer's to those listed below:
- .2 JLR Specified Products and bases of design:
  - .1 Air Handling Units                      Haakon

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for air handling equipment installation in accordance with manufacturer's written instructions.
  - .1 Visually inspect substrate.
  - .2 Inform Consultant of unacceptable conditions immediately upon discovery.
  - .3 Proceed with installation only after unacceptable conditions have been remedied.

### **3.2 INSTALLATION**

- .1 Install units on a flat surface level within 1/8 inch and of sufficient strength to support the units.
- .2 Provide components furnished as per manufacturer's literature.
- .3 Provide all water piping so water circuits are serviceable, without having to dismantle excessive lengths of pipe.
- .4 Provide valves in water piping upstream and downstream of each coil for isolating the coils for maintenance and to balance and trim the system.
- .5 Provide drain valves and vent cocks to each coil.
- .6 Provide strainers ahead of all pumps and automatic modulating valves.
- .7 Provide certified wiring schematics to the electrical division for the equipment and controls.
- .8 Provide all necessary control wiring as recommended by the manufacturer.
- .9 Provide condensate traps in accordance with manufacturers recommendations.
- .10 Insulate all piping and equipment mounted inside the corridor.
- .11 Provide sheaves and belts required for final air balance.
- .12 Install flexible connections at fan inlets and outlets
  - .1 Ensure metal bands of connectors are parallel and no touching.
  - .2 Ensure that fan outlet and duct are aligned when fan is running.
- .13 Install P trap on drain lines.
  - .1 Depth of water seal to 1.5 minimum times static pressure at this point.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 SUMMARY**

- .1 This section describes the minimum performance and build quality of Fan Coil Units.

### **1.2 REFERENCES**

- .1 American National Standards Institute/American Society of Heating, Refrigeration and Air Condition Engineers/Illuminating Engineering Society (ANSI/ASHRAE/IES)
  - .1 ANSI/ASHRAE/IES 90.1-2010, Energy Standard for Buildings Except Low-Rise Residential Buildings.
- .2 National Fire Protection Association (NFPA)
  - .1 NFPA 90A-12, Standard for the Installation of Air Conditioning and Ventilating Systems.
- .3 Sheet Metal and Air-Conditioning Contractors' National Association (SMACNA)

### **1.3 INFORMATIONAL SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 01 – Submittals.
- .2 Product Data:
  - .1 Product data will be submitted for all PART 2 – PRODUCTS specified herein.
  - .2 Provide manufacturer's printed product literature and datasheets for material specified, and include product characteristics, performance criteria, physical size, finish and limitations.
  - .3 Product data will include all maintenance access points and dimensional clearances, such that the contractor can properly layout the equipment to ensure proper access.
  - .4 Product data will include all relevant information to confirm the specifications have been met.
  - .5 Product data will provide all relevant data and operational points that verify the engineered criteria have been met and that field operational tolerances can be accommodated, i.e., equipment are not supplied, which are operating at their upper and lower limits for their design duty performance.
  - .6 Product data will identify all ancillary field installed devices and provide all information required for the coordination of the installation with other trades.
  - .7 Product data will include any relevant information which Division 25 requires for a properly functioning building automation system.
  - .8 Product data will include information as specified in 20 01 01 Common Work Results – Mechanical unless modified with additional information required below.
  - .9 Product data to include:
    - .1 Filters, fan accessibility.
    - .2 Anchoring of cabinet.
    - .3 Thermostat, transformer, controls where integral.
    - .4 kW rating, voltage, phase.
    - .5 Cabinet material thicknesses.
    - .6 Unit assembly instructions.
    - .7 Unit dimensions.
    - .8 Required clearances.

- .3 Maintenance Data:
  - .1 Provide maintenance data including certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties, for incorporation into manuals specified in Section 01 77 01 – Closeout Procedures.
  - .2 Maintenance data will include but not be limited to:
    - .1 Certificates, signed by the manufacturer or their representative, certifying that the materials have been installed as per their installation instructions.
    - .2 The approved shop drawings with performance criteria, edited with field observations and commissioned operational set points and adjustments.
    - .3 The manufacturer's maintenance and installation data.
    - .4 Safety informational data for maintenance staff prior to performing maintenance requirements.
    - .5 List of all routine maintenance requirements as well as monthly, annual or other periodical maintenance recommendations from the manufacturer.
    - .6 Any maintenance requirements that may affect the warranty periods of the associated equipment.
- .4 Provide copies WHMIS MSDS - Material Safety Data Sheets in accordance with Division 1 where material specified has MSDS Sheets.

#### **1.4 MAINTENANCE REQUIREMENTS**

- .1 Contractor will verify and demonstrate that proper maintenance can be performed on equipment and material installed.
- .2 Contractor will supply the following materials to site just prior to substantial being awarded:
  - .1 Provide one set of V belts for each belt drive fan.

#### **1.5 QUALITY ASSURANCE**

- .1 Performance Requirements Defined: catalogued or published ratings for manufactured items obtained from tests carried out by manufacturer or those ordered by manufacturer from an independent testing agency signifying adherence to codes and standard and standardized testing of performance criteria.
- .2 Electrical equipment will bear a CSA label or have an ESA certification.
- .3 Air moving equipment will bear an AMCA label.
- .4 Where applicable equipment will bear a ULC or UL label.
- .5 All fans prior to shipment will be completely assembled and test run as a unit at operating speed or maximum RPM allowed for the particular construction type. Each wheel will be statically and dynamically balanced. Fans balance readings maintained and a written copy will be available upon request.

## 1.6 COMMISSIONING

- .1 The manufacturer and/or their factory representative will participate in the commissioning process. The manufacturer will inspect the final installation and verify that the product has been installed as per the manufacturer's instructions. The manufacturer will report compliance or discrepancies directly to the Consultant.

## **PART 2 - PRODUCTS**

### 2.1 FAN COIL UNITS

- .1 Cabinet: steel, internally insulated with 1" thick 1.5 lb. /ft<sup>3</sup> dual density fiberglass, baked enamel coat finish, in-ceiling mounted, inlet/outlet as indicated on drawings and access panel for ease of maintenance.
- .2 Return Plenum: Complete with filter frame and filter, fabricated of 18 gauge galvanized steel, insulated with 1/2" matt-faced fiberglass insulation
  - .1 Insulation conforms to:
    - .1 ASTM C1071 (including C665).
    - .2 UL 181 for erosion.
    - .3 25/50 rating for flame spread/smoke developed per ASTM E-84, UL 723 and NFPA 90A.
- .3 Cooling Coil: performance as indicated, seamless copper tubes with intruded tube holes, copper sweat connection, and vent and drain connections. Stainless steel drain pan positively sloped and insulated. Coils to be leak tested and furnish AHRI labels and certifications.
- .4 Heating Coil (if specified on drawings): performance as indicated, seamless copper tubes with intruded tube holes, copper sweat connection, and vent and drain connections. Coils to be leak tested and furnish AHRI labels and certifications.
- .5 Fans: DWDI forward curved, statically and dynamically balanced, removable for maintenance, ECM blower motor.
- .6 Controls:
  - .1 Unit shall be supplied with a DDC interface board.
  - .2 DDC Interface board shall have three 24-volt relays with line-voltage contactors to operate the fan motor speeds.
  - .3 DDC interface board shall have terminal connections for interfacing to:
    - .1 Wall-Mounted Thermostat.
    - .2 Low-voltage, on-off valve actuators.
    - .3 A return air sensor.
    - .4 A pipe temperature sensor for changeover from heating to cooling on two-pipe systems.
    - .5 Condensate overflow switch.
    - .6 Room occupancy sensor.
- .7 Capacity: as indicated on drawings.

## **2.2 JLR AND OWNER SPECIFIED PRODUCTS**

- .1 Refer to Division 00 and 01 for requirements for alternate manufacturer's to those listed below:
- .2 The following are Owner acceptable manufacturers, all others will be rejected unless pre-approved during tender:
  - .1 Fan Coil Units Daiken, IEC, Nailor, EH Price
  - .2 JLR Specified Products and bases of design: Nil

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- .1 Install in accordance with manufacturers recommendations.
- .2 Support independently of ductwork.
- .3 Locate controls, dampers and access panels for easy access.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 SUMMARY**

- .1 This section describes the minimum performance and build quality of cabinet convector heaters.

### **1.2 REFERENCES**

- .1 Canadian Standards Association (CSA International):
  - .1 CSA C22.2 No.46-M1988 (R2001), Electric Air-Heaters.
- .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS):
  - .1 Material Safety Data Sheets (MSDS).

### **1.3 INFORMATIONAL SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 01 – Submittals.
- .2 Product Data:
  - .1 Product data shall be submitted for all PART 2 – PRODUCTS specified herein.
  - .2 Provide manufacturer's printed product literature and datasheets for material specified, and include product characteristics, performance criteria, physical size, finish and limitations.
  - .3 Product data shall include all maintenance access points and dimensional clearances, such that the contractor can properly layout the equipment to ensure proper access.
  - .4 Product data shall include all relevant information to confirm the specifications have been met.
  - .5 Product data shall provide all relevant data and operational points that verify the engineered criteria have been met and that field operational tolerances can be accommodated, i.e., equipment are not supplied, which are operating at their upper and lower limits for their design duty performance.
  - .6 Product data shall identify all ancillary field installed devices and provide all information required for the coordination of the installation with other trades.
  - .7 Product data shall include any relevant information that Division 25 requires for a properly functioning building automation system.
  - .8 Product data shall include information as specified in 20 01 01 Common Work Results – Mechanical unless modified with additional information required below.
  - .9 Additional information required.
- .3 Provide shop drawings in accordance with Section 01 33 01 – Submittals. Indicate:
  - .1 Product characteristics.
  - .2 Performance criteria.
  - .3 Mounting methods.
  - .4 Physical size.
  - .5 kW rating, voltage, phase.
  - .6 Cabinet material thicknesses.
  - .7 Limitations.
  - .8 Colour and finish.

- .4 Maintenance Data:
  - .1 Provide maintenance data including certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties, for incorporation into manuals specified in Section 01 77 00 – Closeout Procedures.
  - .2 Maintenance data shall include but not be limited to:
    - .1 Certificates, signed by the manufacturer or their representative, certifying that the materials have been installed as per their installation instructions.
    - .2 The approved shop drawings with performance criteria, edited with field observations and commissioned operational set points and adjustments.
    - .3 The manufacturer's maintenance and installation data.
    - .4 Safety informational data for maintenance staff prior to performing maintenance requirements.
    - .5 List of all routine maintenance requirements as well as monthly, annual or other periodical maintenance recommendations from the manufacturer.
    - .6 Any maintenance requirements that may affect the warranty periods of the associated equipment.
- .5 Provide copies WHMIS MSDS - Material Safety Data Sheets in accordance with Division 1 where material specified has MSDS Sheets.

#### **1.4 QUALITY ASSURANCE**

- .1 Performance Requirements Defined: catalogued or published ratings for manufactured items obtained from tests carried out by manufacturer or those ordered by manufacturer from an independent testing agency signifying adherence to codes and standard and standardized testing of performance criteria.
- .2 Perform a review of existing conditions to ensure cabinet unit heater will fit into existing void. Contractor is responsible for any revisions to the existing conditions to install cabinet unit heater.

### **PART 2 - PRODUCTS**

#### **2.1 FORCE FLOW UNITS**

- .1 Provide recessed mounted force flow unit of rating and capacity as indicated on drawings.
- .2 Cabinet: heavy duty corrosion resistant steel with removable front panel to provide inhibited access to internal structure for servicing the motor, fans, controls and coils. Glass fiber insulation, collars for recessed installation and integral air outlet and inlet grille. Maximum depth 242 mm, adjustable bezel full perimeter allowing recess from 25 mm to 230 mm.
- .3 All components including enclosures, covers, grilles, hangers, brackets, access doors, end caps, corners, trim strips, and pilaster covers to be cleaned, phosphatized and finished with a baked grey enamel primer. Perform touch-up of prime finish on site. Spot weld prior to painting.
- .4 Coils: evenly spaced aluminum fins mechanically bonded to copper tubes. Water coils suitable for 1035 kPa rated at 18°C standard entering air, 49°C maximum leaving air temperature, 93°C entering water temperature, 11°C temperature drop.
- .5 Fans: centrifugal double width wheels, statically and dynamically balanced, direct driven on sleeve bearings, resilient mounted, corrosion resistant.

- .6 Motor: multi-speed, tapped wound permanent split capacitor type with sleeve bearings, built-in thermal overload protection and resilient rubber isolation mounting.
- .7 Provide integral control system incorporating heavy duty switch with integral thermal overload: electric thermostat with speed control, all rated at 120/1/60 and as indicated on drawings and schedule.

## **2.2 JLR AND OWNER SPECIFIED PRODUCTS**

- .1 Refer to Division 00 and 01 for requirements for alternate manufacturer's to those listed below:
- .2 The following are Owner acceptable manufacturers, all others will be rejected unless pre-approved during tender:
  - .1 Cabinet Convector Units: Sigma, Rittling
  - .2 JLR Specified Products and bases of design: Nil

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- .1 Comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.
- .2 Install wall mounted thermostats in locations indicated.
- .3 Make power and control connections.

### **3.2 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by cabinet convector heater installation.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 SUMMARY**

- .1 This section describes the minimum performance and build quality of finned tube radiation heaters.

### **1.2 REFERENCES**

- .1 Health Canada/Workplace Hazardous Materials Information System (WHMIS):
  - .1 Material Safety Data Sheets (MSDS).
- .2 Hydronic Institute of Boiler and Radiator Manufacturers (IBR).

### **1.3 INFORMATIONAL SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 01 – Submittals.
- .2 Product Data:
  - .1 Product data will be submitted for all PART 2 – PRODUCTS specified herein.
  - .2 Provide manufacturer's printed product literature and datasheets for material specified, and include product characteristics, performance criteria, physical size, finish and limitations.
  - .3 Product data will include all maintenance access points and dimensional clearances, such that the contractor can properly layout the equipment to ensure proper access.
  - .4 Product data will include all relevant information to confirm the specifications have been met.
  - .5 Product data will provide all relevant data and operational points that verify the engineered criteria have been met and that field operational tolerances can be accommodated, i.e., equipment not supplied, which are operating at their upper and lower limits for their design duty performance.
  - .6 Product data will identify all ancillary field installed devices and provide all information required for the coordination of the installation with other trades.
  - .7 Product data will include any relevant information that Division 25 requires for a properly functioning building automation system.
  - .8 Product data will include information as specified in 20 01 01 – Common Work Results – Mechanical unless modified with additional information required below.
  - .9 Additional information required.
- .3 Provide shop drawings in accordance with Section 01 33 01 – Submittals. Indicate:
  - .1 Equipment, capacity, piping, and connections.
  - .2 Dimensions, internal and external construction details, recommended method of installation with proposed structural steel support, sizes and location of mounting bolt holes.
  - .3 Special enclosures.
- .4 Maintenance Data:
  - .1 Provide maintenance data including certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties, for incorporation into manuals specified in Section 01 77 01 – Closeout Procedures.

- .2 Maintenance data will include but not be limited to:
  - .1 Certificates, signed by the manufacturer or their representative, certifying that the materials have been installed as per their installation instructions.
  - .2 The approved shop drawings with performance criteria, edited with field observations and commissioned operational set points and adjustments.
  - .3 The manufacturer's maintenance and installation data.
  - .4 Safety informational data for maintenance staff prior to performing maintenance requirements.
  - .5 List of all routine maintenance requirements as well as monthly, annual or other periodical maintenance recommendations from the manufacturer.
  - .6 Any maintenance requirements that may affect the warranty periods of the associated equipment.
- .5 Provide copies WHMIS MSDS - Material Safety Data Sheets in accordance with Division 1 where material specified has MSDS Sheets.

#### **1.4 QUALITY ASSURANCE**

- .1 Performance Requirements Defined: catalogued or published ratings for manufactured items obtained from tests carried out by manufacturer or those ordered by manufacturer from an independent testing agency signifying adherence to codes and standard and standardized testing of performance criteria.

### **PART 2 - PRODUCTS**

#### **2.1 FINNED TUBE CONVECTOR UNITS**

- .1 Enclosures: steel, factory baked prime coated, complete with jointed components for wall-to-wall installation. Support rigidly top and bottom, on wall-mounted brackets. Backplate: galvanized, full length.
- .2 Spot weld prior to painting. Clean, phosphatize and finish with a baked grey enamel primer: all components including enclosures, covers, grilles, hangers, brackets, access doors, end caps, corners, trim strips and pilaster covers.
- .3 Provide cabinets that do not run wall-to-wall with end caps. End caps that are exposed to view not to have knockouts or cutouts.
- .4 Heating element: seamless copper tubing, mechanically expanded into flanged collars of evenly spaced aluminum fins 100 mm x 100 mm nominal, 162 fins per metre, suitable for solder fittings.
- .5 Element hangers: quiet operating, plastic-lined cradle type, unrestricted longitudinal movement on enclosure brackets, on 1 m cc maximum.

#### **2.2 PERFORMANCE**

- .1 Sizes, capacities and arrangements indicated on drawings.

## **2.3 JLR AND OWNER SPECIFIED PRODUCTS**

- .1 Refer to Division 00 and 01 for requirements for alternate manufacturer's to those listed below:
- .2 The following are Owner acceptable manufacturers, all others will be rejected unless pre-approved during tender:
  - .1 Finned Tube Convector Units: Sigma, Rittling
  - .2 JLR Specified Products and bases of design: Nil

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- .1 Comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.
- .2 Install in accordance with piping layout and reviewed shop drawings.
- .3 Provide for pipe movement during normal operation.
- .4 Maintain sufficient clearance to permit service maintenance.
- .5 Valves:
  - .1 Install valves with stems upright or horizontal unless approved otherwise.
  - .2 Install isolating gate valves on inlet and lockshield globe balancing valves on outlet of each unit.
- .6 Venting:
  - .1 Install screwdriver vent on cabinet convector, terminating flush with surface of cabinet.
  - .2 Install standard air vent with cock on continuous finned tube radiation.
- .7 Clean finned tubes and comb straight.
- .8 Install flexible expansion compensators as indicated.

### **3.2 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by radiation heater installation.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 SUMMARY**

- .1 This section describes the minimum performance and build quality of unit heaters.

### **1.2 REFERENCES**

- .1 Canadian Standards Association (CSA International):
  - .1 CSA C22.2 No.46-M1988 (R2001), Electric Air-Heaters.
- .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS):
  - .1 Material Safety Data Sheets (MSDS).
- .3 ASTM International
  - .1 ASTM E 84-11a, Standard Test Method for Surface Burning Characteristics of Building Materials.
  - .2 ASTM C916-1985(R2007), Standard Specification for Adhesives for Duct Thermal Insulation.
  - .3 ASTM C 1071-05e1, Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material).
- .4 National Fire Protection Association (NFPA)
  - .1 NFPA 90A-2012, Standard for the Installation of Air Conditioning and Ventilating Systems.
  - .2 NFPA 90B-2012, Standard for the Installation of Warm Air Heating and Air Conditioning Systems (ANSI).
- .5 Underwriters' Laboratories (UL) Inc.
  - .1 UL 2021-1997, Fixed and Location-Dedicated Electric Room Heaters.

### **1.3 INFORMATIONAL SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 01 – Submittals.
- .2 Product Data:
  - .1 Product data shall be submitted for all PART 2 – PRODUCTS specified herein.
  - .2 Provide manufacturer's printed product literature and datasheets for material specified, and include product characteristics, performance criteria, physical size, finish and limitations.
  - .3 Product data shall include all maintenance access points and dimensional clearances, such that the contractor can properly layout the equipment to ensure proper access.
  - .4 Product data shall include all relevant information to confirm the specifications have been met.
  - .5 Product data shall provide all relevant data and operational points that verify the engineered criteria have been met and that field operational tolerances can be accommodated, i.e., equipment are not supplied, which are operating at their upper and lower limits for their design duty performance.
  - .6 Product data shall identify all ancillary field installed devices and provide all information required for the coordination of the installation with other trades.
  - .7 Product data shall include any relevant information which Division 25 requires for a properly functioning building automation system.
  - .8 Product data shall include information as specified in 20 01 01 – Common Work Results – Mechanical unless modified with additional information required below.
  - .9 Additional information required.

- .3 Provide shop drawings in accordance with Section 01 33 01 – Submittals. Indicate:
  - .1 Product characteristics.
  - .2 Performance criteria.
  - .3 Mounting methods.
  - .4 Physical size.
  - .5 kW rating, voltage, phase.
  - .6 Cabinet material thicknesses.
  - .7 Limitations.
  - .8 Colour and finish.
- .4 Maintenance Data:
  - .1 Provide maintenance data including certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties, for incorporation into manuals specified in Section 01 77 01 – Closeout Procedures.
  - .2 Maintenance data shall include but not be limited to:
    - .1 Certificates, signed by the manufacturer or their representative, certifying that the materials have been installed as per their installation instructions.
    - .2 The approved shop drawings with performance criteria, edited with field observations and commissioned operational set points and adjustments.
    - .3 The manufacturer's maintenance and installation data.
    - .4 Safety informational data for maintenance staff prior to performing maintenance requirements.
    - .5 List of all routine maintenance requirements as well as monthly, annual or other periodical maintenance recommendations from the manufacturer.
    - .6 Any maintenance requirements that may affect the warranty periods of the associated equipment.
- .5 Provide copies WHMIS MSDS - Material Safety Data Sheets in accordance with Division 1 where material specified has MSDS Sheets.

#### 1.4 QUALITY ASSURANCE

- .1 Performance Requirements Defined: catalogued or published ratings for manufactured items obtained from tests carried out by manufacturer or those ordered by manufacturer from an independent testing agency signifying adherence to codes and standard and standardized testing of performance criteria.
- .2 Electrical equipment shall bear a CSA label or have an ESA certification.
- .3 Air moving equipment shall bear an AMCA label.
- .4 Where applicable equipment shall bear a ULC or UL label.
- .5 All fans prior to shipment shall be completely assembled and test run as a unit at operating speed or maximum RPM allowed for the particular construction type. Each wheel shall be statically and dynamically balanced. Fans Balance readings maintained and a written copy shall be available upon request.

## **PART 2 - PRODUCTS**

### **2.1 UNIT HEATER - HYDRONIC**

- .1 Provide unit heaters of rating and capacity as indicated on drawings. Outlet to have integral double folded discharge frame. Inlets to have integral inlet collars for superior rigidity.
- .2 Cabinet: heavy duty cold rolled and corrosion resistant steel with rounded exposed corners and edges. Suspension tappings securely fastened to top panel.
- .3 All components including enclosures, covers, grilles, hangers, brackets, access doors, end caps, corners, trim strips, and pilaster covers to be cleaned, phosphatized and finished with a baked grey enamel primer. Perform touch-up of prime finish on site. Spot weld prior to painting.
- .4 Coils: evenly spaced aluminum fins mechanically bonded to copper tubes. Copper tubes to be heavy wall 5/8" outside diameter copper tube. Water coils pressure tested to 350 PSIG suitable for 1035 kPa rated at 18°C standard entering air, 49°C maximum leaving air temperature, 93°C entering water temperature, 11°C temperature drop. Coils suitable to steam applications up to 100 PSIG
- .5 Fans: propeller fan, statically and dynamically balanced, direct driven on sleeve bearings, resilient mounted, complete with fan guard.
- .6 Motor: multi-speed, tapped wound permanent split capacitor type with sleeve bearings, built-in thermal overload protection and resilient rubber isolation mounting.
- .7 Diffuser: Horizontal louvres with individually adjustable blades for maximum air distribution adaptability.
- .8 Provide integral control system incorporating heavy duty switch with integral thermal overload: electric thermostat with speed control, all rated at 120/1/60.

### **2.2 JLR AND OWNER SPECIFIED PRODUCTS**

- .1 Refer to Division 00 and 01 for requirements for alternate manufacturer's to those listed below:
- .2 The following are Owner acceptable manufacturers, all others will be rejected unless pre-approved during tender:
  - .1 Unit Heaters: Sigma, Rittling
- .3 JLR Specified Products and bases of design:
  - .1 Nil

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- .1 Comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.
- .2 Installation type, height and clearances shall be as per manufacture's installation instructions and recommendations.
- .3 Install wall mounted thermostats in locations indicated.
- .4 Include double swing pipe joints as indicated.
- .5 Check final location with Consultant if different from that indicated prior to installation.
  - .1 Should deviations beyond allowable clearances arise, request and Consultant's directive.
- .6 Hot water units: for each unit, install ball valve on inlet and balancing valve on outlet of each unit. Install drain valve at low point.
  - .1 Install manual air vent at high point.
- .7 Clean finned tubes and comb straight.
- .8 Provide supplementary suspension steel as required.
- .9 Before acceptance, set discharge patterns and fan speeds to suit requirements.

#### **3.2 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by unit heaters installation.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 DIVISION 25 BASE BID CONTRACTOR**

- .1 The Owner, University of Guelph, maintains numerous buildings, which are controlled by a common Energy Management and Control System.
- .2 The Division 25 contractor shall be: **Siemens Canada Limited**
- .3 The base bid contractor shall insure that the system install meets or exceeds the requirements of the owners design standard, Design Standards DSM-03, Building Automation Systems.
- .4 The base bid contractor shall provide a system, which provides connectivity with the campus wide EMCS system. The installed system shall utilize the latest current technology and software that provides that connectivity.

### **1.2 WARRANTY AND MAINTENANCE**

- .1 Provide services, materials, and equipment to maintain EMCS for specified warranty period. Provide detailed preventative maintenance schedule for system components described in Submittal article.
- .2 Emergency Service Calls: Initiate service calls when EMCS is not functioning correctly. Qualified control personnel to be available during warranty period to provide service to "CRITICAL" components whenever required at no extra cost. Furnish Owner with telephone number where service personnel may be reached at any time. Service personnel to be on site ready to service EMCS within 2 hours after receiving request for service.
- .3 Perform Work continuously until EMCS restored to reliable operating condition.
- .4 Operation: foregoing and other servicing to provide proper sequencing of equipment and satisfactory operation of EMCS based on original design conditions and as recommended by manufacturer.
- .5 No system modification, including operating parameters and control settings, to be made without prior written approval of Owners technical representative.

### **1.3 DOCUMENTS**

- .1 The contact documents are complementary, what is required by any one shall be as binding as if required by all. Specification sections and drawings cannot be read in isolation and it shall be the responsibility of the contractor and suppliers to ensure they have sufficient information to provide specified material and services as required by the complete contract documents
- .2 These specifications are an integral part of the Contract Documents. Refer to other Sections to ensure a completed operational product and fully coordinated standard of work.
- .3 Definitions:
  - .1 "Provide" means to "supply and install".
  - .2 "Concealed" means within chase, furred space, shaft, or hung ceiling.
  - .3 "Exposed" means "not concealed" as defined herein.
  - .4 "Demolish" means to "remove from site and depose of in an appropriate manner".
- .4 Conform to Canadian Metric Practice Guide CSA CAN3- 234.1.

- .5 Provide all required adapters between "metric" and "Imperial" installations.
- .6 Metric descriptions in this Division are nominal equivalents of Imperial values.
- .7 "NPS" refers to Nominal Pipe Size and is the ASME B36 designation for various standard pipe sizes.
- .8 Drawings do not indicate exact architectural, structural or electrical features. Examine drawings prior to fabricating and installing work to ensure no interference exists. Report conflict with work to Consultant before proceeding.
- .9 Drawings show general design and arrangement of mechanical system installation, and are diagrammatic in some details. Coordinate all drawings and with all trades for complete operational system.
- .10 Do not scale drawings to order material. Take field measurements before ordering materials and make material conform to site conditions.

#### **1.4 OWNERS DESIGN STANDARD DSM-03**

- .1 The Owner, University of Guelph, maintains a design standard identified as:  
University of Guelph  
Physical Resources, Design engineering and Construction  
Design Standards DSM-03  
Building Automation Systems
- .2 This standard is appended to this specification and takes precedence over all documentation presented on the drawings or specifications.
- .3 The Division 25 contractor shall make themselves aware of the conditions and requirements of this standard and install a system that meets this standard.

#### **1.5 COOPERATION WITH OTHER TRADES**

- .1 Review all contract documents, including those of the other trades, and coordinate with work of other Divisions and trades.
- .2 Cooperate fully with Divisions 21, 22, 23, 25 and Division's 26 and 27 prior to installation to lay out location of ducts, diffusers, piping, lighting fixtures and other mechanical and electrical components in all areas.
- .3 Report areas of conflict immediately to Consultant for comment. Do not continue work until corrective measures are prescribed.
- .4 Locate distribution systems, access doors, equipment and materials for maximum useable space to satisfaction of Consultant.

#### **1.6 CONTRACTOR COORDINATION SUBMITTALS**

- .1 This Contractor shall assist and review the Interference and Coordination drawings for spaces identified in 20 01 01 - Common Work Results For Mechanical.

## **1.7 CONTRACTOR REQUESTS FOR INFORMATION**

- .1 The Contractor may, after exercising due diligence to locate required information, request from the Consultant clarification or interpretation of the requirements of the Contract Documents. The Consultant shall, with reasonable promptness, respond to the Contractor's requests for clarification or interpretation.

However, if the information requested by the Contractor is apparent from field observations, is contained in the Contract Documents or is reasonably inferable from them, the Contractor shall be responsible to the Client for all reasonable costs charged by the Consultant to the Client for the additional services required to provide such information.

## **1.8 FIRE STOPPING**

- .1 Reference Section 07 84 00 – Fire stopping.
- .2 All fire stopping to be performed by a single certified contractor.
- .3 This contractor will coordinate the construction of all openings through fire rated assemblies with the fire stopping contractor.

## **1.9 COMMISSIONING**

- .1 Reference Section 01 91 00.02 – General Commissioning (CX) Requirements.
- .2 The Contractor to make themselves, their subcontractors and their suppliers aware of the commissioning requirements for this project.
- .3 The Contractor shall work with the designated commissioning agent to achieve a completely commissioned system. The contractor shall provide all material and labour to achieve the project commissioning objectives as specified.
- .4 Plan, organize and implement the commissioning process for the control systems and equipment.
- .5 Assist in preparation of the Commissioning Plan and schedule, identifying responsibility for activities and documentation to be provided.
- .6 Deliver a system that performs in accordance with the contract documents and equipment manufacturer's requirements.

## **1.10 INSTRUCTION OF OPERATING STAFF**

- .1 Provide trained personnel to instruct operating staff in maintenance, adjustment and operation of mechanical equipment.
- .2 Provide instruction during regular work hours for a minimum 2 full days prior to acceptance and turnover to operating staff.
- .3 Utilize the Controls Shop Drawings and Sequence of Operation and updated record drawings for instruction purposes.
- .4 Instruct staff on changes made under terms of warranty or of modifications to equipment.

### **1.11 IDENTIFICATION**

- .1 All controls components will be distinctly identified, controls wiring shall be colour coded to match U of G standards, controls cabinets shall be labeled with lamacoid labels, identifying purpose and referenced back to system architecture.

## **PART 2 - PRODUCTS**

### **2.1 ARCHITECTURAL SERVICE ACCESS DOORS**

- .1 Coordinate with architectural drawings for locations and wall and ceiling finishes.
- .2 Size: 300 mm x 300 mm or larger, as required to properly service concealed equipment and devices.
- .3 Material: 2.5 mm thick, flush type steel door, frame and anchor straps, with concealed hinge.
- .4 Fire rated where penetrating fire rated assemblies.
- .5 Finish: to suit painted gypsum, plaster or suspended tile ceiling.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- .1 Location of access doors to be located by responsible division. Access doors to be installed by drywall or block installer.
- .2 Locate access doors to serve concealed controls equipment.
- .3 Be prepared to demonstrate accessibility of devices through access doors. Relocate or enlarge access doors to suit conditions.

### **3.2 DEMONSTRATION**

- .1 Consultant and Owner's Representative will use equipment and systems for test purposes prior to acceptance. Supply labour, material, and instruments required for testing.
- .2 Supply tools, equipment and personnel to demonstrate and instruct operating and maintenance personnel in operating, controlling, adjusting, trouble-shooting and servicing of all systems and equipment during regular work hours, prior to acceptance.

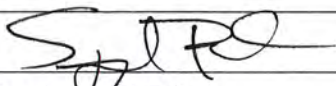
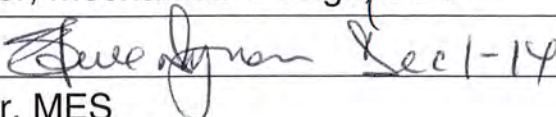
END OF SECTION

# **University of Guelph Design Standards DSM-03 Building Automation Systems**



**PHYSICAL RESOURCES  
DESIGN, ENGINEERING, AND CONSTRUCTION**

**DESIGN STANDARD DSM-03  
BUILDING AUTOMATION SYSTEMS**

Version	Revision 0
Effective Date	15-September-2014
Approved By	 Manager, Mechanical Design, DEC
Reviewed By	 Director, MES

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## 1 INTRODUCTION

### 1.1 General

- .1 This Building Automation Systems (BAS) Design Standard has been developed to establish the University's minimum expectations and requirements for new BAS installations on campus.
- .2 This Standard is based on current Codes and Standards, Industry Best Practices and the University's preferred approach to standardizing design from the perspective of system configuration and performance, operating flexibility and efficiency, maintenance practices and protocols and inventory management.

### 1.2 Compliance Criteria

- .1 Full compliance is mandatory on projects involving new construction.
- .2 Full compliance is mandatory for new BAS installation within projects involving significant renovations.
- .3 Compliance is recommended to the extent practical and feasible for all projects involving minor renovations and rework of existing BAS infrastructure.
- .4 Any deviations from the minimum requirements outlined in this Standard must be approved by the Manager, Mechanical Design, DEC before the completion of Schematic Design.

### 1.3 Responsibility of the Designer

- .1 The System Designer remains responsible for ensuring any proposed design solution is in full compliance with applicable Codes & Standards in force at the time of the design.
- .2 Any conflict between applicable Codes & Standards and this Standard shall be identified and presented to the Manager, Mechanical Design, DEC, together with proposed measures for addressing the conflict.

### 1.4 Design Innovation

- .1 This Standard is not intended to preclude or constrain an Innovative Approach to Design. It however remains the responsibility of the Designer to demonstrate that any proposed design innovations are in general compliance with the design intent outlined in this Standard.
- .2 All proposed Design Innovation shall be tabled for consideration by the Manager, Mechanical Design, DEC, before the completion of Schematic Design.

### 1.5 Reference Documents

- .1 Ontario Building Code
- .2 Canadian Electrical Code
- .3 ASHRAE Standard ANSI/ASHRAE 135 - BACnet
- .4 ASHRAE Guideline 13, Specifying Direct Digital Control Systems.
- .5 ANSI/TIA/EIA862 Building Automation Systems Cabling Standard for Commercial Buildings.
- .6 Federal Communication Commission (FCC) Rules and Regulations, Part 15, Subpart J for computing devices
- .7 Public Health Agency of Canada - Laboratory Biosafety Guidelines
- .8 Canadian Council for Animal Care Guidelines
- .9 LEED Guidelines
- .10 Mechanical Plumbing Systems Standard DSM-02\*
- .11 Mechanical HVAC Systems Standard DSM-01\*
- .12 Electrical Power Systems Standard DSE-01\*
- .13 Architectural Space Planning & Finishes Standard DSA-01\*

\* A copy of these standards is available on University of Guelph Physical Resources web page

## **2 DESIGN STANDARDS**

### **2.1 General**

- .1 The requirements outlined in the following clauses are applicable to all Building Automation System (BAS) installations. Application Specific requirements are outlined under clauses 2.2 – 2.17
- .2 This document is not intended to describe the controls or sensors required for correct operation of the building systems or equipment. The Designer remains responsible for ensuring equipment and systems can be appropriately operated and maintained.
- .3 Overarching Design Principles
  - .1 All new BAS installations shall be designed as an integrated, open protocol, BACnet compliant system to ANSI/ASHRAE Standard 135.
  - .2 All BAS installations in projects involving significant renovations shall be designed as an integrated, open protocol, BACnet compliant system to ANSI/ASHRAE Standard 135; any proposed deviations shall be presented to the Manager, Mechanical Design, DEC, for approval during the Schematic Design Phase.
  - .3 All BAS installations in projects involving minor renovations to areas currently served by Legacy (KMD) systems shall comply with 2.1.2.2 above; any proposed deviations, including modifying existing Legacy (KMD) system, shall be presented to the Manager, Mechanical Design, DEC, for approval during the Schematic Design Phase.
  - .4 Buildings shall not have multiple BAS systems.
- .4 Interfacing Standards:
  - .1 Input/output devices to use ASCII (American Standard for Communication and Information Interchange) code and standard EIA (Electronic Industry Association) interfaces.
  - .2 CSA T530: Building Facilities, Design Guidelines for Telecommunications (same as EIA/TIA 569).
  - .3 IEEE 802.3 Ethernet 10Base-T LAN
- .5 All Components and Equipment shall be designed and selected to provide the requisite level of function and performance when operating in following minimum ambient condition ranges:
  - .1 Temperature: 0° to 40°C (32° to 104°F) for Indoor Installation / -30° to 40°C (-22° to 104°F) for Outdoor Installation
  - .2 Relative Humidity: 10% to 90% non-condensing
  - .3 Withstand VHF, UHF, FM, AM or background RFI as generated by commercial or private, portable or fixed transmitters that meet regulatory codes
- .6 All equipment, components & devices shall be designed to operate on an electrical power service rated at 120 VAC +/- 10%, 60 Hz nominal.
  - .1 Components installed within Motor Control Devices to be designed to operate with transient electrical fields occurring within these devices
- .7 Licences and Ownership
  - .1 Ownership of, and licences for, all hardware and software originally installed or required for ongoing system operation, maintenance and modification to be registered, without restrictions, in Owner's name.
  - .2 Licensing to permit an unlimited number of users to access system without additional fees.
  - .3 As of last month of the warranty period, software is to be upgraded to current version or release at no cost to the Owner.

## **2.2 BAS Architecture – Individual Buildings**

- .1 BAS Network Architecture
  - .1 Dedicated LAN for BAS:
  - .2 BAS communication architecture to consist of at least two tiers with each tier using local area networks.
    - .1 Tier 1: Building Controller network;
      - High level network providing communication between Building Control Unit's (BCU's) and workstations
      - Ethernet communications (ISO 8802-3/IEEE 802-3), using high speed local area network communications. TCP/IP to be used as communication protocol on first tier network.
      - Shall be designed with an expansion capacity of at least 10 additional BCU/Routers over and above those required to complete the original installation.
    - .2 Tier 2: Equipment Controller network;
      - Lower level network providing communications between Equipment Control Units (ECU's) and BCU's.
      - Open, peer-to-peer control networks to interconnect BAS controllers (Building Control Units, BCU's, and/or Equipment Control Units, ECU's) on ring or star topology bus.
      - Peer-to-peer configuration means units exist and speak equally on same bus.
      - Controllers in peer-to-peer configuration can share data without assistance from Operator Interface.
  - .3 System architecture to be modular, permitting stepped expansion of application software, system peripherals, and field hardware
  - .4 Use of non-networked stand-alone control devices is not permitted.
- .2 Control System:
  - .1 High-speed, peer-to-peer network comprising microprocessor based Direct Digital Control (DDC) controllers with a web-based operator interface,
  - .2 Each system controlled or monitored through the BAS, building floor plan, and control device to be displayed through point-and-click graphics,
  - .3 Web server with network interface card to gather data from this system and generate web pages that can be accessed through conventional web browser on any PC connected to network,
  - .4 Operators to access this system through web browser, and browser interface to perform normal operator functions.
  - .5 OEM Controller integration
    - .1 BAS to incorporate hardware and software to allow bi-directional data communications between BAS and 3rd party manufacturers' control panels.

## **2.3 BAS Functional Requirements**

- .1 Functional requirements shall be defined through the use of Control Sequences & Schematics and Points List used in combination.
  - .1 Control sequences shall be developed based on overarching criteria defined under Clause 2.10.
- .2 Controllers
  - .1 Designed to operate with local closed loop programming, independent from server, if peer-to-peer communication is interrupted.
- .3 Central BAS Web Server

- .1 Designed to perform global application programs and data consolidation including:
  - .1 communications with controllers,
  - .2 host software routines for:
    - BAS Server operation,
    - Database creation and data storage,
    - Web based Graphical User Interface (GUI) with graphics generation and display,
    - Reporting

## **2.4 BAS Server – Individual Buildings**

- .1 A dedicated BAS Server is not required; rather the BAS software shall be installed on a designated Campus Server residing on a Tier I network.
  - .1 Minimum performance levels for the server shall be estimated before completion of the Design Development Phase and submitted to the Manager, Mechanical Design, DEC.
  - .2 Performance levels for the server shall be validated by the chosen BAS vendor and finalized within 60 days of commencement of the Construction Phase

## **2.5 Main Operator Workstation – Individual Buildings**

- .1 A dedicated Main Operator Workstation (OWS) is not required.
- .2 However, each Mechanical Room / Equipment Room shall have at least one (1) designated connection point to allow access to the BAS Graphics using a portable device.

## **2.6 Internet Appliances**

- .1 BAS architecture and software to incorporate thin client design software to allow use of web appliances such as Tablets and web-enabled cellular telephones

## **2.7 Fibre Optic Cable**

- .1 Duplex 900 mm tight-buffer construction designed for intra-building environments
- .3 UL listed sheath OFNP meeting requirements of FDDI, ANSI X3T9.5 PMD for 62.5/125mm.
- .4 field terminations made using ST type connectors with ceramic ferrules and metal bayonet latching bodies.

## **2.8 Routers and Bridges**

- .1 Selected as Industry standard hardware
  - .1 Central system to use an Ethernet Local Area Network (LAN) for communication.
  - .2 Communication between central server and controllers to be IP.
  - .3 Router to bridge IP and data link (ARCNET, BACnet, MS/TP, LON) to be used between controllers if required.
  - .4 Router to use FLASH memory and allow firmware updates to be performed from remote work station.

## **2.9 BAS Software**

- .1 System software to support alternate operating systems, such as Red Hat Linux, or Sun Solaris.
- .2 Software to be completely web based without need for interface/translation devices or need to load software individually on each computer.
- .3 System and software to permit remote access, for multiple users, through internet connections.
- .4 Graphic files to be created with use of graphics generation package furnished with system.
- .5 Software to support concurrent operation of multiple standard and non-standard protocols including but not limited to:

- BACnet
- MODBUS
- LONTalk
- OPC
- SNMP
- .6 Operator Interface designed to operate through standard desk top or lap top personal computers without requiring purchase of special software from BAS manufacturer.
  - .1 Interface on these personal computers to be standard Web Browser by Microsoft, Chrome or Firefox.
- .7 System software to support automatic paging

## **2.10 Control Sequences - Overarching Criteria**

- .1 Control sequences shall be developed with consideration to the overarching criteria listed below. Where criteria have not been defined, develop control sequences based on guidelines published in the ASHRAE Handbook and/or following Industry Best Practices.
- .2 Control sequence descriptions, and list of control and alarm points, shall be submitted for review/approval by the Manager, Mechanical Design, DEC and Manager, Maintenance & Energy Services prior to the completion of Design Development.
- .3 Minimum Requirements
  - .1 Occupied/Unoccupied mode schedule for terminal unit set-back controls
  - .2 Occupied/Unoccupied mode schedule and Occupancy sensors to control AHU(s) dedicated to an individual classroom
  - .3 Standalone local washroom exhaust fan interfaced with the light switch and an Off-Timer
  - .4 Control Valve sequences shall incorporate a feedback loop to detect leakage past valve when in "Closed Position"
  - .5 Supply Air Temperature Reset based on Terminal Unit Damper Position (for VAV Systems) and Reheat Valve Position.
  - .6 Mixed Air Temperature as a means of controlling Fresh Air Damper.
- .4 Fan Scheduling
  - .1 Ability to set fan schedules for Summer and Winter Schedules. This schedule will be based on School terms.
  - .2 Override Schedules to turn fans on or off for Holidays and special events.
  - .3 Systems that can be shut down will do so based on the schedule
  - .4 Systems that cannot be shut down will have their SAT setpoint offset based on the schedule.
- .5 Mode Control
  - .1 To prevent the various control components (valves and dampers) from competing with one another, they are operated in sequence (based on heating or cooling demand). This sequence is determined by a "mode"; various modes are described below. In each mode the PHT LL controller will always be active and will keep the heating valve from closing when the PHT is below its low limit setpoint. In each mode the MAT LL controller will be active and will close the dampers (even below the min fresh air setting) when the MAT is below its low limit setpoint.
  - .2 Mode 0: Shutdown
    - Fans will stop
    - Dampers will close
    - Cooling valves will close
    - Humidity valves will close

- If outside air is colder than the MAT LL SP then the heating valve will modulate to control the MAT at the LL setpoint, otherwise the heating valve will close.
- .3 Mode 1: Startup
  - This mode is only necessary when it is cold outside otherwise the system will simply jump out of it and into one of the control modes.
  - On 100%FA units the heating valve will fully open (on cold days) to preheat the coil before the fan starts (this is necessary since the coils may not respond fast enough when a cold PHT is detected and the unit will trip off on freezestat). Once the fan starts the heating valve will ramp down to the control point.
  - On mixed air units the outside dampers will remain closed on cold days (to remove any residual heat that may have accumulated in the duct when it was off). After the morning warm-up the dampers will slowly ramp open to the control point.
  - After the morning warm-up period the system will switch out of startup mode.
- .4 Mode 2: Damper
  - The heating coil will modulate to maintain the PHT LL setpoint.
  - Cooling coil will be closed.
  - Damper will modulate to maintain the SAT SP
- .5 Mode 3: Heating
  - Cooling coil will be closed.
  - Damper will be at minimum.
  - The heating valve will modulate to maintain the SAT at setpoint.
- .6 Mode 4: F/B Damper or Reheat
  - The damper will be at minimum position.
  - The cooling coil will be closed.
  - When this mode is active the heating valve will be open at least 75% and the damper will modulate the air around the coil. If the air is being all directed to the coil then the heating valve will ramp open further.
- .7 Mode 5/6: Heating Stage 1 and Stage 2
  - The damper will be at minimum position.
  - The cooling coil will be closed.
  - This mode is used for on/off heating stages (gas or electric).
- .8 Mode 7: Cooling
  - The damper will be at maximum (economizer/enthalpy control may close this to minimum position).
  - Heating valve will be closed (PHT LL always active).
  - The cooling coil will modulate to maintain the SAT at setpoint.
- .9 Mode 8/9: DX Stage 1 and Stage 2
  - The damper will be at maximum (economizer/enthalpy control may close this to minimum position).
  - Heating valve will be closed (PHT LL always active).
- .10 Mode10: Dehumidification *(\*without dehumidification wheel)*
  - This mode is rarely used (it requires a cooling coil before a reheat coil).
  - If a temperature sensor is installed after the cooling coil then the coil will be modulated to maintain the coil discharge temperature at the dew point. If no temperature sensor is installed after the cooling coil then the coil will be 100% open.
  - The reheat coil will be used to maintain the SAT at its setpoint.

.6 Mixed Air Handling Units

- .1 To prevent a large inrush current draw the fans across the campus are staggered using the following formula:  
$$\text{Delay time(in seconds)} = (\text{Building number}) + 10 * (\text{fan number})$$
- .2 Lag fans (when controlled by the automation system) will start 5 seconds after the lead fan.
- .3 When the unit is off, the dampers will be closed and the heating valve will be used to maintain the MAT at its low limit setpoint (cold side of the coil). If the outside air temperature is below the MAT LL SP then a morning warmup flag will be enabled.
- .4 On system startup, if the morning warmup is enabled then the dampers will remain closed during the warmup period. Once the warmup period is over the dampers will ramp open to their control point.
- .5 The system will operate according to the "Mode Control" as outlined above.
- .7 Fresh Air Handling Units
  - .1 To prevent a large inrush current draw the fans across the campus are staggered using the following formula:  
$$\text{Delay time(in seconds)} = (\text{Building number}) + 10 * (\text{fan number})$$
  - .2 Lag fans (when controlled by the automation system) will start 5 seconds after the lead fan.
  - .3 When the unit is off, the dampers will close automatically and the heating valve will be used to maintain the PHT at its low limit setpoint (cold side of the coil is preferable if a sensor is available). If the outside air temperature is below the MAT LL SP then a morning warmup "Heat Blast" flag will be enabled.
  - .4 The "Heat Blast" will just open the heating coil 100% for 2 minutes before the fan is given a start command. Once the fan is running the heating valve will ramp down to the control point.
  - .5 The system will operate according to the "Mode Control" as outlined above.
- .8 Variable Air Volume Units (VAV's)
  - .1 VAV's will maintain space temperature by adjusting the volume of air into the space while keeping it between an operator adjustable minimum and maximum volume.
  - .2 If a reheat coil is installed then a discharge temperature sensor after the coil must be provided to identify any leaking valve.
  - .3 If the space temperature is below the setpoint then the VAV will switch to reheat mode in which case the volume of air will increase to a heating setpoint (minimum air volume may be too little to allow the warm air from reaching the occupants); this is typically 10% of the span between minimum and maximum and then added to the minimum.
  - .4 A demand limit variable is generated which can be used by the AHU to adjust the duct pressure and supply air temperature (we can't just use the space temperature and setpoint since we won't be able to determine if the VAV had more capacity to satisfy the space temperature). A value of 0% indicates the AHU should increase the supply air temperature while a value of 100% indicates that the temperature should be lowered. The AHU will only use this information if it has feedback from most of the spaces it affects.
- .9 Exhaust Fans
  - .1 Exhaust fans will typically operate based on a predefined Occupancy Schedule.
- .10 Standard Reset Schedules
  - .1 Air handlers will use a standard outdoor air temperature reset schedule unless there is a calculated reset from the space (typically if an AHU only feeds a few areas).

OAT	SP
30	18
20	15

10	18
----	----

- .2 In the winter it may be possible to throttle (close) a heating valve to a point which causes an air handling unit to trip on a freezestat. To minimize this occurrence a minimum position for the heating valve is calculated from the outdoor air temperature.

OAT	SP
5	0
-15	20

- .3 The return air humidity setpoint is also adjusted by an outdoor air temperature reset schedule.

OAT	SP
-25	15
10	40

#### .11 Heat Reclaim

- .1 Plate heat exchanger for air to air systems will use a bypass damper when the exhaust air "ices up" and the pressure increases across the exhaust plates.
- .2 "Run around" glycol loops heat reclaim systems will be disabled in the when the energy required to run the pumps is greater than the heat reclaimed (typically OAT > 10 deg C).

#### .12 Global Commands

- .1 Chilled Water Clamp.
  - ability to clamp all chilled water control valves to a fixed position (excluding critical systems)
  - this will allow the chilled water valves to be limited to a maximum position for extreme hot days as well as any CUP production limitations
- .2 Heating setpoint Offset
  - ability to offset the setpoint for all heating systems (excluding critical systems)
  - this will allow temperature setbacks for Holidays, and will limit steam requirements due to any CUP production limitations
- .3 Maximum Damper Position (all Mixed Air units)
  - ability to adjust maximum damper position
  - this will allow maximum damper position to be limited based on outdoor temperature and humidity
- .4 SAT setpoint Offset
  - ability to put an offset on all fan units.
  - this will allow a temperature offset to be introduced for extreme temperature days to allow for reduction of chilled water use as well as steam use
- .5 Perimeter Heating Disable
  - ability to disable perimeter heating for all buildings.
  - this will allow buildings, on days with cool mornings and warmer days, to not use Perimeter heat in the morning and chilled water later on.
- .6 VFD Maximum Clamp
  - ability to limit the VFD speed for critical global adjustment days (excluding critical areas)

- .7 Global Command Page
  - .1 a Global Command Page shall be created on each BAS system to allow operator to monitor status of global command points and have the ability to set the values and override automatically calculated values.
  - .2 this page will include:
    - Current Schedule running
    - Chilled Water Maximum clamp value
    - Heating setpoint offset value
    - Damper Maximum Position value
    - SAT offset value
    - Perimeter Heating enable status
    - VFD Maximum clamp value
    - Chilled water pressures and temperatures in various locations
  - .3 this page is also to display the status of chilled water cooling systems that have domestic water backup

## **2.11 BAS Graphics**

- .1 At a minimum BAS graphics shall display the following:
  - .1 Facility Site Graphic
  - .2 Individual Graphics for each System
  - .3 Terminal Unit & Equipment Floor Plan
    - Room Number and Area designation for each Terminal Unit & piece of Equipment
  - .4 A Main Page in Tabular Format displaying, as applicable, the following information for each piece of equipment/system
    - Command Status
    - State Status
    - Current Setpoints
    - Current Speed
    - Current Temperatures
    - Alarm Condition, if any, displayed in a different color.
      - Alarms to be assigned a Priority Ranking and include Descriptor identifying relevant equipment and its location. (eg. E1 BLDG 040 P4 Condensate Pump failed to start <Room 008>)
    - Area served by Equipment/System with a link to the individual graphic for the said Equipment/System
- .2 Graphics shall be developed using a standard library of image files and industry standard symbols.

## **2.12 BAS Alarms**

- .1 The BAS system shall be complete with all alarming required for proper operation of the equipment and systems.
- .2 All time delays and alarm thresholds shall be adjustable via the software, not via the BAS graphics.
- .3 Alarms shall include any specific alarms required for specialized applications.
- .4 At a minimum the following alarms are to be provided:
  - .1 Motor not started after commanded on
    - applies to all motors (pumps, fans, etc.)

- .2 Motor not stopped after commanded off
  - applies to all motors (pumps, fans, etc.)
- .3 High-high level for all condensate tanks, sump pits, or any other application where a flood will occur if the high-high level is surpassed
- .4 High CO<sub>2</sub> level (when CO<sub>2</sub> sensor(s) are utilized)
- .5 Differential pressure across filter bank exceeds 250pa
- .6 High supply humidity level in supply air duct
- .7 High duct pressure
- .8 High duct temperature
- .9 Low plenum air temperature after 3 resets of Freezestat
- .10 Temperature difference across all heating or cooling coils greater than 5°C after a 5 minute delay following control valve closing
- .11 Supply air temperatures more than 5°C from setpoint for more than 10 minutes
- .12 Converter temperatures more than 10°C from setpoint for more than 10 minutes

### **2.13 Power Supplies and Line Filtering**

- .1 Power Supplies:
  - .1 where Essential Power is available in a building, all Tier I devices shall be fed off an Essential Power source.
  - .2 power supplies to all BCU's and all ECU's/Control Elements associated with equipment fed off an Essential Power source shall be extended from an Essential Power source, preferably the same Essential Power source feeding the equipment in question.
    - an On-Board UPS Power source with a minimum 12 hour battery life shall be provided withing each BCU & ECU.
  - .3 control transformers shall be UL listed ,
  - .4 line voltage units shall be CSA listed,
  - .5 provided with over-current protection in primary and secondary circuits,
  - .6 sized to limit connected loads to 80% of rated capacity.
  - .7 equipped with
- .2 DC power supplies:
  - .1 output to match equipment current and voltage requirements,
  - .2 units to be full-wave rectifier type with output ripple of 5.0 mV maximum peak-to-peak. Regulation to be 1.0% line and load combined, with 100-microsecond response time for 50% load changes,
  - .3 units shall have built-in over-voltage and over-current protection and to be able to withstand 150% current overload for at least three seconds without trip-out or failure,
  - .4 units shall be capable of operation between 0°C and 50°C (32°F and 120°F). EM/RF to meet FCC Class B and VDE 0871 for Class B and MILSTD 810C for shock and vibration.
- .3 Power Line Filtering:
  - .1 shall be provided to afford internal or external transient voltage and surge suppression for workstations and control modules,
  - .2 surge protection:
    - dielectric strength of 1000 V minimum,
    - response time of 10 nanoseconds or less,
    - transverse mode noise attenuation of 65 dB or greater,
    - common mode noise attenuation of 150 dB or greater at 40-100 Hz.

## **2.14 Automatic Control Valves**

- .1 Performance:
  - .1 General:
    - Straight through water valves shall be single seated type with equal percentage flow characteristics and minimum resolution of 40:1 or greater.
    - designed to close at a differential pressure of 280 kPa (40 psi), with an inlet pressure of 1035 kPa (150 psi).
    - three-way mixing water valves: linear for each port giving constant total flow.
    - modulating steam valves: modified linear flow characteristics.
  - .2 Steam Valves, Pressure Drop,
    - modulating, 100 kPa (15 psig) or less steam supply pressure: maximum 80% of inlet gauge pressure.
    - two position, 100 kPa (15 psig) or less steam supply pressure: maximum 15 kPa (2 psig).
    - modulating, greater than 100 kPa (15 psig) steam supply pressure: 42% of the inlet absolute pressure.
  - .3 Water Valves, Pressure Drop
    - two position: maximum 10% of system pump head.
    - modulating, two-way: maximum of 36 kPa (12 ft) pressure drop.
    - modulating, three-way: maximum of 60 kPa (20 ft) pressure drop.
- .2 Proportional valves - Globe:
  - .1 Body:
    - carbon steel, bolted body.
    - maximum allowable water pressure: 860 kPa (150 psi)
    - maximum working temperature: 216°C (260°F).
  - .2 Trim:
    - stem guided plug,
    - V-port cage, equal percentage,
    - T316 stainless steel
    - threaded seat ring, T316 stainless steel.
    - disc, seals, and other valve components suitable for clean water.
  - .3 ANSI Class IV leakage.
- .3 Actuators:
  - .1 electric or electronic action
  - .2 electronic interface control board, solid state drive, reversible motor, oil immersed gear train
  - .3 spring return mechanism to return valve to "normal" position on power failure (i.e. Normally Open (NO), or Normally Closed (NC)),
  - .4 manual override for valves over NPS 2½.
  - .5 valve positioners:
    - microprocessor based digital valve controllers,
    - HART communications protocol,
    - two independent adjustable travel position switches and wiring to BAS for indication of valve position.
    - to be provided on automatic valves NPS 2½ and larger.
  - .6 general purpose, drip proof NEMA 2 die-cast housing with corrosion resistant steel cover for indoor applications, watertight NEMA 4 enclosure for outdoor use,

## **2.15 Automatic Dampers**

- .1 Multi-leaf Dampers for general service
  - .1 shall be parallel blade type for two-position OPEN/CLOSED service
  - .2 shall be parallel blade or opposed blade type for modulating service
  - .3 Performance:
    - leakage in closed position: maximum 2% of rated air flow at 500Pa (2 in wg) differential across assembly,
    - pressure drop in open position: maximum 50 Pa (0.2 in wg) differential at 5 m/s (1000 fpm).
  - .4 Frame & Blade Construction :
    - insulated or non-insulated depending upon service. Thermal breaks in insulated frame construction.
    - extruded aluminum for general applications; formed stainless steel for corrosive environments.
    - extruded aluminum, thermally broken,
    - seals: extruded vinyl seals, and spring stainless steel side seals,
    - maximum blade width: 125 mm (5 in),
    - maximum blade length: 1200 mm (4 ft).
    - self-lubricated bronze bearings.
    - blade linkage with steel tie rods, brass pivots and steel brackets.
  - .5 Damper Actuator (Operator)
    - Electric or electronic action
    - electronic interface control board, solid state drive, reversible motor, oil immersed gear train
    - spring return mechanism to return valve to “normal” position on power failure (i.e. Normally Open (NO), or Normally Closed (NC)),
    - manual override.
    - Damper positioners: microprocessor based digital damper controllers c/w
    - HART communications protocol two independent adjustable travel limit switches with wiring to BAS for indication of damper position and alarm annunciation in the event position is not positively verified.
    - general purpose, drip proof NEMA 2 die-cast housing with corrosion resistant steel cover for indoor applications, watertight NEMA 4 enclosure for outdoor use,
- .2 Isolation / Control Valves Type for Isolation Service:
  - .1 Single blade type for modulating and two position, OPEN/CLOSED, service..
  - .2 Performance:
    - leakage in closed position: maximum 0.01% of rated air flow at 7 kPa (28 in wg) differential across assembly,
    - linear characteristic with 20:1 turndown,
    - sized using Cv numbers in 65% open position for pressure drop of less than 150 Pa (0.6 in wg) differential at 5 m/s (1000 fpm),
  - .3 Construction:
    - 316L stainless steel construction for Body, Trim, Shaft and all elements exposed to the air stream
    - teflon packing glands
    - seat: elastomer seat compatible with paraformaldehyde and ethylene gas
    - flanged gasketed connections for 7 kPa (28 in wg) service

- .4 Damper Actuator (Operator)
  - Electric or electronic action
  - electronic interface control board, solid state drive, reversible motor, oil immersed gear train
  - spring return mechanism to return valve to “normal” position on power failure (i.e. Normally Open (NO), or Normally Closed (NC)),
  - manual override.
  - Damper positioners: microprocessor based digital damper controllers c/w
  - HART communications protocol two independent adjustable travel limit switches with wiring to BAS for indication of damper position.
  - general purpose, drip proof NEMA 2 die-cast housing with corrosion resistant steel cover for indoor applications, watertight NEMA 4 enclosure for outdoor use,

## **2.16 Cleanroom and Laboratory (incl. Animal Labs) Pressure Monitor**

- .1 Space pressure measurement, referenced to adjacent space, designed, tested, and packaged by a single manufacturer.
  - .1 Standard of Acceptance
    - Tek-Air model Iso-Tek
    - TSI
    - Honeywell
    - Phoenix Controls
  - .2 Monitor unit construction:
    - .1 industrial grade metal case mounted on an electrical junction box,
    - .2 local digital display control unit;
      - Range: -50 to + 50 Pa (-0.19999 to +0.19999 in.wg.)
      - Resolution: 5% of reading,
      - Display updated every second,
      - Spill-proof membrane keypad for programming,
      - Local calibration protected by pass-code.
    - .3 Indicating lights:
      - Low pressure alarm
      - Normal
      - High pressure alarm
      - Audible Mute
    - .4 Audible alarm annunciates when pressure in monitored room is in alarm condition.
      - Adjustable time-delay on alarm initiation for door opening,
    - .5 Remote alarm annunciation:
      - High pressure alarm contact - contacts normally open.
      - Low pressure alarm contact - contacts normally open
  - .3 Pressure Sensor:
    - .1 two velocity sensing elements mounted in-line to each other, with temperature compensating element;
      - Pressure measurement accuracy: -50 to + 50 Pa (-0.19999 to +0.19999 in.wg.)
      - Temperature compensation range: 12.7 to 35 °C (55 to 95 °F)
    - .2 Alarm setpoints:
      - Low pressure: 2.5 Pa (0.01 in.wc.) relative to adjacent space,
      - Resettable to any point over sensing range.

### 2.17 Building Pressure Control

- .1 A dynamic Building Pressure Control System shall be provided to maintain the building pressurized relative to the outside.
  - .1 Building reference pressure shall be measured on the 2nd Floor

### 2.18 Sensors and Instrumentation

- .1 All field sensors and instrumentation shall have a measurement range suitable to the application.
- .2 All field sensors, instrumentation, and control loops shall meet the minimum performance requirements tabulated below.

<i>Parameter</i>	<i>Variable</i>	<i>Reporting Accuracy</i>	<i>Control Accuracy</i>	<i>Remarks</i>
Temperature	• space	±0.25°C (±0.50°F)	±1.0°C (±2.0°F)	RTD type  • 3 attempts at Automatic Reset before lockout • range:1.7°C to 7.2°C (35°F to 45°F) • field adjustable
	• ducted air			
	• liquids	±0.5°C (±1.0°F)		
	• outside air	±0.15°C (±0.25°F)		
	• differential	±1.0°C (±2.0°F)		
	• dew point			
	• low limit (Freezestat)			
Humidity	• relative humidity	± 3%	± 5%	Electronic type Range: 10-100% RH
Pressure	Air	± 1%	± 5Pa (±0.02" w.g)	Electronic type • for compressed air see Liquids requirements
	• ducts / space			
	• static / differential			
	Liquids	± 1%	± 1.5 psi	
	• absolute / static / differential			
Flow	Air	± 1% full scale	± 10% full scale	Multiple-head Pitot Tube Type or Thermal Anemometer Probe Type • differential pressure activated diaphragm type
	• proving switch	-		
	Liquids	± 2% full scale		• differential pressure activated paddle type
	• flow switch	-		
Gas Detection	• CO • CO <sub>2</sub>	± 3% ± 5 ppm		

## 3 INSTALLATION STANDARDS

### 3.1 General

- .1 The requirements outlined in the following clauses are applicable to all BAS Installation.  
Application Specific requirements are outlined under clauses 3.2 – 3.13

- .2 All campus network drops required to complete the BAS installation shall be provided by the BAS Contractor.
  - .1 Extend network a connection(s) from the nearest IT/Communications Closet; coordinate this activity with the Electrical/Communications contractor.

### **3.2 BAS Panels & Cabinets**

- .1 Install Building Control Units, Equipment Control Units, and Field Panels in cabinets.
  - .1 cabinets shall be mounted on a painted non-combustible backboard which is rigidly mounted to a wall or on a galvanized steel, floor mounted support frame.
    - installation on ductwork, equipment, and locations subject to vibration is not acceptable
    - cabinets for Terminal Equipment Controllers may be installed on the terminal equipment provided there is no vibration that could affect controller operation or calibration of control device(s).
  - .2 cabinets to be sized to accommodate 20% future I/O points.
  - .3 cabinet locations are to be coordinated with other trades and the general contractor.
- .2 No panels (except Terminal Equipment Controllers) shall be installed in the ceiling space or at an elevation inaccessible for normal & ready access from the finished floor.

### **3.3 BAS Wiring**

- .1 Wiring:
  - .1 wiring shall be installed in conduit, raceways and enclosures separated from other wiring.
  - .2 wiring may be installed without conduit in the interstitial space above finished ceilings provided the following conditions are met:
    - wiring has a minimum rating of FT6; and
    - interstitial ceiling space is within the room where final termination of wire will be made
  - .3 each run of communication wiring to be continuous length without splices
  - .4 wiring within BCU's, ECU's and Field Panels (Cabinets) shall be installed in a plastic tray with a removable cover
    - wiring shall be terminated at field-removable, modular terminal strips
  - .5 connections within cabinets and panels shall be done using terminals
    - wire nuts and Marr connections are not acceptable
  - .6 wiring to field sensors shall not be daisy-chained
  - .7 should it become necessary to splice field wiring it shall be soldered and a 500mm (20in.) loop length is to be provided
    - wire nuts and Marr connections are not acceptable
    - if soldering is not possible approved B-type crimp connectors are an acceptable alternative
- .2 Conduit:
  - .1 thin wall (EMT) conduit up to and including 32mm (1¼") size for exposed wiring up to 3 m (10 ft) above floor level
  - .2 rigid galvanized steel conduit in locations accessible to public, subject to mechanical injury, or outdoors; and for conduit 40mm (1½") size and larger
  - .3 conduit to be parallel with, or at right angles to, building walls
  - .4 concealed within finished shafts, ceilings, and walls where possible
  - .5 route all conduit to clear beams, plates, footings, and structural members
  - .6 watertight compression fittings in exterior locations
  - .7 provide watertight seals at penetrations through outside walls

- .8 conduits leaving a building to the outside shall be sealed internally to prevent moist air from being pulled through the conduits, condensing, and then the water freezing inside the conduit
- .9 empty or unused conduit openings and stubs to be plugged or capped with compatible fittings
  - plugs or caps on conduit openings are to be maintained during construction
- .10 conduits travelling between separate pressure regime areas shall be sealed internally to prevent migration of air and odors
- .11 conduit to field sensors shall not be daisy chained
- .3 Flexible conduit:
  - .1 shall be provided for the final conduit run to vibrating or rotating equipment so that vibration and equipment noise is not transmitted to the rigid conduit
    - minimum 450mm (18in.) / maximum 900mm (36in.)
  - .2 shall be provided for the last 450mm (18 in.) of conduit runs to field sensors
    - a junction box / enclosure shall be provided for terminations
  - .3 waterproof flexible conduit to be provided where exposed to weather or in damp or wet locations
- .4 Lightning arrester shall be provided according to manufacturer's recommendations between the communication cable and ground wherever cable enters or exits building.

### **3.4 Air Handling Units**

- .1 At a minimum instrumentation shall be provided at each Air Handling Unit to monitor the following:
  - .1 Outside Air Temperature (may be common to a building)
  - .2 Return Air Temperature
  - .3 Mixed Air Temperature
  - .4 Filter Pressure Drop across each bank of filters
  - .5 Air Temperature Upstream & Downstream of all Coils
  - .6 Supply Air Relative Humidity
  - .7 Supply Air Static Pressure
  - .8 Supply Air Flow
  - .9 Supply Fan Speed (where fan is equipped with a Variable Frequency Drive)
  - .10 Return Air Relative Humidity
  - .11 Return Fan Speed (where fan is equipped with a Variable Frequency Drive)
  - .12 Return Air CO2 sensor.

### **3.5 Heating & Cooling Coils**

- .1 A water temperature sensor shall be provided on the inlet and outlet of each coil installed within an air handling unit.
- .2 An air temperature sensor shall be provided upstream and downstream of each coil installed within an air handling unit.

### **3.6 Reheat Coils & VAV Boxes**

- .1 An air temperature sensor shall be provided downstream of each reheat coil.
- .2 Air temperature sensors shall be provided such that the discharge temperature of each VAV can be measured.

### **3.7 Terminal Units**

- .1 Terminal units shall be equipped with an Air-flow Monitoring device interfaced with the BAS.

### **3.8 Heat Exchangers**

- .1 Temperature sensors shall be provided on the inlet and outlet of each heat exchanger.
- .2 Where a dual (or triple) heat exchanger system is used temperature sensors shall be provided on the outlet of each exchanger plus a common sensor for the mixed outlet.

### **3.9 Steam**

- .1 A pressure sensor shall be provided downstream of every PRV station.
- .2 A pressure sensor shall be provided on the building's incoming high pressure steam line.

### **3.10 Compressed Air**

- .1 A pressure sensor shall be provided on the building's incoming compressed air line (if present).

### **3.11 Water**

- .1 A pressure sensor shall be provided on the building's incoming domestic water line.
- .2 A pressure sensor shall be provided on the building's incoming deionized water line (if present).
- .3 Pressure and temperature sensors shall be provided on the building's incoming chilled water supply and chilled water return lines.

### **3.12 Identification**

- .1 Point Object Numbering systems shall include the Building Number as a prefix to all object identifiers. (eg. <99.AC1.SAT> is Building 99 Air Handling Unit 1 Supply Air Temperature).
- .2 All Equipment shall be identified in accordance with the University's Identification Standards and numbering convention. Equipment numbers are to be provided by the University's PM Scheduler.
- .3 Equipment numbering strategy shall be presented for review/approval by the Manager, Mechanical Design, DEC and Manager, Maintenance & Energy Services prior to completion of Design Development.
- .4 Wiring
  - .1 All wires shall be tagged at both ends. The tagging shall identify the device a wire is connected to. Use of the point object name is an acceptable means of device identification.
  - .2 All junction boxes shall be tagged "BAS" with a sequential number suffix.
- .5 Control Devices shall be labelled using a Blue Flag Tie-Marker, such as Nelco PT#N-9L (or equivalent). Labels shall be white or yellow with large black text.
- .6 All local alarm devices (lights, strobes, horns, etc.) shall be clearly labelled as to their purpose with an appropriately sized lamacoid plastic plate that is securely affixed so as to be visible and legible from the direction of normal approach.
  - .1 Prior to fabrication, proposed alarm device labels (wording, size, colors) shall be presented for review/approval by the Manager, Mechanical Design, DEC and Manager, Maintenance & Energy Services.

### **3.13 Redundant or Obsolete Pneumatic, Electric, Electronic, and DDC Devices**

- .1 Existing BAS control equipment rendered redundant or obsolete by the installation of a new BAS system or component shall be removed to the greatest extent possible.
  - .1 control drawings and graphics shall be updated accordingly.
- .2 Removal shall include the clean-up, removal, and proper termination of all existing pneumatic equipment (tubing, piping, panels, actuators, sensors, etc.), existing electronics (wiring, conduit, actuators, sensors) or existing DDC system (controllers, cabinets, sensors, relays, transformers, power supplies, etc.) no longer used by the BAS.
  - .1 ductwork or walls affected shall be patched and sealed or covered with a suitable wall plate

- .2 removal may require the re-piping or rewiring of existing BAS control equipment that is to remain
- .3 pneumatic tubing or piping that cannot be removed shall be suitably plugged to prevent air leakage. Crimping or folding of tubing/piping is not acceptable.
- .4 wiring remaining shall be suitably terminated
- .3 Removal shall occur immediately after commissioning of the new control system in the building is complete.

#### **4 VERSION CONTROL SUMMARY**

<b>Revision No.</b>	<b>Effective Date</b>	<b>Section / Page</b>	<b>Brief Description of Revision</b>
0	15-09-2014	Entire Standard	Original Issue

## **PART 1 - GENERAL**

### **1.1 SUMMARY**

- .1 Section Includes.
  - .1 Requirements and procedures for identification of devices, sensors, wiring tubing, conduit and equipment, for building Energy Monitoring and Control System (EMCS) Work and nameplates materials, colours and lettering sizes.

### **1.2 REFERENCE STANDARDS**

- .1 Canadian Standards Association (CSA International).
  - .1 CSA C22.1-02, The Canadian Electrical Code, Part I (19th Edition), Safety Standard for Electrical Installations.

### **1.3 DEFINITIONS**

- .1 For acronyms and definitions refer to Section 25 05 01 - EMCS: General Requirements.

### **1.4 SYSTEM DESCRIPTION**

- .1 Language Operating Requirements: provide identification for control items in English.

### **1.5 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures supplemented and modified by requirements of this Section.
- .2 Submit to Consultant for approval samples of nameplates, identification tags and list of proposed wording.

## **PART 2 - PRODUCTS**

### **2.1 NAMEPLATES FOR PANELS**

- .1 Identify by Plastic laminate, 3 mm thick Melamine, matt white finish, black core, square corners, lettering accurately aligned and engraved into core.
- .2 Sizes: 25 x 67 mm minimum.
- .3 Lettering: minimum 7 mm high, black.
- .4 Inscriptions: machine engraved to identify function.

## **2.2 NAMEPLATES FOR FIELD DEVICES**

- .1 Identify by plastic encased cards attached by chain plastic tie.
- .2 Sizes: 50 x 100 mm minimum.
- .3 Lettering: minimum 5 mm high produced from laser printer in black.
- .4 Data to include: point name and point address.
- .5 Companion cabinet: identify interior components using plastic enclosed cards with point name and point address.

## **2.3 NAMEPLATES FOR ROOM SENSORS**

- .1 Identify by stick-on labels using point identifier.
- .2 Location: as directed by Consultant.
- .3 Letter size: to suit, clearly legible.

## **2.4 WARNING SIGNS**

- .1 Equipment including motors, starters under remote automatic control: supply and install orange coloured signs warning of automatic starting under control of EMCS.
- .2 Sign to read: "Caution: This equipment is under automatic remote control of EMCS" as reviewed by Departmental Representative's DCC Representative's Consultant's.

## **2.5 WIRING**

- .1 Supply and install numbered tape markings on wiring at panels, junction boxes, splitters, cabinets and outlet boxes.
- .2 Colour coding: to CSA C22.1. Use colour coded wiring in communications cables, matched throughout system.
- .3 Power wiring: identify circuit breaker panel/circuit breaker number inside each EMCS panel.

## **2.6 PNEUMATIC TUBING**

- .1 Numbered tape markings on tubing to provide uninterrupted tracing capability.

## **2.7 CONDUIT**

- .1 Colour code EMCS conduit.
- .2 Pre-paint box covers and conduit fittings.
- .3 Coding: use fluorescent orange paint and confirm colour with Consultant during "Preliminary Design Review".

## **PART 3 - EXECUTION**

### **3.1 NAMEPLATES AND LABELS**

- .1 Ensure that manufacturer's nameplates, CSA labels and identification nameplates are visible and legible at all times.

### **3.2 EXISTING PANELS**

- .1 Correct existing nameplates and legends to reflect changes made during Work.

END OF SECTION

## **PART 1- GENERAL**

### **1.1 SYSTEM DESCRIPTION**

- .1 Electrical:
  - .1 Provide power wiring from locations as indicated on Div 26 drawings for room mounted controllers.
  - .2 Provide power from existing emergency power panels to EMCS field panels. Circuits to be for exclusive use of EMCS equipment. Panel breakers to be identified on panel legends tagged and locks applied to breaker switches.
  - .3 Hard wiring between field control devices and EMCS field panels.
  - .4 Communication wiring between EMCS field panels and OWS's including main control centre BECC.
- .2 Mechanical:
  - .1 Pipe Taps Required For EMCS equipment will be supplied and installed by Division 22 and Division 23.
  - .2 Wells and Control Valves Shall Be Supplied by EMCS Contractor and Installed by Division 23.
  - .3 Installation of air flow stations, dampers, and other devices requiring sheet metal trades to be mounted by Division 23. Costs to be carried by designated trade.
- .3 VAV Terminal Units.
  - .1 Air flow probe for VAV boxes to be supplied and installed under Section 23 36 00 - Air Terminal Units. Air flow dp sensor, actuator and associated VAV controls to be supplied and installed by EMCS contractor. Tubing from air probe to dp sensor as well as installation and adjustment of air flow sensors and actuators to be the responsibility of EMCS contractor. Coordinate air flow adjustments with balancing trade.

## **PART 2- PRODUCTS**

### **2.1 WIRING**

- .1 As per requirements of Division 26.
- .2 For 70V and above copper conductor with chemically cross-linked thermosetting polyethylene insulation rated RW90 and 600V. Colour code to CSA 22.1.
- .3 For wiring under 70 volts use FT6 rated wiring where wiring is not run in conduit. All other cases use FT4 wiring.
- .4 Sizes:
  - .1 120V Power supply: to match or exceed breaker, size #12 minimum.
- .5 Terminations:
  - .1 Terminate wires with screw terminal type connectors suitable for wire size, and number of terminations.

## 2.2 CONDUIT

- .1 As per requirements of Division 26.
- .2 Electrical metallic tubing to CSA C22.2 No. 83. Flexible and liquid tight flexible metal conduit to CSA C22.2 No. 56. Rigid steel threaded conduit to CSA C22.2 No. 45.1.
- .3 Junction and pull boxes: welded steel.
  - .1 Surface mounting cast FS: screw-on flat covers.
  - .2 Flush mounting: covers with 25 mm minimum extension all round.
- .4 Cabinets: sheet steel, for surface mounting, with hinged door, latch lock, 2 keys, complete with perforated metal mounting backboard. Panels to be keyed alike for similar functions and or entire contract as approved.
- .5 Outlet boxes: 100 mm minimum, square.
- .6 Conduit boxes, fittings:
  - .1 Bushings and connectors: with nylon insulated throats.
  - .2 With push pennies to prevent entry of foreign materials.
- .7 Fittings for rigid conduit:
  - .1 Couplings and fittings: threaded type steel.
  - .2 Double locknuts and insulated bushings: use on sheet metal boxes.
  - .3 Use factory "ells" where 90 degree bends required for 25 mm and larger conduits.
- .8 Fittings for thin wall conduit:
  - .1 Connectors and couplings: steel, set screw type.

## 2.3 SUPPORTS FOR CONDUIT, FASTENINGS, EQUIPMENT

- .1 Solid masonry, tile and plastic surfaces: lead anchors or nylon shields.
- .2 Hollow masonry walls, suspended drywall ceilings: toggle bolts.
- .3 Exposed conduits or cables:
  - .1 50 mm diameter and smaller: one-hole steel straps.
  - .2 Larger than 50 mm diameter: two-hole steel straps.
- .4 Suspended support systems:
  - .1 Individual cable or conduit runs: support with 6 mm diameter threaded rods and support clips.
  - .2 Two or more suspended cables or conduits: support channels supported by 6 mm diameter threaded rod hangers.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- .1 Install equipment, components so that manufacturer's and CSA labels are visible and legible after commissioning is complete.

### **3.2 ELECTRICAL GENERAL**

- .1 Do complete installation in accordance with requirements of:
  - .1 Division 26, this specification.
  - .2 CSA 22.1 Canadian Electrical Code.
  - .3 ANSI/NFPA 70.
  - .4 ANSI C2.
- .2 Fully enclose or properly guard electrical wiring, terminal blocks, high voltage above 70 V contacts and mark to prevent accidental injury.
- .3 Do underground installation to CAN/CSA-C22.3 No.7, except where otherwise specified.
- .4 Conform to manufacturer's recommendations for storage, handling and installation.
- .5 Check factory connections and joints. Tighten where necessary to ensure continuity.
- .6 Install electrical equipment between 1000 and 2000 mm above finished floor wherever possible and adjacent to related equipment.
- .7 Protect exposed live equipment such as panel, mains, outlet wiring during construction for personnel safety.
- .8 Shield and mark live parts "LIVE 120 VOLTS" or other appropriate voltage.
- .9 Install conduits, and sleeves prior to pouring of concrete.
- .10 Holes through exterior wall and roofs: flash and make weatherproof.
- .11 Make necessary arrangements for cutting of chases, drilling holes and other structural work required to install electrical conduit, cable, pull boxes, outlet boxes.
- .12 Install cables, conduits and fittings which are to be embedded or plastered over, neatly and closely to building structure to minimize furring.

### **3.3 CONDUIT SYSTEM**

- .1 Communication wiring shall be installed in conduit. Provide complete conduit system to link Building Controllers to BECC. Conduit sizes to suit wiring requirements and to allow for future expansion capabilities specified for systems. Maximum conduit fill not to exceed 40%. Design drawings do not show conduit layout.

- .2 Install conduits parallel or perpendicular to building lines, to conserve headroom and to minimize interference.
- .3 Do not run exposed conduits in normally occupied spaces unless otherwise indicated or unless impossible to do otherwise. Obtain approval from Consultant before starting such work. Provide complete conduit system to link field panels and devices with main control centre. Conduit size to match conductors plus future expansion capabilities as specified.
- .4 Locate conduits at least 150 mm from parallel steam or hot water pipes and at least 50 mm at crossovers.
- .5 Bend conduit so that diameter is reduced by less than 1/10th original diameter.
- .6 Field thread on rigid conduit to be of sufficient length to draw conduits up tight.
- .7 Limit conduit length between pull boxes to less than 30 m.
- .8 Use conduit outlet boxes for conduit up to 32 mm diameter and pull boxes for larger sizes.
- .9 Fastenings and supports for conduits, cables, and equipment:
  - .1 Provide metal brackets, frames, hangers, clamps and related types of support structures as indicated and as required to support cable and conduit runs.
  - .2 Provide adequate support for raceways and cables, sloped vertically to equipment.
  - .3 Use supports or equipment installed by other trades for conduit, cable and raceway supports only after written approval from Consultant.
- .10 Install polypropylene fish cord in empty conduits for future use.
- .11 Where conduits become blocked, remove and replace blocked sections.
- .12 Pass conduits through structural members only after receipt of Consultant's written approval.
- .13 Conduits may be run in flanged portion of structural steel.
- .14 Group conduits wherever possible on suspended or surface channels.
- .15 Pull boxes:
  - .1 Install in inconspicuous but accessible locations.
  - .2 Support boxes independently of connecting conduits.
  - .3 Fill boxes with paper or foam to prevent entry of construction material.
  - .4 Provide correct size of openings. Reducing washers not permitted.
  - .5 Mark location of pull boxes on record drawings.
  - .6 Identify AC power junction boxes, by panel and circuit breaker.
- .16 Install bonding conductor for 120 volt and above in conduit.

### **3.4 WIRING**

- .1 Install multiple wiring in ducts simultaneously.
- .2 Do not pull spliced wiring inside conduits or ducts.
- .3 Use CSA certified lubricants of type compatible with insulation to reduce pulling tension.
- .4 Tests: use only qualified personnel. Demonstrate that:
  - .1 Circuits are continuous, free from shorts, unspecified grounds.
  - .2 Resistance to ground of all circuits is greater than 50 Megohms.
- .5 Provide Consultant with test results showing locations, circuits, results of tests.
- .6 Remove insulation carefully from ends of conductors and install to manufacturer's recommendations. Accommodate all strands in lugs. Where insulation is stripped in excess, neatly tape so that only lug remains exposed.
- .7 Wiring in main junction boxes and pull boxes to terminate on terminal blocks only, clearly and permanently identified. Junctions or splices not permitted for sensing or control signal covering wiring.
- .8 Do not allow wiring to come into direct physical contact with compression screw.
- .9 Install ALL strands of conductor in lugs of components. Strip insulation only to extent necessary for installation.

### **3.5 WIRING DEVICES, COVER PLATES**

- .1 Receptacles:
  - .1 Install vertically in gang type outlet box when more than one receptacle is required in one location.
- .2 Cover plates:
  - .1 Install suitable common cover plate where wiring devices are grouped.
  - .2 Use flush type cover plates only on flush type outlet boxes.

### **3.6 GROUNDING**

- .1 Install complete, permanent, continuous grounding system for equipment, including conductors, connectors and accessories.
- .2 Install separate grounding conductors in conduit within building.
- .3 Install ground wire in all PVC ducts and in tunnel conduit systems.
- .4 Tests: perform ground continuity and resistance tests, using approved method appropriate to site conditions.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 SUMMARY**

- .1 Section includes:
  - .1 Control devices integral to the Building Energy Monitoring and Control System (EMCS): transmitters, sensors, controls, meters, switches, transducers, dampers, damper operators, valves, and valve actuators.

### **1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit shop drawings and manufacturer's installation instructions in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Manufacturer's Instructions:
  - .1 Submit manufacturer's installation instructions for specified equipment and devices.

## **PART 2 - PRODUCTS**

### **2.1 GENERAL**

- .1 Meet the requirements of University of Guelph, Physical Resources, Design engineering and Construction, Design Standards DSM-03
- .2 Building Automation Systems Control devices of each category to be of same type and manufacturer.
- .3 Terminations: use standard conduit box with slot screwdriver compression connector block unless otherwise specified.
- .4 Transmitters and sensors to be unaffected by external transmitters including walkie-talkies.
- .5 Account for hysteresis, relaxation time, maximum and minimum limits in applications of sensors and controls.
- .6 Devices installed in user occupied space not exceed Noise Criteria (NC) of 35. Noise generated by any device must not be detectable above space ambient conditions.

### **2.2 TEMPERATURE SENSORS**

- .1 General: except for room sensors to be resistance or thermocouple type to following requirements:
  - .1 Thermocouples: limit to temperature range of 20 degrees C and over.
  - .2 RTD's: 100 or 1000 ohm at 0degrees C (plus or minus 0.2 ohms) platinum element with strain minimizing construction, 3 integral anchored lead wires, Coefficient of resistivity: 0.00385 ohms/ohm degrees C.
  - .3 Sensing element: hermetically sealed.
  - .4 Stem and tip construction: copper or type 304 stainless steel.
  - .5 Time constant response: less than 3 seconds to temperature change of 10 degrees C.
  - .6 Immersion wells: NPS 3/4, stainless steel spring loaded construction, with heat transfer compound compatible with sensor. Insertion length 100 mm.

- .2 Room temperature sensors and display wall modules.
  - .1 Temperature sensing and display wall module.
    - .1 LCD display to show space temperature and temperature setpoint.
    - .2 Buttons for occupant selection of temperature setpoint and occupied/unoccupied mode.
    - .3 Jack connection for plugging in laptop personal computer for access to zone bus.
    - .4 Integral thermistor sensing element 10,000 ohm at 24 degrees.
    - .5 Accuracy 0.2 degrees C over range of 0 to 70 degrees C.
    - .6 Stability 0.02 degrees C drift per year.
    - .7 Separate mounting base for ease of installation.
  - .2 Room temperature sensors.
    - .1 Wall mounting, in slotted type covers having brushed aluminum finish.
- .3 Duct temperature sensors:
  - .1 General purpose duct type: suitable for insertion into ducts at various orientations.
- .4 Outdoor air temperature sensors:
  - .1 Outside air type: complete with probe, non-corroding shield to minimize solar and wind effects, threaded fitting for mating to 13 mm conduit, weatherproof construction in NEMA 4 enclosure.

## **2.3 TEMPERATURE TRANSMITTERS**

- .1 Requirements:
  - .1 Input circuit: to accept 3-lead, 100 or 1000 ohm at 0 degrees C, platinum resistance detector type sensors.
  - .2 Power supply: 24 V DC into load of 575 ohms. Power supply effect less than 0.01 degrees C per volt change.
  - .3 Output signal: 4 - 20 mA into 500 ohm maximum load.
  - .4 Input and output short circuit and open circuit protection.
  - .5 Output variation: less than 0.2 % of full scale for supply voltage variation of plus or minus 10 %.
  - .6 Combined non-linearity, repeatability, hysteresis effects: not to exceed plus or minus 0.5 % of full scale output.
  - .7 Maximum current to 100 or 1000 ohm RTD sensor: not to exceed 25 mA.
  - .8 Integral zero and span adjustments.
  - .9 Temperature effects: not to exceed plus or minus 1.0 % of full scale/ 50 degrees C.
  - .10 Transmitter ranges: to suit application.

## **2.4 HUMIDITY SENSORS**

- .1 Room and Duct Requirements:
  - .1 Range: 5 - 90 % RH minimum.
  - .2 Operating temperature range: 0 - 60 degrees C.
  - .3 Absolute accuracy: plus or minus 3%.
  - .4 Sheath: stainless steel with integral shroud for specified operation in air streams of up to 10 m/s.
  - .5 Maximum sensor non-linearity: plus or minus 2% RH with defined curves.
  - .6 Duct mounted sensors: locate so that sensing element is in air flow in duct.

## **2.5 HUMIDITY TRANSMITTERS**

- .1 Requirements:
  - .1 Input signal: from RH sensor.
  - .2 Output signal: 4 - 20 mA onto 500 ohm maximum load.
  - .3 Input and output short circuit and open circuit protection.
  - .4 Output variations: not to exceed 0.2 % of full scale output for supply voltage variations of plus or minus 10 %.
  - .5 Output linearity error: plus or minus 1.0% maximum of full scale output.
  - .6 Integral zero and span adjustment.

## **2.6 PRESSURE TRANSDUCERS**

- .1 Requirements:
  - .1 Combined sensor and transmitter measuring pressure.
    - .1 Internal materials: suitable for continuous contact with industrial standard instrument air, compressed air, water, steam, as applicable.
  - .2 Output signal: 4 - 20 mA into 500 ohm maximum load.
  - .3 Output variations: less than 0.2 % full scale for supply voltage variations of plus or minus 10 %.
  - .4 Combined non-linearity, repeatability, and hysteresis effects: not to exceed plus or minus 0.5 % of full scale output over entire range.
  - .5 Temperature effects: not to exceed plus or minus 1.5 % full scale/ 50 degrees C.
  - .6 Over-pressure input protection to at least twice rated input pressure.
  - .7 Output short circuit and open circuit protection.
  - .8 Accuracy: plus or minus 1% of Full Scale.

## **2.7 DIFFERENTIAL PRESSURE TRANSMITTERS**

- .1 Requirements:
  - .1 Internal materials: suitable for continuous contact with industrial standard instrument air, compressed air, water, steam, as applicable.
  - .2 Output signal: 4 - 20 mA into 500 ohm maximum load.
  - .3 Output variations: less than 0.2 % full scale for supply voltage variations of plus or minus 10 %.
  - .4 Combined non-linearity, repeatability, and hysteresis effects: not to exceed plus or minus 0.5 % of full scale output over entire range.
  - .5 Integral zero and span adjustment.
  - .6 Temperature effects: not to exceed plus or minus 1.5 % full scale/ 50 degrees C.
  - .7 Over-pressure input protection to at least twice rated input pressure.
  - .8 Output short circuit and open circuit protection.
  - .9 Unit to have 12.5 mm N.P.T. conduit connection. Enclosure to be integral part of unit.

## **2.8 STATIC PRESSURE SENSORS**

- .1 Requirements:
  - .1 Multipoint element with self-averaging manifold.
    - .1 Maximum pressure loss: 160 Pa at 10 m/s. (Air stream manifold).
  - .2 Accuracy: plus or minus 1 % of actual duct static pressure.

## 2.9 STATIC PRESSURE TRANSMITTERS

- .1 Requirements:
  - .1 Output signal: 4 - 20 mA linear into 500 ohm maximum load.
  - .2 Calibrated span: not to exceed 150 % of duct static pressure at maximum flow.
  - .3 Accuracy: 0.4 % of span.
  - .4 Repeatability: within 0.5 % of output.
  - .5 Linearity: within 1.5 % of span.
  - .6 Deadband or hysteresis: 0.1% of span.
  - .7 External exposed zero and span adjustment.
  - .8 Unit to have 12.5 mm N.P.T. conduit connection. Enclosure to be integral part of unit

## 2.10 SUMP LEVEL SWITCHES

- .1 Requirements:
  - .1 Liquid level activated switch sealed in waterproof and shockproof enclosure.
  - .2 Complete with float, flexible cord, weight. Instrument casing to be suitable for immersion in measured liquid.
  - .3 N.O./N.C. Contacts rated at 15 amps at 120V AC. CSA approval for up to 250 volt 10 amps AC.

## 2.11 CURRENT SENSING RELAYS

- .1 Requirements:
  - .1 Suitable to detect belt loss or motor failure.
  - .2 Trip point adjustment, output status LED.
  - .3 Split core for easy mounting.
  - .4 Induced sensor power.
  - .5 Relay contacts: capable of handling 0.5 amps at 30 VAC / DC. Output to be NO solid state.
  - .6 Suitable for single or 3 phase monitoring. For 3-Phase applications: provide for discrimination between phases.
  - .7 Adjustable latch level.

## 2.12 CONTROL DAMPERS

- .1 Construction: blades, 152 mm wide, 1219 mm long, maximum. Modular maximum size, 1219 mm wide x 1219 mm high. Three or more sections to be operated by jack shafts.
- .2 Materials:
  - .1 Frame: 2.03 mm minimum thickness extruded aluminum. For outdoor air and exhaust air applications, frames to be insulated.
  - .2 Blades: extruded aluminum. For outdoor air/exhaust air applications, blades to be internally insulated.
  - .3 Bearings: maintenance free, synthetic type of material.
  - .4 Linkage and shafts: aluminum, zinc and nickel plated steel.
  - .5 Seals: synthetic type, mechanically locked into blade edges.
    - .1 Frame seals: synthetic type, mechanically locked into frame sides.

- .3 Performance: minimum damper leakage meet or exceed AMCA Standard 500-D ratings.
  - .1 Size/Capacity: refer to damper schedule
  - .2 25 L/s/m<sup>2</sup> maximum allowable leakage against 1000 Pa static pressure for outdoor air and exhaust air applications.
  - .3 Temperature range: minus 40degrees C to plus 100 degrees C.
- .4 Arrangements: dampers mixing warm and cold air to be parallel blade, mounted at right angles to each other, with blades opening to mix air stream.
- .5 Jack shafts:
  - .1 25 mm diameter solid shaft, constructed of corrosion resistant metal complete with required number of pillow block bearings to support jack shaft and operate dampers throughout their range.
  - .2 Include corrosion resistant connecting hardware to accommodate connection to damper actuating device.
  - .3 Install using manufacturers installation guidelines.
  - .4 Use same manufacturer as damper sections.

## **2.13 ELECTRONIC CONTROL DAMPER ACTUATORS**

- .1 Requirements:
  - .1 Direct mount proportional type as indicated.
  - .2 Spring return for "fail-safe" in Normally Open or Normally Closed position as indicated.
  - .3 Operator: size to control dampers against maximum pressure and dynamic closing/opening pressure, whichever is greater.
  - .4 Power requirements: 5 VA maximum at 24 V AC.
  - .5 Operating range: 0 - 10 V DC or 4 - 20 mA DC.
  - .6 For VAV box applications floating control type actuators may be used.
  - .7 Damper actuator to drive damper from full open to full closed in less than 120 seconds.

## **2.14 PERIMETER RADIATION AND FAN COIL CONTROL VALVES**

- .1 Body: characterized ball.
  - .1 Flow characteristic as indicated on control valve schedule: equal percentage.
  - .2 Flow factor (KV) as indicated on control valve schedule: CV in imperial units.
  - .3 Normally open (Heating Applications) or Normally closed (Cooling Applications).
  - .4 Two port, as indicated.
  - .5 Leakage rate ANSI class IV, 0.01% of full open valve capacity.
  - .6 Stem, stainless steel.
  - .7 NPS 2 and under:
    - .1 Screwed National Pipe Thread (NPT) tapered female connections.
    - .2 Valves to ANSI Class 125, valves to bear ANSI mark.
  - .8 Rangeability 50:1 minimum.

## **2.15 AHU CONTROL VALVES**

- .1 Body: globe style.
  - .1 Flow characteristic as indicated on control valve schedule: equal percentage.
  - .2 Flow factor (KV) as indicated on control valve schedule: CV in imperial units.
  - .3 Normally open (Heating Applications) or Normally closed (Cooling Applications).
  - .4 Two port, as indicated.
  - .5 Leakage rate ANSI class IV, 0.01% of full open valve capacity.
  - .6 Packing easily replaceable.
  - .7 Stem, stainless steel.
  - .8 Plug and seat, stainless steel.
  - .9 Disc, replaceable, material to suit application.
  - .10 NPS 2 and under:
    - .1 Screwed National Pipe Thread (NPT) tapered female connections.
    - .2 Valves to ANSI Class 250, valves to bear ANSI mark.
    - .3 Rangeability 50:1 minimum.
  - .11 NPS 2½ and larger:
    - .1 Flanged connections.
    - .2 Valves to ANSI Class 150 as indicated, valves to bear ANSI mark.
    - .3 Rangeability 100:1 minimum.

## **2.16 ELECTRONIC / ELECTRIC VALVE ACTUATORS**

- .1 Requirements:
  - .1 Construction: steel, cast iron, aluminum.
  - .2 Control signal: 0-10V DC or 4-20 mA DC.
  - .3 Positioning time: to suit application.
  - .4 Fail to normal position as indicated.
  - .5 Scale or dial indication of actual control valve position.
  - .6 Size actuator to meet requirements and performance of control valve specifications.
  - .7 For interior and perimeter terminal heating and cooling applications floating control actuators are acceptable.
  - .8 Minimum shut-off pressure: refer to control valve schedule.

## **2.17 PANELS**

- .1 Wall mounted enameled steel cabinets with hinged and key-locked front door.
- .2 Multiple panels as required to handle requirements with additional space to accommodate 25% additional without adding additional cabinets.
- .3 Panels to be lockable with same key.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- .1 Install equipment, components so that manufacturer's and CSA labels are visible and legible after commissioning is complete.
- .2 Install field control devices in accordance with manufacturers recommended methods, procedures and instructions.
- .3 Temperature transmitters, humidity transmitters, current-to-pneumatic transducers, solenoid air valves, controllers, relays: install in NEMA I enclosure or as required for specific applications. Provide for electrolytic isolation in cases when dissimilar metals make contact.
- .4 Support field-mounted panels, transmitters and sensors on pipe stands or channel brackets.
- .5 Fire stopping: provide space for fire stopping in accordance with Section 07 84 00 – Fire stopping. Maintain fire rating integrity.
- .6 VAV Terminal Units: supply, install and adjust as required.
  - .1 Air probe, actuator and associated VAV controls.
  - .2 Tubing from air probe to dp sensor as well as installation and adjustment of air flow sensors and actuators.
  - .3 Co-ordinate air flow adjustments with balancing trade.

### **3.2 TEMPERATURE AND HUMIDITY SENSORS**

- .1 Stabilize to ensure minimum field adjustments or calibrations.
- .2 Readily accessible and adaptable to each type of application to allow for quick easy replacement and servicing without special tools or skills.
- .3 Outdoor installation:
  - .1 Protect from solar radiation and wind effects by non-corroding shields.
  - .2 Install in NEMA 4 enclosures.
- .4 Duct installations:
  - .1 Do not mount in dead air space.
  - .2 Locate within sensor vibration and velocity limits.
  - .3 Securely mount extended surface sensor used to sense average temperature.
  - .4 Thermally isolate elements from brackets and supports to respond to air temperature only.
  - .5 Support sensor element separately from coils, filter racks.
- .5 Averaging duct type temperature sensors.
  - .1 Install averaging element horizontally across the ductwork starting 300 mm from top of ductwork. Each additional horizontal run to be no more than 300 mm from one above it. Continue until complete cross sectional area of ductwork is covered. Use multiple sensors where single sensor does not meet required coverage.
  - .2 Wire multiple sensors in series for low temperature protection applications.
  - .3 Wire multiple sensors separately for temperature measurement.
  - .4 Use software averaging algorithm to derive overall average for control purposes.

- .6 Thermowells: install for piping installations.
  - .1 Locate well in elbow where pipe diameter is less than well insertion length.
  - .2 Thermowell to restrict flow by less than 30%.
  - .3 Use thermal conducting paste inside wells.

### **3.3 PANELS**

- .1 Arrange for conduit and tubing entry from top, bottom or either side.
- .2 Wiring and tubing within panels: locate in trays or individually clipped to back of panel.
- .3 Identify wiring and conduit clearly.

### **3.4 PRESSURE AND DIFFERENTIAL PRESSURE SWITCHES AND SENSORS**

- .1 Install isolation valve and snubber on sensors between sensor and pressure source where code allows.
- .2 Protect sensing elements on steam and high temperature hot water service with pigtail syphon between valve and sensor.

### **3.5 TESTING AND COMMISSIONING**

- .1 Calibrate and test field devices for accuracy and performance in accordance with Commissioning.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 COMMISSIONING DESCRIPTION**

- .1 The Electrical Contractor will assist in the commissioning of all electrical equipment, fire alarm system, lighting control system, and electrical systems for mechanical equipment within the building. The Contractor will appoint a person who will be responsible for the electrical commissioning process in conjunction with the commissioning manager.
- .2 The appointed electrical representative will be part of the building commissioning team and be required to attend all scheduled commissioning progress meetings.
- .3 Should any factors such as lack of occupancy prevent start-up of any electrical equipment or systems within the construction /commissioning stage of the Project; the Manufacturer will carry out these performance testing procedures at any time within the 12-month warranty period of the contract.
- .4 Refer to Section 01 91 13 – Commissioning for more information on the building commissioning process

### **1.2 COMMISSIONING REQUIREMENTS**

- .1 The electrical representative will be responsible for coordination of electrical system start-up. The representative will schedule these system start-ups, including all manufacturer assisted start-ups, based on the overall building start-ups schedule as provided by the commissioning manager.
- .2 The electrical representative will complete all equipment information forms as supplied in the specification or provided by the commissioning manager. The information will detail the building electrical equipment as installed.
- .3 The point to point verification for the Fire Alarm and Lighting Control systems will be documented and submitted to the commissioning manager and design engineer for review and acceptance. The commissioning manager will review the point-to-point verification of these systems.
- .4 The electrical trade contractor will document all equipment start-up and testing, as detailed herein. The system testing will include, but not be limited to, the following:
  - .1 Pre-service main incoming power and switchboard verification.
  - .2 Post-service power distribution and grounding.
  - .3 Fire alarm system certification.
  - .4 Lighting control system.
  - .5 Facility failure mode verification.
- .5 The proper operation of all building electrical distribution systems must be proven by the electrical trade prior to Phase 3 (Functional Verification) of the building commissioning process.
- .6 The electrical contractor will verify the sequence of operation for the fire alarm and lighting control systems during the functional verification commissioning process. The system functional testing will be carried out by the system manufacturer representative and be observed by the commissioning manager and any other member of the commissioning team.

- .7 All system start-up/testing documentation, authority inspection reports and equipment information forms will be submitted by the trade contractor to the commissioning manager for inclusion into the commissioning manual.
- .8 The electrical trade representative will participate in the building failure mode test. The failure mode test will take place over a one-day period. The basis for the failure mode testing will be loss of normal power to the facility. The test will be a dynamic, in that all building systems will be in normal running operation. The building power will be transferred from normal to emergency and all building systems will be observed. The building will then be restored to normal power. The failure mode test observations will be documented in a separate report by the commissioning manager.
- .9 The electrical contractor is responsible for training and instruction to the owner on the electrical systems and equipment once the commissioning verification process is complete. The Contractor will also coordinate and schedule all fire alarm and lighting control system instruction sessions.

## **PART 2 - PRODUCTS**

### **2.1 NOT USED**

- .1 Not Used.

## **PART 3 - EXECUTION**

### **3.1 NOT USED**

- .1 Not Used.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 SCOPE**

- .1 The Contractor to furnish short-circuit and protective device coordination studies as prepared by the equipment manufacturer.
- .2 The Contractor to furnish an Arc-Flash Hazard Analysis Study per NFPA 70E – Standard for Electrical Safety in the Workplace, reference Article 130.3 and Annex D.

### **1.2 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 – Guide for Performing Arc-Flash Hazard Calculations.
- .2 American National Standards Institute (ANSI):
  - .1 ANSI C57.12.00 – Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers.
  - .2 ANSI C37.13 – Standard for Low Voltage AC Power Circuit Breakers Used in Enclosures.
  - .3 ANSI C37.010 – Standard Design Tests for High Voltage Fuses, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches and Accessories.
- .3 The National Fire Protection Association (NFPA):
  - .1 NFPA 70 – National Electrical Code, latest edition.
  - .2 NFPA 70E – Standard for Electrical Safety in the Workplace.

### **1.3 SUBMITTALS FOR REVIEW**

- .1 The short-circuit and protective device coordination studies to be submitted to the design engineer prior to receiving final approval 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 Consultant may be obtained for preliminary submittal of sufficient study data to ensure that the selection of device and characteristics will be satisfactory.

### **1.4 SUBMITTALS FOR CONSTRUCTION**

- .1 The results of the short circuit, protective device coordination and Arc-Flash Hazard analysis studies to be summarized in a final report. No more than five (5) bound copies of the complete final report to be submitted, as well as on CD in PDF format.
- .2 The report to include the following sections:
  - .1 One-line diagram.
  - .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 Incident energy and flash protection boundary calculations.
- .7 Recommendations for system improvements, where needed.
- .8 Executive Summary.

## **1.5 QUALIFICATIONS**

- .1 The short-circuit, protective device coordination and Arc-Flash Hazard analysis studies to be conducted under the supervision and approval of a Registered Professional Electrical Engineer skilled in performing and interpreting the power system studies. The Registered Professional Electrical Engineer to be a full-time employee of the Engineering Services Organization.

## **PART 2 - PRODUCTS**

### **2.1 STUDIES**

- .1 Contractor to furnish short-circuit and protective device coordination studies as prepared by equipment manufacturer.
- .2 The Contractor to furnish an Arc-Flash Hazard Analysis Study per NFPA 70E – Standard for Electrical Safety in the Workplace, reference Article 130.3 and Annex D.
- .3 The short circuit and protective device coordination study and the Arc flash Hazard analysis shall be carried out for building Wings A, B and C.

### **2.2 DATA COLLECTION**

- .1 Contractor to furnish all data as required by the power system studies. The Consultant performing the short-circuit, protective device coordination and Arc-Flash Hazard Analysis studies to furnish the Contractor with a listing of required data immediately after award of the contract. The Contractor to 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 Load data utilized may include existing and proposed loads obtained from Contract Documents provided by Owner, or Contractor.
- .4 Include fault contribution of existing motors in the study, with motors < 100 hp grouped together. Contractor to obtain required existing equipment data, if necessary, to satisfy the study requirements.
- .5 Obtain from local utility, fault level characteristics available at building entrance switchgear.
- .6 Verify cable lengths of existing feeders for panels in Wing A to remain and incorporate details in study.

## **2.3 SHORT-CIRCUIT AND PROTECTION DEVICE EVALUATION STUDY**

- .1 Use actual conductor impedances if known. If unknown, use typical conductor impedances based on IEEE Standards 141-1993.
- .2 Transformer design impedances to be used when test impedances are not available.
- .3 Provide the following:
  - .1 Calculation methods and assumptions.
  - .2 Selected base per unit quantities.
  - .3 One-line diagram of the system being evaluated.
  - .4 Source impedance data, including electric utility system and motor fault contribution characteristics.
  - .5 Typical calculations.
  - .6 Tabulations of calculated quantities.
  - .7 Results, conclusions, and recommendations.
- .4 Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault at each:
  - .1 Electric utility's supply termination point.
  - .2 Incoming switchgear.
  - .3 Unit substation primary and secondary terminals.
  - .4 Low voltage switchgear.
  - .5 Motor control centres.
  - .6 Standby generators and automatic transfer switches.
  - .7 Branch circuit panel boards.
  - .8 Other significant locations throughout the system.
- .5 For grounded systems, provide a bolted line-to-ground fault current study for areas as defined for the three-phase bolted fault short-circuit study.
- .6 Protective Device Evaluation:
  - .1 Evaluate equipment and protective devices and compare to short circuit ratings.
  - .2 Adequacy of switchgear, motor control centres, and panel board bus bars to withstand short-circuit stresses.
  - .3 Adequacy of transformer windings to withstand short-circuit stresses.
  - .4 Cable and busway sizes for ability to withstand short-circuit heating.
  - .5 Notify Owner in writing, of existing, circuit protective devices improperly rated for the calculated available fault current.

## **2.4 PROTECTIVE DEVICE COORDINATION STUDY**

- .1 Proposed protective device coordination time-current curves to be graphically displayed on log-log scale paper.
- .2 Include on each curve sheet a complete title and one-line diagram with legend identifying the specific portion of the system covered.
- .3 Terminate device characteristic curves at a point reflecting maximum symmetrical or asymmetrical fault current to which device is exposed.
- .4 Identify device associated with each curve by manufacturer type, function, and, if applicable, tap, time delay, and instantaneous settings recommended.

- .5 Plot the following characteristics on the curve sheets, where applicable:
  - .1 Electric utility's protective device.
  - .2 Medium voltage equipment relays.
  - .3 Medium and low voltage fuses including manufacturer's minimum melt, total clearing, tolerance, and damage bands.
  - .4 Low voltage equipment circuit breaker trip devices, including manufacturer's tolerance bands.
  - .5 Transformer full-load current, magnetizing inrush current, and ANSI transformer withstand parameters.
  - .6 Conductor damage curves.
  - .7 Ground fault protective devices, as applicable.
  - .8 Pertinent motor starting characteristics and motor damage points.
  - .9 Pertinent generator short-circuit decrement curve and generator damage point.
  - .10 Other system load protective devices for the largest branch circuit and the largest feeder circuit breaker in each motor centre.
- .6 Provide adequate time margins between device characteristics such that selective operation is provided, while providing proper protection.

## **2.5 ARC-FLASH HAZARD ANALYSIS**

- .1 The Arc-Flash Hazard analysis to be performed according to the IEEE 1584 equations that are presented in NFPA 70E-2004, Annex D.
- .2 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. Alternative methods to be presented in the proposal.
- .3 The flash protection boundary and the incident energy to be calculated at all significant locations in the electrical distribution system (switchboards, switchgear, motor-control centres, panel boards, busway and splitters) where work could be performed on energized parts.
- .4 The Arc-Flash Hazard Analysis to include all significant locations in 240 volt and 208 volt systems fed from transformers equal to or greater than 125 kVA.
- .5 Safe working distances to be specified for calculated fault locations based upon the calculated Arc Flash boundary considering an incident energy of 1.2 cal/cm<sup>2</sup>.
- .6 The Arc-Flash Hazard analysis to include calculations for maximum and minimum contributions of fault current magnitude. The minimum calculation to assume that the utility contribution is at a minimum and to assume a maximum contribution from the utility and to assume motors to be operating under full-load conditions.
- .7 Arc Flash computation to include both line and load side of main breaker calculations, where necessary.
- .8 Arc-Flash calculations to be based on actual overcurrent protective device clearing time. Maximum clearing time will be capped at 2 seconds based on IEEE 1584-2002 section B.1.2.

## **2.6 REPORT SECTIONS**

- .1 Input Data:
  - .1 Short-circuit reactance of rotating machines.
  - .2 Cable and conduit materials.

- .3 Bus ducts.
- .4 Transformers.
- .5 Automatic transfer switches.
- .6 Reactors.
- .7 Aerial lines.
- .8 Circuit resistance and reactive values.
- .2 Short-Circuit Data:
  - .1 Source fault impedance and generator contributions.
  - .2 X to R ratios.
  - .3 Asymmetry factors.
  - .4 Motor contributions.
  - .5 Short circuit kVA.
  - .6 Symmetrical and asymmetrical fault currents.
- .3 Recommended Protective Device Settings:
  - .1 Phase and Ground Relays:
    - .1 Current transformer ratio.
    - .2 Current setting.
    - .3 Time setting.
    - .4 Instantaneous setting.
    - .5 Specialty non-overcurrent device settings.
    - .6 Recommendations on improved relaying systems, if applicable.
  - .2 Circuit Breakers:
    - .1 Adjustable pick-ups and time delays (long time, short time, ground).
    - .2 Adjustable time-current characteristic.
    - .3 Adjustable instantaneous pick-up.
    - .4 Recommendations on improved trip systems, if applicable.
- .4 Incident Energy and Flash Protection Boundary Calculations:
  - .1 Arcing fault magnitude.
  - .2 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.

### **PART 3 - EXECUTION**

#### **3.1 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 Start-up 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.
- .4 Following completion of all studies, acceptance testing and start up by the field engineering service division of the equipment manufacturer, a 2-year warranty to be provided on all components manufactured by the engineering service parent manufacturing company.

### **3.2 ARC-FLASH WARNING LABELS**

- .1 The vendor to provide a 3.5" x 5" thermal transfer type label of high adhesion polyester for each work location analyzed. The format of the label shall be approved by the University of Guelph. Sample label to be provided for approval.
- .2 The label to have an orange header with the wording "WARNING, ARC-FLASH HAZARD", and to include the following information:
  - .1 Location designation.
  - .2 Nominal voltage.
  - .3 Flash protection boundary.
  - .4 Hazard risk category.
  - .5 Incident energy.
  - .6 Working distance.
  - .7 Engineering report number, revision number and issue date.
- .3 Labels to be machine printed, with no field markings.
- .4 Arc-Flash labels to be provided in the following manner and all labels to be based on recommended overcurrent device settings:
  - .1 For each 600, 480 and applicable 208 volt panel boards, one Arc-Flash label to be provided.
  - .2 For each motor control centre, one Arc-Flash label to be provided.
  - .3 For each low voltage switchboard, one Arc-Flash label to be provided.
  - .4 For each switchgear, one flash label to be provided.
  - .5 For medium voltage switches one Arc-Flash label to be provided.
- .5 Labels to be field installed by the engineering service division of the equipment manufacturer under the Start-up and Acceptance Testing contract portion.
- .6 The label format shall also meet the University standards and shall be approved prior to installation.

### **3.3 ARC-FLASH TRAINING**

- .1 The equipment vendor to train personnel of the potential Arc-Flash hazards associated with working on energized equipment (minimum of 4 hours). Maintenance procedures in accordance with the requirements of NFPA 70E, Standard for Electrical Safety Requirements for Employee Workplaces, to be provided in the equipment manuals. The training to be certified for continuing education units (CEUs) by the International Association for Continuing Education Training (IACET).

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 RELATED REQUIREMENTS**

- .1 Division 01.
- .2 Electrical Specifications.
- .3 Communications Specifications.

### **1.2 REFERENCES**

- .1 Canadian Standards Association (CSA International):
  - .1 CSA C22.1-06, Canadian Electrical Code, Part 1 (20th Edition), Safety Standard for Electrical Installations.
  - .2 CAN3-C235-83(R2000), Preferred Voltage Levels for AC Systems, 0 to 50,000 V.
- .2 Electrical and Electronic Manufacturer's Association of Canada (EEMAC):
  - .1 EEMAC 2Y-1-1958, Light Gray Colour for Indoor Switchgear.
- .3 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.

### **1.3 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.

### **1.4 DESIGN REQUIREMENTS**

- .1 Operating voltages: To CAN3-C235.
- .2 Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard.
  - .1 Equipment to operate in extreme operating conditions established in above standard without damage to equipment.
- .3 Language operating requirements: Provide identification nameplates and labels for control items in English.
- .4 Use one nameplate or label for each language.

### **1.5 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submittals: In accordance with Section 01 33 00 – Submittal Procedures.
- .2 Submit for review single line electrical diagrams in glazed frames and locate as indicated.
  - .1 Electrical distribution system in main electrical room.

- .3 Submit for review fire alarm riser diagram, plan and zoning of building in glazed frames at fire alarm control panel, annunciator and at the main fire alarm panel/annunciator at Building 049.
- .4 Shop drawings:
  - .1 Submit drawings stamped and signed by professional engineer registered or licensed in the Province of Ontario, Canada.
  - .2 Submit wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure coordinated installation.
  - .3 Identify on wiring diagrams circuit terminals and indicate internal wiring for each item of equipment and interconnection between each item of equipment.
  - .4 Indicate on drawings clearances for operation, maintenance, and replacement of operating equipment devices.
  - .5 Submit two (2) of 600 x 600 mm minimum size drawings and product data to authorities having jurisdiction and inspection authorities.
  - .6 If changes are required, notify Consultant of these changes before they are made.
  - .7 The review of Contractor prepared submissions (shop drawings, reports, etc.) by the Consultant is not to be considered part of the Contractor Quality Assurance Program.
  - .8 Provide CSA certified equipment and materials.
  - .9 Where CSA certified equipment and materials are not available, submit such equipment and material to authorities having jurisdiction and inspection authorities for special approval before delivery to site.
  - .10 Submit test results of installed electrical systems and instrumentation.
  - .11 Permits and fees: In accordance with General Conditions of contract.
  - .12 Submit, upon completion of Work, load balance report as described in PART 3 – LOAD BALANCE.
  - .13 Submit certificate of acceptance from authority having jurisdiction upon completion of Work to Departmental Representative Consultant Engineer.
- .5 Manufacturer's Field Reports: submit manufacturer's written report to Consultant, within three (3) days of review, verifying compliance of Work, and electrical system, and instrumentation testing, as described in PART 3 – FIELD QUALITY CONTROL.

## 1.6 QUALITY ASSURANCE

- .1 Quality Assurance: In accordance with Section 01 45 00 – Quality Control.
- .2 Qualifications: Electrical Work to be carried out by qualified, licensed electricians who hold valid Master Electrical Contractor license or apprentices in accordance with authorities having jurisdiction as per the conditions of the Provincial Act respecting manpower vocational training and qualification.
  - .1 Employees registered in provincial apprentices program: Permitted, under direct supervision of qualified licensed electrician, to perform specific tasks.
  - .2 Permitted activities: Determined based on training level attained and demonstration of ability to perform specific duties.
  - .3 Site Meetings: as part of Manufacturer's Field Services described in Part 3 – FIELD QUALITY CONTROL, schedule site visits, to review Work, at stages listed.
    - .1 After delivery and storage of products, and when preparatory Work is complete but before installation begins.
    - .2 During progress of Work.
    - .3 Upon completion of Work, after cleaning is carried out.

## **1.7 DELIVERY, STORAGE AND HANDLING**

- .1 Material Delivery Schedule: Provide Consultant with schedule within 2 weeks after award of Contract.
- .2 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 21 – Construction/Demolition Waste Management and Disposal.

## **1.8 SYSTEM START-UP**

- .1 Instruct Consultant and operating personnel in operation, care and maintenance of systems, system equipment and components.
- .2 Arrange and pay for services of manufacturer's factory service engineer to supervise start-up of installation, check, adjust, balance and calibrate components and instruct operating personnel.
- .3 Provide these services for such period, and for as many visits as necessary to put equipment in operation, and ensure that operating personnel are conversant with aspects of its care and operation.
- .4 Provide 72 hours written notice for de-energizing, transferring and re-energizing of any and all systems. Arrange and pay for all associated costs outside normal working hours.

## **1.9 OPERATING INSTRUCTIONS**

- .1 Provide for each system and principal item of equipment as specified in technical sections for use by operation and maintenance personnel.
- .2 Operating instructions to include following:
  - .1 Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.
  - .2 Start up, proper adjustment, operating, lubrication, and shutdown procedures.
  - .3 Safety precautions.
  - .4 Procedures to be followed in event of equipment failure.
  - .5 Other items of instruction as recommended by manufacturer of each system or item of equipment.
- .3 Print or engrave operating instructions and frame under glass or in approved laminated plastic.
- .4 Post instructions where directed.
- .5 For operating instructions exposed to weather, provide weather-resistant materials or weatherproof enclosures.
- .6 Ensure operating instructions will not fade when exposed to sunlight and are secured to prevent easy removal or peeling.

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS AND EQUIPMENT**

- .1 Material and equipment to be CSA certified. Where CSA certified material and equipment are not available, obtain special approval from authority having jurisdiction before delivery to site and submit such approval as described in PART 1 - SUBMITTALS.
- .2 Factory assemble control panels and component assemblies.

### **2.2 ELECTRIC MOTORS, EQUIPMENT AND CONTROLS**

- .1 Verify installation and coordination responsibilities related to motors, equipment and controls, as indicated.
- .2 Control wiring and conduit: In accordance with Section 26 29 03 – Control Devices except for conduit, wiring and connections below 50 V which are related to control systems specified in mechanical sections and as shown on mechanical drawings.

### **2.3 WARNING SIGNS**

- .1 Warning Signs: in accordance with requirements of the authority having jurisdiction.
- .2 Porcelain enamel signs, minimum size 175 x 250 mm.

### **2.4 WIRING TERMINATIONS**

- .1 Ensure lugs, terminals, screws used for termination of wiring are suitable for either copper or aluminum conductors.

### **2.5 EQUIPMENT IDENTIFICATION**

- .1 Identify all electrical equipment supplied under this Division as per approval and to meet the standards of the University of Guelph. Hand-painted identification will not be accepted.
- .2 Identify electrical equipment with nameplates and labels to maintain the design criteria for the existing installation per University Design Standards, and as follows:
  - .1 Nameplates for normal power equipment: lamacoid 3 mm thick plastic engraving sheet, black face, white core, lettering accurately aligned and engraved into core and mechanically attached with self-tapping screws.
  - .2 Nameplates for essential power equipment: lamacoid 3 mm thick plastic engraving sheet, orange face, white core, lettering accurately aligned and engraved into core and mechanically attached with self-tapping screws.

.3 Sizes as follows:

**Nameplate Sizes**

	DIMENSIONS	# LINES	LETTER HEIGHT
(Metric)			
Size 1	10 x 50 mm	1	3 mm
Size 2	12 x 70 mm	1	5 mm
Size 3	12 x 70 mm	2	3 mm
Size 4	20 x 90 mm	1	8 mm
Size 5	20 x 90 mm	2	5 mm
Size 6	25 x 100 mm	1	12 mm
Size 7	25 x 100 mm	2	6 mm
Size 8	50 x 150 mm	1	25 mm
Size 9	75 x 150 mm	2	19 mm

- .3 Labels: Embossed plastic labels with 6 mm high letters unless specified otherwise. Secure each label with 2 self-tapping screws or tie to cables with Ty-raps.
- .4 Wording on nameplates and labels to be approved by Consultant prior to manufacture.
- .5 Allow for minimum of 25 letters per nameplate and label.
- .6 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.
- .7 Disconnects, starters and contactors: indicate equipment being controlled and voltage.
- .8 Terminal cabinets and pull boxes: indicate system and voltage.
- .9 Transformers: Indicate capacity, primary and secondary voltages.
- .10 Panel nameplates, size 7, to identify panels, as indicated, and voltage characteristics.
- .11 For distribution panels provide a nameplate, size 5, for each circuit appropriately engraved identifying equipment or panel controlled.
- .12 For branch circuit panels provide a typed directory inside door of each panel stating type of load and room location for each circuit. Supply a protective plastic envelope for directory.
- .13 Identify circuit numbers on back of receptacle and switches with wire markers.
- .14 Correct existing panel legends and nameplates to reflect changes made.
- .15 Transformer nameplates, size 7, to show capacity, primary and secondary voltages.
- .16 Nameplates, size 5, for disconnect switches, splitters and contactors to indicate equipment being controlled, voltage characteristics, ampere or horsepower kilowatt rating of equipment.
- .17 Nameplate for each manual starter to be size 1 engraved "name of equipment controlled".

- .18 Nameplate for each magnetic starter to be size 3 engraved "name of equipment controlled".
- .19 Nameplate on each remote control device to be size 1 engraved "name of equipment controlled".
- .20 Nameplates, size 5, for terminal cabinets, pull boxes and junction boxes to indicate system and/or voltage characteristics.
- .21 At underground service entrance, size 9 on outside wall stating "Underground Service Entrance".
- .22 Identify equipment with size 3 labels engraved "Asset Inventory No. ..." Number as, and if, directed by Consultant.

## 2.6 WIRING IDENTIFICATION

- .1 Identify wiring with permanent indelible identifying markings, coloured plastic tapes, 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 codes wires in communication cables, matched throughout system.

## 2.7 CONDUIT AND CABLE IDENTIFICATION

- .1 Colour code conduits, boxes, and metallic sheathed cables.
- .2 Coding to be located on all conduits and cables exposed after completion of building and in suspended removable ceilings.
- .3 Coding to be plastic tape or paint at all points where conduit or cable enters wall, ceiling, or floor, and at 15 m intervals.
- .4 Colours to be 25 mm" wide prime colour and 20 mm wide auxiliary colour.

	<b>Prime</b>	<b>Auxiliary</b>
Up to 250 V	Yellow	
Up to 600 V	Yellow	Green
Up to 5 kV	Yellow	Blue
Up to 15 kV	Yellow	Red
Fire Alarm	Red	

## **2.8 FINISHES**

- .1 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two coats of finish enamel.
  - .1 Paint outdoor electrical equipment "equipment green" finish.
  - .2 Paint indoor switchgear and distribution enclosures light grey.
  - .3 All electrical equipment/panels indicated as fed from back-up power to be factory painted Omaha orange.
- .2 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.
- .3 Clean and prime exposed non-galvanized hangers, racks and fastenings.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- .1 Do complete installation in accordance with CSA C22.1 except where specified otherwise.
- .2 Do overhead and underground systems in accordance with CSA C22.3 No.1 except where specified otherwise.

### **3.2 NAMEPLATES AND LABELS**

- .1 Ensure manufacturer's nameplates, CSA labels and identification nameplates are visible and legible after equipment is installed.

### **3.3 CONDUIT AND CABLE INSTALLATION**

- .1 Install conduit and sleeves prior to pouring of concrete.
- .2 Sleeves through concrete: schedule 40 steel pipe sized for free passage of conduit, and protruding 50 mm.
- .3 If plastic sleeves are used in fire rated walls or floors, remove before conduit installation.
- .4 Install cables, conduits and fittings embedded or plastered over, close to building structure so furring can be kept to minimum.
- .5 Holes through exterior walls and roof to be flashed and made waterproof. Seal inside the conduit with suitable compound to prevent entry of water through conduit.
- .6 Provide all cutting of chases, drilling holes and other structural work required to install electrical conduits, cables, pull boxes and outlet boxes.

### 3.4 LOCATION OF OUTLETS

- .1 Locate outlets in accordance with Section 26 05 32 – Outlet Boxes, Conduit Boxes and Fittings.
- .2 Do not install outlets back-to-back in wall; allow minimum 150 mm horizontal clearance between boxes.
- .3 Change location of outlets at no extra cost or credit, providing distance does not exceed 3000 mm, and information is given before installation.
- .4 Locate light switches on latch side of doors.
  - .1 Locate disconnect devices in mechanical and elevator machine rooms on latch side of floor.
- .5 Make all necessary adjustments when interior finish is completed.
- .6 In acoustic tile and inverted "T" bar ceilings locate equipment in centre of tile or on "T" bar. Obtain location ruling from Consultant.

### 3.5 MOUNTING HEIGHTS

- .1 Mounting height of equipment is from finished floor to centreline of equipment unless specified or indicated otherwise.
- .2 If mounting height of equipment is not specified or indicated, verify before proceeding with installation.
- .3 Install electrical equipment at following heights unless indicated otherwise.
  - .1 Local switches: 1100 mm.
  - .2 Wall receptacles:
    - .1 General: 400 mm.
    - .2 Above top of continuous baseboard heater: 200 mm.
    - .3 Above top of counters or counter splash backs: 175 mm.
    - .4 In mechanical rooms: 1400 mm.
  - .3 Panel boards: as required by Code or as indicated.
  - .4 Fire alarm stations: 1200 mm.
  - .5 Fire alarm bells: 2100 mm.
  - .6 Television outlets: 1525 mm.
  - .7 Clocks: 2100 mm.

### 3.6 COORDINATION OF PROTECTIVE DEVICES

- .1 Ensure circuit protective devices such as overcurrent trips, relays and fuses are installed to required values and settings.

### 3.7 FIELD QUALITY CONTROL

- .1 Load Balance:
  - .1 Measure phase current to panel boards with normal loads (lighting) operating at time of acceptance; adjust branch circuit connections as required to obtain best balance of current between phases and record changes.
  - .2 Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment.
  - .3 Provide upon completion of work, load balance report as directed in PART 1 – SUBMITTALS: phase and neutral currents on panel boards, dry-core transformers and motor control centres, operating under normal load, as well as hour and date on which each load was measured, and voltage at time of test.
- .2 Conduct following tests in accordance with Section 01 45 00 – Quality Control.
  - .1 Power distribution system, including phasing, voltage, grounding and load balancing.
  - .2 Circuits originating from branch distribution panels.
  - .3 Lighting and its control.
  - .4 Motors, heaters and associated control equipment, including sequenced operation of systems where applicable.
  - .5 Systems: fire alarm system communications.
  - .6 Insulation resistance testing:
    - .1 Megger circuits, feeders and equipment up to 350 V with a 500 V instrument.
    - .2 Megger 350-600 V circuits, feeders and equipment with a 1000 V instrument.
    - .3 Check resistance to ground before energizing.
- .3 Carry out tests in presence of Consultant.
- .4 Provide instruments, metres, equipment and personnel required to conduct tests during and at conclusion of project.
- .5 Manufacturer's Field Services:
  - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.
  - .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, as directed in PART 1 - QUALITY ASSURANCE.

### 3.8 CLEANING

- .1 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.
- .2 Clean and prime exposed non-galvanized hangers, racks, and fastenings to prevent rusting.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 REFERENCES**

- .1 CSA International:
  - .1 CAN/CSA-C22.2 No.18-98(R2003), Outlet Boxes, Conduit Boxes and Fittings.
  - .2 CAN/CSA-C22.2 No.65-03(R2008), Wire Connectors (Tri-National Standard with UL 486A-486B and NMX-J-543-ANCE-03).
- .2 Electrical and Electronic Manufacturers' Association of Canada (EEMAC):
  - .1 EEMAC 1Y-2-1961, Bushing Stud Connectors and Aluminum Adapters (1200 ampere Maximum Rating).
- .3 National Electrical Manufacturers Association (NEMA).

### **1.2 CLOSEOUT SUBMITTALS**

- .1 Submit in accordance with Section 01 78 00 – Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for wire and box connectors for incorporation into manual.

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS**

- .1 Pressure type wire connectors to: CAN/CSA-C22.2 No.65, with current carrying parts sized to fit copper or aluminum conductors as required.
- .2 Fixture type splicing connectors to: CAN/CSA-C22.2 No. 65, with current carrying parts copper conductors 10 AWG or less.
- .3 Bushing stud connectors: to NEMA to consist of:
  - .1 Connector body and stud clamp for stranded round copper conductors or bus bar.
  - .2 Clamp for stranded round copper conductors.
  - .3 Stud clamp bolts.
  - .4 Bolts for copper conductors.
  - .5 Sized for conductors as indicated.
- .4 Clamps or connectors for armoured cable, TECK cable, mineral insulated cable, flexible metallic conduit as required to: CAN/CSA-C22.2 No.18.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- .1 Verification of Conditions: Verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for wire and box connector installation in accordance with manufacturer's written instructions.
  - .1 Visually inspect substrate in presence of Consultant.
  - .2 Inform Consultant of unacceptable conditions immediately upon discovery.
  - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Consultant.

#### **3.2 INSTALLATION**

- .1 Remove insulation carefully from ends of conductors and cables and:
  - .1 Apply coat of zinc joint compound on aluminum conductors prior to installation of connectors.
  - .2 Install mechanical pressure-type connectors and tighten screws with appropriate compression tool recommended by manufacturer. Installation shall meet secureness tests in accordance with CAN/CSA-C22.2 No. 65.
  - .3 Install fixture type connectors and tighten to CAN/CSA-C22.2 No. 65. Replace insulating cap.
  - .4 Install bushing stud connectors in accordance with EEMAC 1Y-2.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 REFERENCES**

- .1 Refer to Section 26 05 00 – Common Work Results for Electrical.

### **1.2 PRODUCT DATA**

- .1 Provide product data in accordance with Section 01 33 00 – Submittal Procedures.

### **1.3 DELIVERY, STORAGE AND HANDLING**

- .1 Packaging Waste Management: Remove for reuse and return of pallets, crates, padding, and packaging materials.

## **PART 2 - PRODUCTS**

### **2.1 BUILDING WIRES**

- .1 Conductors: Stranded for 10 AWG and larger. Minimum size: 12 AWG.
- .2 Copper conductors: size as indicated, with 600 V insulation of cross-linked thermosetting polyethylene material rated RW90 XLPE or RWU90 XLPE in underground installations..

### **2.2 ARMOURED CABLES**

- .1 Conductors: insulated, copper, size as indicated.
- .2 Type: AC90, RW90 XLPE – minimum size: 12 AWG.
- .3 Armour: interlocking type fabricated from aluminum strip.
- .4 Jacket Type: None.
- .5 Connectors: anti-short connectors.

### **2.3 CONTROL CABLES**

- .1 Type: LVT: 2 soft annealed copper conductors, sized as indicated:
  - .1 Insulation: thermoplastic.
  - .2 Sheath: thermoplastic jacket.
- .2 Type: low energy 300 V control cable: stranded annealed copper conductors sized as indicated LVT: 2 soft annealed copper conductors, sized as indicated:
  - .1 Insulation: TWH.
  - .2 Shielding: tape coated with paramagnetic over each conductor pair.
  - .3 Overall covering: PVC jackets.

## **PART 3 - EXECUTION**

### **3.1 FIELD QUALITY CONTROL**

- .1 Perform tests in accordance with Section 26 05 00 Common Work Results for Electrical.
- .2 Perform tests using method appropriate to site conditions and to approval Consultant and local authority having jurisdiction over installation.
- .3 Perform tests before energizing electrical system.

### **3.2 GENERAL CABLE INSTALLATION**

- .1 Terminate cables in accordance with Section 26 05 20 – Wire and Box Connectors - (0-1000 V).
- .2 Cable Colour Coding: to Section 26 05 00 – Common Work Results for Electrical.
- .3 Conductor length for parallel feeders to be identical.
- .4 Lace or clip groups of feeder cables at distribution centres, pull boxes, and termination points.
- .5 Wiring in walls: typically drop or loop vertically from above to better facilitate future renovations. Generally wiring from below and horizontal wiring in walls to be avoided unless indicated.
- .6 Branch circuit wiring for surge suppression receptacles and permanently wired computer and electronic equipment to be 2-wire circuits only, i.e., common neutrals not permitted.
- .7 Provide numbered wire collars for control wiring. Numbers to correspond to control shop drawing legend. Obtain wiring diagram for control wiring.

### **3.3 INSTALLATION OF BUILDING WIRES**

- .1 Install wiring as follows:
  - .1 In conduit systems in accordance with Section 26 05 34 – Conduits, Conduit Fastenings and Conduit Fittings.
  - .2 In underground ducts in accordance with Section 33.
  - .3 In surface and lighting fixture raceways in accordance with Section 26.

### **3.4 INSTALLATION OF ARMOURED CABLES**

- .1 Group cables wherever possible on channels.

### **3.5 INSTALLATION OF CONTROL CABLES**

- .1 Install control cables in conduit.
- .2 Ground control cable shield.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 REFERENCES**

- .1 American National Standards Institute /Institute of Electrical and Electronics Engineers (ANSI/IEEE ):
  - .1 ANSI/IEEE 837-02, IEEE Standard for Qualifying Permanent Connections Used in Substation Grounding.
- .2 CSA International:
  - .1 CSA Z32-09, Electrical Safety and Essential Electrical Systems in Health Care Facilities.

### **1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for grounding equipment and include product characteristics, performance criteria, physical size, finish and limitations.

### **1.3 CLOSEOUT SUBMITTALS**

- .1 Submit in accordance with Section 01 78 00 – Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for grounding equipment for incorporation into manual.

### **1.4 RELATED REQUIREMENTS**

- .1 Section 27 05 26 – Grounding & Bonding for Communications Systems.

## **PART 2 - PRODUCTS**

### **2.1 EQUIPMENT**

- .1 Clamps for grounding of conductor: size as required to electrically conductive underground water pipe.
- .2 Copper conductor: minimum 6 m long for each concrete-encased electrode, bare, stranded, tinned, soft annealed, size as required.
- .3 Rod electrodes: copper clad steel 19 mm diameter by minimum 3 m long.
- .4 Grounding conductors: bare stranded copper, soft annealed, size as required by applicable codes.
- .5 Insulated grounding conductors: green, copper conductors, size as required by applicable codes.
- .6 Ground bus: copper, size as required, complete with insulated supports, fastenings, connectors.

- .7 Non-corroding accessories necessary for grounding system, type, size, material as indicated, including but not necessarily limited to:
  - .1 Grounding and bonding bushings.
  - .2 Protective-type clamps.
  - .3 Bolted-type conductor connectors.
  - .4 Thermit welded-type conductor connectors.
  - .5 Bonding jumpers, straps.
  - .6 Pressure wire connectors.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other sections or contracts are acceptable for grounding equipment installation in accordance with manufacturer's written instructions:
  - .1 Visually inspect substrate in presence of Consultant.
  - .2 Inform Consultant of unacceptable conditions immediately upon discovery.
  - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Consultant.

#### **3.2 INSTALLATION GENERAL**

- .1 Install complete permanent, continuous grounding system, including electrodes, conductors, connectors, accessories. Where EMT is used, run ground wire in conduit.
- .2 Install connectors in accordance with manufacturer's instructions.
- .3 Protect exposed grounding conductors from mechanical injury.
- .4 Make buried connections, and connections to conductive water main, electrodes, using copper welding by Thermit process permanent mechanical connectors or inspectable wrought copper compression connectors to ANSI/IEEE 837.
- .5 Use mechanical connectors for grounding connections to equipment provided with lugs.
- .6 Soldered joints not permitted.
- .7 Install bonding wire for flexible conduit, connected at both one ends to grounding bushing, solderless lug, clamp or cup washer and screw. Neatly cleat bonding wire to exterior of flexible conduit.
- .8 Install separate ground conductor to outdoor lighting standards.
- .9 Connect building structural steel and metal siding to ground.
- .10 Make grounding connections in radial configuration only, with connections terminating at single grounding point. Avoid loop connections.
- .11 Bond single-conductor, metallic armoured cables to cabinet at supply end.
- .12 Ground secondary service pedestals.

- .13 Provide grounding and bonding for systems as per Section 27 05 26 – Grounding & Bonding for Communications Systems. Coordinate requirements as per communications drawings.

### **3.3 MAINTENANCE HOLES**

- .1 Install conveniently located grounding stud, electrode, size to suit stranded copper conductor in each maintenance hole.
- .2 Install ground rod in each maintenance hole so that top projects through bottom of maintenance hole. Provide with lug to which grounding connection can be made. Confirm ground resistance meets or exceeds Canadian Electrical Code minimum requirements.

### **3.4 ELECTRODES**

- .1 Make ground connections to continuously conductive underground water pipe on street side of water meter.
- .2 Install water meter shunt.
- .3 Install concrete encased electrodes in building foundation footings, with terminal connected to grounding network.
- .4 Install rod electrodes and make grounding connections.
- .5 Bond separate, multiple electrodes together.
- .6 Use size 4/0 AWG copper conductors for connections to electrodes.

### **3.5 SYSTEM AND CIRCUIT GROUNDING**

- .1 Install system and circuit grounding connections to neutral of primary system if required in addition to secondary 120/208V system.

### **3.6 EQUIPMENT GROUNDING**

- .1 Install grounding connections to typical equipment included in, but not necessarily limited to, the following list: service equipment, transformers, switchgear, duct systems, frames of motors, motor control centres, starters, control panels, building steel work, generators, elevators and escalators, distribution panels, outdoor lighting, cable trays.

### **3.7 GROUNDING BUS**

- .1 Install copper grounding bus mounted on insulated supports on wall of electrical room and communication equipment room.
- .2 Ground items of existing and new electrical equipment in electrical room and IT equipment in communication equipment room to ground bus with individual bare stranded copper connections size 2/0 AWG.

### **3.8 COMMUNICATION SYSTEMS**

- .1 Install grounding connections for telephone, sound, fire alarm, security systems, intercommunication systems as follows:
  - .1 Telephones: Make telephone grounding system in accordance with telephone company's requirements.
  - .2 Sound, fire alarm, security systems, intercommunication systems as indicated.

### **3.9 FIELD QUALITY CONTROL**

- .1 Perform tests in accordance with Section 26 05 00 – Common Work Results for Electrical.
- .2 Perform ground continuity and resistance tests using method appropriate to site conditions and to approval of Consultant and local authority having jurisdiction over installation.
- .3 Perform tests before energizing electrical system.
- .4 Disconnect ground fault indicator during tests.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 REATED REQUIREMENTS**

- .1 Section 26 05 00 – Common Work Results for Electrical.

### **1.2 REATED REQUIREMENTS**

- .1 Remove from site and dispose of all packaging materials at appropriate recycling facilities.
- .2 Collect and separate for disposal paper, plastic, polystyrene and corrugated cardboard packaging materials in appropriate on-site bins for recycling in accordance with Waste Management Plan.
- .3 Divert unused metal materials from landfill to metal recycling facility ad approved by Consultant.
- .4 Fold up metal banding, flatten, and place in designated area for recycling.

## **PART 2 - PRODUCTS**

### **2.1 SUPPORT CHANNELS**

- .1 U-shape, size 41 x 41 mm, 2.5 mm thick, surface mounted or suspended.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- .1 Secure equipment to masonry, tile and plaster surfaces with approved anchors.
- .2 Secure equipment to poured concrete with expandable inserts.
- .3 Secure surface-mounted equipment with twist-clip fasteners to inverted T-bar ceilings. Ensure that T-bars are adequately supported to carry weight of equipment specified before installation.
- .4 Support equipment, conduit or cables using clips, spring-loaded bolts, cable clamps designed as accessories to basic channel members.
- .5 Fasten exposed conduit or cables to building construction or support system using straps:
  - .1 One-hole malleable iron straps to secure surface conduits and cables 50 mm and smaller.
  - .2 Two-hole steel straps for conduits and cables larger than 50 mm.
  - .3 Beam clamps to secure conduit to exposed steel work.
- .6 Suspended support systems:
  - .1 Support individual cable or conduit runs with 6 mm diameter threaded rods and spring clips.
  - .2 Support two or more cables or conduits on channels supported by 6 mm diameter threaded rod hangers where direct fastening to building construction is impractical.

- .7 For surface mounting of two (2) or more conduits use channels at 1.5 m on centre spacing.
- .8 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.
- .9 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.
- .10 Do not use wire lashing or perforated strap to support or secure raceways or cables.
- .11 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of Consultant.
- .12 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 REFERENCES**

- .1 Canadian Standards Association (CSA International):
  - .1 CSA C22.1-06, Canadian Electrical Code, Part 1, 20th Edition.

### **1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product Data:
  - .1 Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Provide shop drawings: in accordance with Section 01 33 00 – Submittal Procedures:
  - .1 Provide drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.

## **PART 2 - PRODUCTS**

### **2.1 SPLITTERS**

- .1 Construction: sheet metal enclosure, welded corners and formed hinged cover suitable for locking in closed position.
- .2 Terminations: main and branch lugs to match required size and number of incoming and outgoing conductors as indicated.
- .3 Spare Terminals: minimum three (3) spare terminals or lugs on each connection or lug block sized less than 400 A.

### **2.2 JUNCTION AND PULL BOXES**

- .1 Construction: welded steel enclosure.
- .2 Covers Flush Mounted: 25 mm minimum extension all around.
- .3 Covers Surface Mounted: screw-on flat covers.

### **2.3 CABINETS**

- .1 Construction: welded sheet steel hinged door, handle, latch, lock, two (2) keys and catch.
- .2 Type E Empty: surface mounting as indicated.
- .3 Type T Terminal: surface mounting containing 19 mm fir plywood backboard.

### **PART 3 - EXECUTION**

#### **3.1 SPLITTER INSTALLATION**

- .1 Mount plumb, true and square to building lines.
- .2 Extend splitters full length of equipment arrangement except where indicated otherwise.

#### **3.2 JUNCTION, PULL BOXES AND CABINETS INSTALLATION**

- .1 Install pull boxes in inconspicuous but accessible locations.
- .2 Mount cabinets with top not higher than 2 m above finished floor except where indicated otherwise.
- .3 Install terminal block as indicated in Type T cabinets.
- .4 Only main junction and pull boxes are indicated. Install additional pull boxes as required by CSA C22.1.

#### **3.3 IDENTIFICATION**

- .1 Equipment Identification: Refer to Section 26 05 00 – Common Work Results for Electrical.
- .2 Identification Labels: Size 2 indicating system name, voltage and phase or as indicated.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 REFERENCES**

- .1 Canadian Standards Association (CSA International):
  - .1 CSA C22.1-06, Canadian Electrical Code, Part 1, 20<sup>th</sup> Edition.

### **1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Submit samples for floor box in accordance with Section 01 33 00 – Submittal Procedures.

## **PART 2 - PRODUCTS**

### **2.1 OUTLET AND CONDUIT BOXES GENERAL**

- .1 Size boxes in accordance with CSA C22.1.
- .2 102 mm square or larger outlet boxes as required.
- .3 Gang boxes where wiring devices are grouped.
- .4 Blank cover plates for boxes without wiring devices.
- .5 347 V outlet boxes for 347 V switching devices.
- .6 Combination boxes with barriers where outlets for more than one system are grouped.
- .7 All fittings used to be manufactured as accessories to the associated raceway and of consistent material, i.e., PVC where PVC conduit is used.

### **2.2 GALVANIZED STEEL OUTLET BOXES**

- .1 One-piece electro-galvanized construction.
- .2 Single and multi-gang flush device boxes for flush installation, minimum size 76 x 50 x 38 mm or as indicated. 102 mm square outlet boxes when more than one conduit enters one side with extension and plaster rings as required.
- .3 Utility boxes for outlets connected to surface-mounted EMT conduit, minimum size: 102 x 54 x 48 mm.
- .4 102 mm square or octagonal outlet boxes for lighting fixture outlets.
- .5 Extension and plaster rings for flush mounting devices in finished plaster tile walls.

## **2.3 MASONRY BOXES**

- .1 Electro-galvanized steel masonry single and multi-gang boxes for devices flush mounted in exposed block walls.

## **2.4 CONCRETE BOXES**

- .1 Electro-galvanized sheet steel concrete type boxes for flush mount in concrete with matching extension and plaster rings as required.

## **2.5 FLOOR BOXES**

- .1 Concrete tight, electro-galvanized sheet steel floor boxes with adjustable finishing rings to suit floor finish with brass faceplate. Device mounting plate to accommodate short or long ear duplex receptacles. Minimum depth: 73 mm for receptacles. Floor boxes to be Thomas & Betts 665-C1 Series.
- .2 Adjustable, watertight, concrete tight, cast floor boxes with openings drilled and tapped for 21 and 27 mm conduit. Minimum size: 73 mm deep.

## **2.6 POKE-THROUGH FLOOR OUTLETS**

- .1 Fire rated poke-through floor boxes to be Thomas & Betts RPT6 Series.

## **2.7 CONDUIT BOXES**

- .1 Cast FS or FD aluminum boxes with factory-threaded hubs and mounting feet for surface wiring of devices.

## **2.8 FITTINGS - GENERAL**

- .1 Bushing and connectors with nylon insulated throats.
- .2 Knock-out fillers to prevent entry of debris.
- .3 Conduit outlet bodies for conduit up to 35 mm and pull boxes for larger conduits.
- .4 Double locknuts and insulated bushings on sheet metal boxes.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- .1 Support boxes independently of connecting conduits.
- .2 Fill boxes with paper, sponges or foam or similar approved material to prevent entry of debris during construction. Remove upon completion of work.

- .3 For flush installations mount outlets flush with finished wall using plaster rings to permit wall finish to come within 6 mm of opening.
- .4 Provide correct size of openings in boxes for conduit, mineral-insulated and armoured cable connections. Do not install reducing washers.
- .5 Vacuum clean interior of outlet boxes before installation of wiring devices.
- .6 Identify systems for outlet boxes as required.
- .7 Back to back outlet boxes to be 600 mm apart.
- .8 Outlet boxes to be at same height from finished floor level as adjacent electrical duplex receptacles except for television outlets, which are to be placed at 1525 mm above finished floor level, unless otherwise indicated.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 RELATED REQUIREMENTS**

- .1 Section 26 05 00 – Common Work Results for Electrical.
- .2 Section 27 05 28 – Pathways for Communications.

### **1.2 REFERENCES**

- .1 Canadian Standards Association (CSA International):
  - .1 CAN/CSA C22.2 No. 18-98(R2003), Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware, A National Standard of Canada.
  - .2 CSA C22.2 No. 45-M1981 (R2003), Rigid Metal Conduit.
  - .3 CSA C22.2 No. 56-04, Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
  - .4 CSA C22.2 No. 83-M1985 (R2003), Electrical Metallic Tubing.
  - .5 CSA C22.2 No. 211.2-M1984 (R2003), Rigid PVC (Unplasticized) Conduit.
  - .6 CAN/CSA C22.2 No. 227.3-05, Non-metallic Mechanical Protection Tubing (NMPT), A National Standard of Canada (February 2006).

### **1.3 ABBREVIATIONS**

- .1 "RC" means rigid heavy-wall galvanized steel.
- .2 "ERC" means zinc electro-galvanized.
- .3 "EMT" means electrical metallic tubing.
- .4 "PVC" means rigid PVC conduit.
- .5 "FC" means flexible conduit.
- .6 "FLC" means flexible liquid tight conduit.

### **1.4 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product data: Submit manufacturer's printed product literature, specifications and datasheets:
  - .1 Submit cable manufacturing data.
- .3 Quality assurance submittals:
  - .1 Test reports: Submit certified test reports.
  - .2 Certificates: Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
  - .3 Instructions: Submit manufacturer's installation instructions.

## **PART 2 - PRODUCTS**

### **2.1 CABLES AND REELS**

- .1 Provide cables on reels or coils:
  - .1 Mark or tag each cable and outside of each reel or coil, to indicate cable length, voltage rating, conductor size, and manufacturer's lot number and reel number.
- .2 Each coil or reel of cable to contain only one continuous cable without splices.
- .3 Identify cables for exclusively dc applications.
- .4 Reel and mark shielded cables rated 2,001 volts and above.

### **2.2 CONDUIT**

- .1 Rigid-metal conduit: to CSA C22.2 No. 45, galvanized steel.
- .2 Epoxy-coated conduit: to CSA C22.2 No. 45, with zinc coating and corrosion resistant epoxy finish inside and outside.
- .3 Electrical metallic tubing (EMT): to CSA C22.2 No. 83, with couplings.
- .4 Rigid PVC conduit: to CSA C22.2 No. 211.2.
- .5 Flexible metal conduit: to CSA C22.2 No. 56, liquid-tight flexible metal.

### **2.3 CONDUIT FASTENINGS**

- .1 One-hole malleable iron straps to secure surface conduits 50 mm and smaller.
  - .1 Two-hole steel straps for conduits larger than 50 mm.
- .2 Beam clamps to secure conduits to exposed steel work.
- .3 Channel type supports for two or more conduits at 1.5 m on centre.
- .4 Threaded rods, 6 mm diameter, to support suspended channels.

### **2.4 CONDUIT FITTINGS**

- .1 Fittings: to CAN/CSA C22.2 No. 18, manufactured for use with conduit specified. Coating: same as conduit.
- .2 Ensure factory "ells" where 90 degree bends for 25 mm and larger conduits.
- .3 Watertight connectors and couplings shall be used for outdoor applications, in raised floor application, indoor applications where environment requires specific application.
- .4 Set screws shall be used for indoor EMT applications.
  - .1 Cast fittings are not acceptable.

## **2.5 EXPANSION FITTINGS FOR RIGID CONDUIT**

- .1 Weatherproof expansion fittings with internal bonding assembly suitable for 100 mm linear expansion.
- .2 Watertight expansion fittings with integral bonding jumper suitable for linear expansion and 19 mm deflection.
- .3 Weatherproof expansion fittings for linear expansion at entry to panel.

## **2.6 FISH CORD**

- .1 Polypropylene.

## **PART 3 - EXECUTION**

### **3.1 MANUFACTURER'S INSTRUCTIONS**

- .1 Compliance: Comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.

### **3.2 INSTALLATION**

- .1 Drawings do not show all conduits. Those shown are in diagrammatic form only. Install conduits to conserve headroom in exposed locations and cause minimum interference in the spaces through which they pass.
- .2 Conceal conduits except in mechanical and electrical service rooms and in unfinished areas.
- .3 Use rigid galvanized steel threaded conduit where specified or subject to mechanical injury.
- .4 Use electrical metallic tubing (EMT) except in cast concrete, and where not subject to mechanical injury.
- .5 Use rigid PVC conduit underground.
- .6 Use liquid-tight flexible metal conduit for connection to motors or vibrating equipment in damp, wet or corrosive locations, and Connections to kitchen equipment.
- .7 Use explosion proof, flexible connection for connection to explosion proof motors.
- .8 Install conduit sealing fittings in hazardous areas.
  - .1 Fill with compound.
- .9 Minimum conduit size for lighting and power circuits: 19 mm.
- .10 Bend conduit cold:
  - .1 Replace conduit if kinked or flattened more than 1/10th of its original diameter.
- .11 Mechanically bend steel conduit over 19 mm diameter.

- .12 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.
- .13 Install fish cord in empty conduits.
- .14 Run 2-25 mm spare conduits up to ceiling space and 2-25 mm spare conduits down to ceiling space from each flush panel.
  - .1 Terminate these conduits in 152 x 152 x 102 mm junction boxes in ceiling space or in case of an exposed concrete slab, terminate each conduit in flush concrete type box.
- .15 Remove and replace blocked conduit sections.
  - .1 Do not use liquids to clean out conduits.
- .16 Dry conduits out before installing wire.

### **3.3 SURFACE CONDUIT**

- .1 Run parallel or perpendicular to building lines.
- .2 Locate conduits behind infrared or gas-fired heaters with 1.5 m clearance.
- .3 Run conduits in flanged portion of structural steel.
- .4 Group conduits wherever possible on suspended channels.
- .5 Do not pass conduits through structural members, except as indicated.
- .6 Do not locate conduits less than 75 mm parallel to steam or hot water lines with minimum of 25 mm at crossovers.

### **3.4 CONCEALED CONDUIT**

- .1 Run parallel or perpendicular to building lines.
- .2 Do not install horizontal runs in masonry walls.
- .3 Do not install conduits in terrazzo or concrete toppings.

### **3.5 CLEANING**

- .1 On completion and verification of performance of installation, remove surplus materials, rubbish, tools, and equipment.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 SUMMARY**

- .1 Section includes:
  - .1 Materials and installation for line and/or low voltage control system designed to provide remote switching of lighting loads by use of:
    - .1 Line voltage manual on / off / 0-10v dimmer c/w built-in vacancy sensor wall switches.
    - .2 Line voltage manual on/off c/w built-in vacancy sensor wall switches.
    - .3 Low voltage digital manual on / off / 0-10v digital dimming wall switches.
    - .4 Low voltage digital manual on / off / 0-10v digital tunable white wall switches.
    - .5 Low voltage manual on / off / 0-10v digital scene control wall switches.
    - .6 ON / OFF / 0-10v digital dimming enhanced room controllers.
    - .7 Emergency lighting control device /unit.
    - .8 Low voltage wall mounted lighting control sensors (Type A and/or Type B).
    - .9 Low voltage ceiling mounted lighting control sensors (Type C and/or Type D).
    - .10 Line voltage ceiling mounted lighting control sensors (Type F).

### **1.2 REFERENCES**

- .1 Health Canada/Workplace Hazardous Materials Information System (WHMIS):
  - .1 Material Safety Data Sheets (MSDS).

### **1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.
  - .2 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 - Submittal Procedures. Indicate VOC content.
- .2 Shop Drawings:
  - .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
  - .2 Retain lighting controls manufacturer to produce and provide detailed wiring diagrams for each custom lighting control system based on the lighting layout drawings E10, E11, E12, lighting controls schedules on drawings E15, E16, E17, E18 and E30.
  - .3 Detailed wiring diagrams to indicate and identify all devices required (room controllers, switches, sensors, emergency relays), wiring for 120v, 0-10v dimming, 0-10v colour tuning, Cat5e cables connection points, from supply circuit(s) to control devices and luminaire fixture / drivers.
  - .4 Each diagram to be submitted as part of the lighting control shop drawing package and to be included in operation and maintenance manuals.

- .3 Closeout Submittals:
  - .1 Submit maintenance data in accordance with Section 01 78 00 - Closeout Submittals.
- .4 Quality Assurance Submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
  - .1 Contractor to retain the services of the manufacturer's authorized service representative to inspect components, assemble and equipment installation, including connectors and to assist in all testing, programming and commissioning of each system. Notify engineer and manufacturers factory authorized representative minimum three (3) weeks prior to system start-up, testing and commissioning.
  - .2 Manufacturer's service representative shall perform inspections and reports for verification of class 1 and class 2 wiring, verify complete task programming for all switches, dimmers time clocks, sensors and room controllers. Verify that the control of each room/area complies with the sequence of operation, various lighting control of each room/space, and/or various scene control of each room/space.
  - .3 Correct any system issues and retest systems to meet the room/area control requirements.
  - .4 Provide written report in table format for each room/space that has manufactures lighting control installed indicating, date if test / inspection, quantity and type of devices installed and device settings for each room/area.
  - .5 Locate and install equipment in accordance with manufacturer's recommendations and as indicated.
  - .6 Test reports:
    - .1 Submit certified test reports indicating compliance with specifications for specified performance characteristics and physical properties.
  - .7 Certificates: Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
  - .8 Manufacturer's Instructions: submit manufacturer's installation instructions.
  - .9 Manufacturer's Field Reports: manufacturer's field reports specified
  - .10 Lighting control system by one manufacturer throughout the project.
  - .11 Cover plates from one manufacturer throughout the project.

## **PART 2 - PRODUCTS**

### **2.1 PRODUCT REQUIREMENTS**

- .1 Materials and products in accordance with Section 01 61 00 – Common Product Requirements.

### **2.2 MATERIALS**

- .1 Control system: By one manufacturer and assembled from compatible components.

### **2.3 LINE VOLTAGE MANUAL ON / OFF / 0-10V DIMMER C/W BUILT-IN VACANCY SENSOR WALL SWITCHES**

- .1 Duel technology 0-10v dimming wall switch vacancy sensor.
- .2 Factory default to Manual ON, Auto OFF.
- .3 Operating voltage: 120/277Vac, 50/60Hz.
- .4 Field adjustable time delay settings for Auto OFF 3, 5, 15 30 minutes. Time delay to be set at 5 minutes. Additional DIP switch setting built-in to allow user to field adjust additional features such as sensing technology, fade rate, visual or audio alerts.
- .5 Vandal resistant colour matched low profile PIR lens.
- .6 Duel sensor coverage Passive infrared (PIR) and Ultrasonic:
  - .1 Major motion PIR 10.6m x 9.1m, Ultrasonic 6.1m x 6.1m
  - .2 Minor motion PIR 6.1m x 4.5m, Ultrasonic 4.5m x 4.5m
- .7 Coloured pre-stripped leads.
- .8 ON / OFF , UP / DOWN dimmer buttons.
- .9 CUL listed.
- .10 Manufacture to provide minimum five (5) year warranty on product within the installation unless otherwise noted, and consisting of a one (1) to one (1) device replacement.
- .11 WattStopper Model # DW-311-W colour white.

### **2.4 LINE VOLTAGE ON/OFF C/W BUILT-IN VACANCY SENSOR WALL SWITCHES**

- .1 Duel technology ON / OFF wall switch vacancy sensor.
- .2 Factory default to Manual ON, Auto OFF.
- .3 Operating voltage: 120/277Vac, 50/60Hz.
- .4 Dimming control signal 0-10 Volt, sinks up to 50mA for control of compatible ballast, Class 1 wiring.
- .5 Field adjustable time delay settings for Auto OFF at 5, 15 30 minutes. Time delay to be set at 5 minutes. Additional DIP switch setting built-in to allow user to field adjust additional features such as sensing technology, visual or audio alerts.
- .6 Vandal resistant colour matched low profile PIR lens.
- .7 Duel sensor coverage Passive infrared (PIR) and Ultrasonic:
  - .1 Major motion PIR 10.6m x 9.1m, Ultrasonic 6.1m x 6.1m
  - .2 Minor motion PIR 6.1m x 4.5m, Ultrasonic 4.5m x 4.5m

- .8 Coloured pre-stripped leads.
- .9 ON / OFF button.
- .10 CUL listed.
- .11 Manufacture to provide minimum five (5) year warranty on product within the installation unless otherwise noted, and consisting of a one (1) to one (1) device replacement.
- .12 WattStopper Model # DSW-301-W colour white.

## **2.5 LOW VOLTAGE MANUAL ON / OFF / 0-10V DIGITAL DIMMING WALL SWITCHES**

- .1 Low voltage ON / OFF / dimming switch for control of dimmable loads via a (DLM) digital lighting management room controllers.
- .2 Hidden Push to learn mode configurable button.
- .3 Operating voltage: 24Vdc, 5mA, from DLM with two (2) RJ45 ports for DLM network connections.
- .4 Control button with LED status indicators. Seven (7) LED Dimming level Indicators.
- .5 Built-in infrared (IR) transceiver.
- .6 ON / OFF , UP / DOWN one (1) buttons switch.
- .7 CUL listed.
- .8 Manufacture to provide minimum five (5) year warranty on product within the installation unless otherwise noted, and consisting of a one (1) to one (1) device replacement.
- .9 Switch to be engraved with to read "DIMMER" c/w up and down arrows.
- .10 WattStopper Model # LMDM-101-W colour white.

## **2.6 LOW VOLTAGE MANUAL ON / OFF / 0-10V DIGITAL TUNABLE WHITE WALL SWITCHES**

- .1 Low voltage ON / OFF / dimming switch for control of dimmable loads via a (DLM) digital lighting management room controllers.
- .2 Hidden Push to learn mode configurable button.
- .3 Operating voltage: 24Vdc, 5mA from DLM with two (2) RJ45 ports for DLM network connections.
- .4 Control button with LED status indicators. Seven (7) LED Dimming level Indicators.
- .5 Built-in infrared (IR) transceiver.
- .6 ON / OFF , UP / DOWN one (1) buttons switch.
- .7 CUL listed.

- .8 Manufacture to provide minimum five (5) year warranty on product within the installation unless otherwise noted, and consisting of a one (1) to one (1) device replacement.
- .9 Switch to be engraved with to read “COLOUR TUNING” c/w up and down arrows.
- .10 WattStopper Model # LMDM-101-G colour grey.

## **2.7 LOW VOLTAGE MANUAL ON / OFF / 0-10V DIGITAL SCENE CONTROL WALL SWITCHES**

- .1 Low voltage ON / OFF / dimming switch for control of dimmable loads via a (DLM) digital lighting management room controllers.
- .2 Hidden Push to learn mode configurable button.
- .3 Operating voltage: 24Vdc, 5mA from DLM with two (2) RJ45 ports for DLM network connections.
- .4 Control buttons with LED status indicators.
- .5 Built-in infrared (IR) transceiver.
- .6 Four (4) scene ON / OFF buttons, one (1) UP / DOWN dimmer buttons switch.
- .7 CUL listed.
- .8 Manufacture to provide minimum five (5) year warranty on product within the installation unless otherwise noted, and consisting of a one (1) to one (1) device replacement.
- .9 Switches to be engraved with to read “SCENE 1”, “SCENE 2”, “SCENE 3”, “SCENE 4” c/w up and down arrows engraved on dimmer button.
- .10 WattStopper Model # LMSW-105-W colour white.

## **2.8 ON / OFF / 0-10V DIGITAL DIMMING ENHANCED ROOM CONTROLLERS**

- .1 Plenum rated controller, (DLM) digital lighting management room controllers with line voltage relays and 0-10v dimming outputs for luminaire dimming and/or luminaire (CCT) correlated colour tuning.
- .2 Operating voltage: 120/277Vac, 50/60Hz, rated for 20A total load.
- .3 Built-in real time monitoring.
- .4 ON / OFF 0-10 volt room controllers: LMRC-211, One (1), LMRC-212, two (2) and LMRC-213, three (3), relay configurations c/w similar 0-10 volt dimming output.
- .5 Relays for dimming control and/or (CCT) Correlated Colour Temperature tuning.
- .6 Smart 250mA switching power supply.
- .7 Four (4) RJ45 DLM local network ports with integral strain relief.

- .8 One (1) dimming output per relay. 0-10v for control of compatible ballast and/or LED drivers. 0-10v output shall automatically open upon loss of power to room controller to assure full lighting output from controlled lighting.
- .9 Plug and go automatic configuration, Store load pre-set level and 16 scene pre-set levels for each load.
- .10 Connection to other components using (LMRJ cables) CAT5E cables with RJ-45 jacks, Line voltage and class 2 0-10v control wiring.
- .11 Mount to standard 100 x 100 x 54mm square junction box within accessible ceiling space.
- .12 CUL listed.
- .13 Manufacture to provide minimum five (5) year warranty on product within the installation unless otherwise noted, and consisting of a one (1) to one (1) device replacement.
- .14 WattStopper Model # LMRC-212 two (2) relay, LMRC-213 three (3) relay.
- .15 Contractor shall provide all necessary components outlet boxes, junction box conduit systems, wall switches, sensors, emergency control devices/units, 120vac power wiring, 0-10v control wiring and LMRJ cables for all devices to provide an acceptable controllable complete and operational lighting system.
- .16 It shall be the contractor's responsibility to make all proper adjustments to assure owner's satisfaction with each area/space lighting control system. Refer to lighting schematics on drawings for various types of connections and conditions lighting control.

## **2.9 EMERGENCY LIGHTING CONTROL DEVICE / UNIT**

- .1 Plenum rated emergency control unit that monitors a single circuit that provides normal lighting to an area/space. When normal power is present the control unit to permit other lighting control devices (e.g., switches, sensors, room controllers to control the emergency lighting fixtures with the general normal circuit lighting fixtures. Where normal power is lost the control unit will force ON the emergency lighting fixtures. Refer to lighting schematics on drawings for various types of connections and conditions of emergency lighting control.
- .2 Operating voltage: 120/277Vac, 50/60Hz, rated for 20A total load.
- .3 Maximum load: ballast 20A, incandescent 10A, and motor 1HP.
- .4 Operates as a control device or as a shunt. Compatible with wiring and controls for Digital room controllers.
- .5 Built-in Push to test button on unit to activate emergency mode for test conditions. Provides fail to on emergency lighting.
- .6 LED indication lights for emergency and normal power.
- .7 Connection to other components using (LMRJ cables) CAT5E cables with RJ-45 jacks, Line voltage and class 2 0-10v control wiring.

- .8 Threaded nipple for mounting to junction box within accessible ceiling space.
- .9 CUL listed.
- .10 Manufacture to provide minimum five (5) year warranty on product within the installation unless otherwise noted, and consisting of a one (1) to one (1) device replacement.
- .11 WattStopper Model # ELCU-200

## **2.10 LOW VOLTAGE WALL MOUNTED LIGHTING CONTROL SENSORS**

- .1 Dual technology wall mount occupancy and/or vacancy sensor with both passive infrared (PIR) and ultrasonic technology to achieve precise and energy efficient sensing for lighting loads.
- .2 Compatible with the digital lighting management (DLM) system for each area/space to be controlled.
- .3 Wall Sensors:
  - .1 Sensor shall not require any manual adjustment after initial configuration / programming of sensor to suit operation of room. Sensor to be configured /Programmed as either Type A Vacancy sensor (Manual ON via room controller and peripheral switch devices with adjustable time delay AUTO OFF) or as Type B Occupancy Sensor (Auto ON / with adjustable time delay Auto OFF).
  - .2 Sensor to be c/w Push and learn functionality for customization without the need for tools or a PC.
  - .3 Sensor detection signature processing eliminates false triggers and provides immunity to RFI and EMI interference.
  - .4 Sensor infrared (IR) Transceiver for wireless configuration and remote control.
  - .5 Sensor shall utilize both passive infrared and ultrasonic technology to detect motion.
  - .6 Sensor operating voltage: 24Vdc, 20mA from DLM with either (1) or two (2) RJ45 ports for DLM network connections as required.
  - .7 Sensor shall incorporate a Fresnel lens.
  - .8 Sensor shall be provided with a variety of mask inserts for PIR rejection to prevent false tripping.
  - .9 Dual sensor coverage Passive infrared (PIR) and Ultrasonic:
    - .1 Major motion PIR 13.7m, Ultrasonic 8.5m & 3.0m above floor mounting height.
  - .10 Sensor shall have manual controls and override switches to force manual adjustments.
  - .11 Sensor shall have time delay that can be adjusted manually from 1 to 30 minutes. Time delay to be initially set at 5 minutes unless indicated or noted otherwise.
  - .12 Sensor sensitivity shall be adjustable from 10% to 100%, 10% increments.
  - .13 Sensor shall have controls behind a cover to resist tampering. All controls shall be accessible from the front of the sensor.
  - .14 Sensor LCD display c/w pushbuttons for setting and/or adjusting sensor and system parameters.
  - .15 Sensor shall be wall mounted to flush 100mm square device outlet box suitable for sensor mounting plate.
  - .16 Sensor shall accept LMRJ cables.

- .17 Sensor shall be white in colour.
- .18 Manufacture to provide minimum five (5) year warranty on product within the installation unless otherwise noted, and consisting of a one (1) to one (1) device replacement.
- .19 CUL listed.
- .20 WattStopper Model # LMDX-100.
- .4 Refer to drawings (Type A to be set / programmed as Vacancy sensor) and (Type B to be set / programmed as Occupancy sensor).

## **2.11 LOW VOLTAGE CEILING MOUNTED LIGHTING CONTROL SENSORS**

- .1 Dual technology ceiling mount occupancy and/or vacancy sensor with both passive infrared (PIR) and ultrasonic technology to achieve precise and energy efficient sensing for lighting loads.
- .2 Compatible with the digital lighting management (DLM) system for each area/space to be controlled.
- .3 Wall Sensors:
  - .1 Sensor shall not require any manual adjustment after initial configuration / programming of sensor to suit operation of room. Sensor to be configured /Programmed as either Type C Vacancy sensor (Manual ON via room controller and peripheral switch devices with adjustable time delay AUTO OFF) or as Type D Occupancy Sensor (Auto ON / with adjustable time delay Auto OFF).
  - .2 Sensor to be c/w Push and learn functionality for customization without the need for tools or a PC.
  - .3 Sensor detection signature processing eliminates false triggers and provides immunity to RFI and EMI interference.
  - .4 Sensor infrared (IR) Transceiver for wireless configuration and remote control.
  - .5 Sensor shall utilize both passive infrared and ultrasonic technology to detect motion.
  - .6 Sensor operating voltage: 24Vdc, 20mA from DLM with either (1) or two (2) RJ45 ports for DLM network connections as required.
  - .7 Sensor shall incorporate a Fresnel lens.
  - .8 Sensor shall be provided with a variety of mask inserts for PIR rejection to prevent false tripping.
  - .9 Dual sensor coverage Passive infrared (PIR) and Ultrasonic:
    - .1 Major motion PIR 9.7m, Ultrasonic 7.6m & 3.0m above floor mounting height.
  - .10 Sensor shall have manual controls and override switches to force manual adjustments.
  - .11 Sensor shall have time delay that can be adjusted manually from 1 to 30 minutes. Time delay to be initially set at 5 minutes unless indicated or noted otherwise.
  - .12 Sensor sensitivity shall be adjustable from 10% to 100%, 10% increments.
  - .13 Sensor shall have controls behind a cover to resist tampering. All controls shall be accessible from the front of the sensor.
  - .14 Sensor LCD display c/w pushbuttons for setting and/or adjusting sensor and system parameters.
  - .15 Sensor shall be wall mounted to flush 100mm octagonal deep device outlet box suitable for sensor mounting.

- .16 Sensor shall accept LMRJ cables.
- .17 Sensor shall be white in colour.
- .18 Manufacture to provide minimum five (5) year warranty on product within the installation unless otherwise noted, and consisting of a one (1) to one (1) device replacement.
- .19 CUL listed.
- .20 WattStopper Model # LMDC-100.
- .4 Refer to drawings (Type C to be set / programmed as Vacancy sensor) and (Type D to be set / programmed as Occupancy sensor).

## **2.12 LINE VOLTAGE CEILING MOUNTED LIGHTING CONTROL SENSORS**

- .1 Dual technology line voltage ceiling mount occupancy and/or vacancy sensor with both passive infrared (PIR) and ultrasonic technology to achieve precise and energy efficient sensing for lighting loads.
- .2 Compatible with the digital lighting management (DLM) system for each area/space to be controlled.
- .3 Wall Sensors:
  - .1 Sensor shall not require any manual adjustment after initial configuration / programming of sensor to suit operation of room. Sensor to be configured /Programmed as Type F Occupancy Sensor (Auto ON / with adjustable time delay Auto OFF)
  - .2 Sensor detection signature processing eliminates false triggers and provides immunity to RFI and EMI interference.
  - .3 Sensor infrared (IR) Transceiver for wireless configuration and remote control.
  - .4 Sensor shall utilize both passive infrared and ultrasonic technology to detect motion.
  - .5 Sensor operating voltage: 120/230Vac, 50/60Hz. Uses line voltage and does not require a power pack.
  - .6 Sensor shall incorporate a Fresnel lens.
  - .7 Sensor shall be provided with a variety of mask inserts for PIR rejection to prevent false tripping.
  - .8 . Dual sensor coverage Passive infrared (PIR) and Ultrasonic:
    - .1 Major motion PIR 10.9m, Ultrasonic 10.9m & 3.0m above floor mounting height.
  - .9 Sensor shall have manual controls and override switches to force manual adjustments.
  - .10 Sensor shall have time delay that can be adjusted manually from 5, 10, 15, 20 or 30 minutes. Time delay to be initially set at 5 minutes unless indicated or noted otherwise.
  - .11 Sensor sensitivity shall be adjustable in 10% increments.
  - .12 Sensor shall have controls behind a cover to resist tampering. All controls shall be accessible from the front of the sensor.
  - .13 Sensor shall have built-in DIP switches for adjusting sensor and system parameters.
  - .14 Sensor shall be wall mounted to flush 100mm octagonal deep device outlet box suitable for sensor mounting c/w CA-1 adapter ring plate.
  - .15 Sensor shall be white in colour.

- .16 Manufacture to provide minimum five (5) year warranty on product within the installation unless otherwise noted, and consisting of a one (1) to one (1) device replacement.
- .17 CUL listed.
- .18 WattStopper Model # DT-355 c/w CA-1.
- .19 Refer to drawings (Type f to be set / programmed as Occupancy sensor).
- .20 Contractor shall provide all necessary components outlet boxes, junction box conduit systems, sensors, 120vac power wiring, lighting control relays as required to provide an acceptable controllable complete and operational lighting system.
- .21 It shall be the contractor's responsibility to make all proper adjustments to assure owner's satisfaction with each area/space lighting control system. Refer to lighting schematics on drawings for various types of connections and conditions lighting control.

### **2.13 PRETERMINATED DLM CABLES**

- .1 Contractor shall provide LMRJ segment network control cables, supplied and tested by the lighting control manufacturer with pre-terminated Cat5e green plenum rated control wiring c/w industry standard RJ-45 connectors compatible with any RJ-45 port on the manufacturer's DLM components.
- .2 Contractor to coordinate on site and determine lengths of cable(s) required to suit installation and manufactures requirements.
- .3 Non-plenum rated pre-terminated jumper cables may be used between devices to be mounted in multi-ganged device outlet boxes.

## **PART 3 - EXECUTION**

### **3.1 MANUFACTURER'S INSTRUCTIONS**

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.
- .2 Locate and install equipment in accordance with manufacturer's recommendations and as indicated.

### **3.2 INSTALLATION**

- .1 Install system in accordance with the approved system shop drawings and manufacturer's instructions.
- .2 Install all room/area devices using manufacturer's factory tested Cat5e cables with pre-terminated RJ-45 connectors.
- .3 All line voltage connectors shall be tagged to indicate circuit and switched legs.
- .4 Calibrate all sensor time delays and sensitivity of all occupancy and/or vacancy devices to guarantee proper detection of occupancy and energy savings.
- .5 Test all devices and installed systems in rooms/area's to ensure proper communication.

- .6 Provide separate dedicated neutral for any phase dimming and colour tuning branch lighting load circuit.
- .7 All class 2 cabling shall enter enclosures from within low voltage wiring areas and shall remain with those areas. No class 1 conductors shall enter a low voltage area.
- .8 All low voltage wiring to comply with manufacturer's requirements / specifications.
- .9 Verify all lighting loads to be free from short circuits prior to connection to room controllers.
- .10 All Cat5e DLM control system wiring to be routed through walls from wall mounted devices and/or in gypsum board ceilings shall be installed in min. 21mm EMT conduit systems with nylon bushing free of burrs from device to accessible ceiling space.
- .11 Locate and install equipment in accordance with manufacturer's recommendations to meet the intent of the lighting control design.
- .12 Provide all necessary components outlet boxes, junction box conduit systems, wall switches, sensors, emergency control devices/units, 120vac power wiring, plenum rated 0-10v control wiring and LMRJ cables for all devices to provide an acceptable controllable complete and operational lighting system. Non-plenum rated network cable maybe used between ganged device wall switches or where cables are routed in enclosed device boxes with conduit systems.
- .13 Aim all sensors in the correct locations to ensure complete and proper volumetric coverage within the range of the sensor coverage or controlled area as per the manufacturer's recommendations. Each room/area shall have 90% to 100% coverage to completely control the space accommodating all occupancy habits of either single or multiple user/occupants at any location within the space.
- .14 Sensors shown on the drawings are diagrammatic and indicate only the rooms which are to be provided with sensors. The contractor shall provide additional sensors if required to properly and completely cover the respective room.
- .15 Proper judgement must be exercised in executing the installation so as to ensure the best possible installation in the available space and to overcome local difficulties due to space limitation or interference of structural components.
- .16 Make all proper adjustments to assure owner's satisfaction with each area/room lighting control system. Refer to lighting schematics on drawings for various types of lighting controls for areas/rooms.
- .17 Install suitable common cover plates where wiring devices are grouped.
- .18 Do not use cover plates meant for flush outlet boxes on surface-mounted boxes.
- .19 Make all proper adjustments to assure owner's satisfaction with each area/room lighting control system. Refer to lighting schematics on drawings for various types of lighting controls for areas/rooms
- .20 Protect installed products and components from damage during construction.
- .21 Protect stainless steel cover plate finish with paper or plastic film until painting and other work is finished.
- .22 Repair damage to adjacent materials caused by wiring device installation.

### 3.3 COMMISSIONING

- .1 Contractor to retain the lighting controls manufacturer service representative / technician to perform on site all acceptance testing, system/device programming for each room/area to be controlled. Contractor to arrange and notify Building owners representative, engineer and manufacturers factory authorized representative minimum three (3) weeks prior to system start-up, testing and commissioning.
- .2 Provide to building owner's personnel, Wireless configuration tool LMCT-100 c/w all necessary training.
- .3 Contractor shall also provide at the owner's facility, the training necessary to familiarize the owner's personnel with the operation, use, adjustment, and problem solving diagnosis of the lighting control systems, wall mounted device switches, occupancy sensing devices.

### 3.4 FIELD QUALITY CONTROL

- .1 Site Tests:
  - .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
  - .2 Actuate control units in presence of Consultant to demonstrate lighting circuits are controlled as designated.
- .2 Manufacturer's Field Services:
  - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.
  - .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, as directed in PART 1 - QUALITY ASSURANCE.
- .3 Verification requirements include:
  - .1 Materials and resources.
  - .2 Storage and collection of recyclables.
  - .3 Construction waste management.
  - .4 Resource reuse.
  - .5 Recycled content.
  - .6 Local/regional materials.
  - .7 Low-emitting materials.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 RELATED REQUIREMENTS**

- .1 Section 26 05 00 – Common Work Results for Electrical.

### **1.2 REFERENCES**

- .1 CSA International:
  - .1 CAN/CSA-C22.2 No.47-M90 (R2007), Air-Cooled Transformers (Dry Type).
  - .2 CSA C9-02 (R2007), Dry-Type Transformers.
  - .3 CAN/CSA-C802.2-06, Minimum Efficiency Values for Dry Type Transformers.
- .2 National Electrical Manufacturers Association (NEMA).

### **1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for dry type transformers and include product characteristics, performance criteria, physical size, finish and limitations.

### **1.4 CLOSEOUT SUBMITTALS**

- .1 Submit in accordance with Section 01 78 00 – Closeout Submittals.
- .2 Operation and Maintenance Data: Submit operation and maintenance data for dry type transformers for incorporation into manual.

## **PART 2 - PRODUCTS**

### **2.1 DESIGN DESCRIPTION**

- .1 Performance Characteristics.
  - .1 Type: ANN
  - .2 Single or three phase, kVA as indicated, V input as indicated, V output as indicated, 60 Hz.
  - .3 Voltage taps: standard.
  - .4 Insulation: Class H, 105 degrees C temperature rise.
  - .5 Basic Impulse Level (BIL): standard.
  - .6 Hi-pot: standard.
  - .7 Average sound level: standard
  - .8 Impedance at 17 degrees C: between 5% and 6%

- .9 Enclosure: CSA, removable metal front panel. Provide NEMA 3RI enclosure for transformers in garage area.
- .10 Mounting: floor, wall, or suspended as indicated.
- .11 Finish: in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .12 Copper windings.
- .13 Winding configuration to be three (3) phase, four (4) wire, star-delta.
- .14 K-rated Transformers as indicated on drawings.
- .15 Voltage Regulation to be 4% or better.

## **2.2 EQUIPMENT IDENTIFICATION**

- .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Label size: 7.
- .3 Nameplate wording: to be determined upon shop drawing review.

## **2.3 APPROVED MANUFACTURERS**

- .1 Delta.
- .2 Hammond.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- .1 Verification of Conditions: Verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for dry type transformers installation in accordance with manufacturer's written instructions.
  - .1 Visually inspect substrate in presence of Consultant.
  - .2 Inform Consultant of unacceptable conditions immediately upon discovery.
  - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Consultant.

### **3.2 INSTALLATION**

- .1 Mount dry type transformers up to 75 kVA as indicated.
- .2 Ensure adequate clearance around transformer for ventilation.
- .3 Install transformers in level upright position.
- .4 Remove shipping supports only after transformer is installed and just before putting into service.

- .5 Loosen isolation pad bolts until no compression is visible.
- .6 Make primary and secondary connections in accordance with wiring diagram using flexible conduit connections.
- .7 Energize transformers after installation is complete.
- .8 Make conduit entry into bottom 1/3 of transformer enclosure.

### **3.3 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 – Cleaning.
- .2 Leave Work area clean at end of each day.
- .3 Final Cleaning: upon completion remove surplus materials, rubbish, tools, and equipment.

### **3.4 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by dry type transformers installation.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 RELATED REQUIREMENTS**

- .1 Section 26 05 00 – Common Work Results for Electrical.

### **1.2 REFERENCES**

- .1 CSA International:
  - .1 CSA C22.2 No.29-11, Panel boards and Enclosed Panel boards.

### **1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for panel boards and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
  - .1 Include on drawings:
    - .1 Electrical detail of panel, branch breaker type, quantity, ampacity and enclosure dimension.

### **1.4 CLOSEOUT SUBMITTALS**

- .1 Submit in accordance with Section 01 78 00 – Closeout Submittals.
- .2 Operation and Maintenance Data: Submit operation and maintenance data for panel boards for incorporation into manual.

## **PART 2 - PRODUCTS**

### **2.1 PANEL BOARDS**

- .1 Panel Boards: to CSA C22.2 No.29 and product of one manufacturer.
  - .1 Install circuit breakers in panel boards before shipment.
  - .2 In addition to CSA requirements manufacturer's nameplate must show fault current that panel including breakers has been built to withstand.
- .2 208 V and 600 V Panel Boards: bus and breakers rated for symmetrical interrupting capacity as indicated on drawings.
- .3 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.
- .4 Panel Boards: mains, number of circuits, and number and size of branch circuit breakers as indicated.

- .5 Minimum of two (2) flush locks for each panel board.
- .6 Two (2) keys for each panel board and key panel boards alike.
- .7 Copper or Aluminum bus with neutral of same ampere rating of mains.
- .8 Mains: suitable for bolt-on breakers.
- .9 Trim with concealed front bolts and hinges.
- .10 Trim and Door Finish: baked enamel.

## **2.2 BREAKERS**

- .1 Breakers: as indicated on drawings.
- .2 Breakers with thermal and magnetic tripping in panelboards except as indicated otherwise.
- .3 Main Breaker: as indicated on drawings and 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 15 % of 15 to 30 A breakers installed as indicated. Turn over unused lock-on devices to Consultant.

## **2.3 EQUIPMENT IDENTIFICATION**

- .1 Provide equipment identification in accordance with Section 26 05 00 – Common Work Results for Electrical.
- .2 Nameplate for each panel board size 4 engraved as indicated.
- .3 Nameplate for each circuit in distribution panel boards Size 2 engraved as indicated.
- .4 Complete circuit directory with typewritten legend showing location and load of each circuit, mounted in plastic envelope at inside of panel door.

## **2.4 APPROVED MANUFACTURERS**

- .1 Eaton.
- .2 Schneider.
- .3 Siemens.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for panelboards installation in accordance with manufacturer's written instructions.
  - .1 Visually inspect substrate in presence of Consultant.
  - .2 Inform Consultant of unacceptable conditions immediately upon discovery.
  - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Consultant.

#### **3.2 INSTALLATION**

- .1 Locate panel boards as indicated and mount securely, plumb, true and square, to adjoining surfaces.
- .2 Mount panel boards to height specified in Section 26 05 00 - Common Work Results for Electrical or as indicated.
- .3 Connect loads to circuits.
- .4 Connect neutral conductors to common neutral bus with respective neutral identified.
- .5 Coordinate with Equipment Manufacturer to provide / retrofit existing Switchboard BP-2 with new panel as detailed on single line drawing. Coordinate shutdown for retrofit and connect new and existing feeders to new panel boards.

#### **3.3 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by panelboards installation.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 REFERENCES**

- .1 CSA International:
  - .1 CAN/CSA C22.2 No.94.1-07, Enclosures for Electrical Equipment, Non Environment Considerations.
- .2 National Electrical Manufacturers Association (NEMA):
  - .1 NEMA 250-2008, Enclosures for Electrical Equipment (1000 Volts Maximum).

### **1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Shop Drawings:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for electrical cabinets and enclosures and include product characteristics, performance criteria, physical size, finish and limitations.

### **1.3 CLOSEOUT SUBMITTALS**

- .1 Submit in accordance with Section 01 78 00 – Closeout Submittals.
- .2 Operation and maintenance data: Submit operation and maintenance data for electrical cabinets and enclosures for incorporation into manual.

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS**

- .1 Enclosure constructed with 2.7 mm thick minimum steel, with weather and corrosion resistant finish, size as indicated.
- .2 Entire enclosure to be capable of withstanding maximum impact force of 86 MN/m<sup>2</sup> area without rupture of material.
- .3 Removable enclosure panels with formed edges galvanized steel external fasteners removable only from inside enclosure.
- .4 Equip enclosure with hot dipped galvanized mounting rails to enable mounting of equipment at any location within housing.
- .5 Door: 3 point latching, with padlocking means.
- .6 Ventilation panel constructed to allow air circulation yet preventing entry of foreign objects, wildlife, and vermin.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for electrical cabinet and enclosure installation in accordance with manufacturer's written instructions:
  - .1 Visually inspect substrate in presence of Consultant.
  - .2 Inform Consultant of unacceptable conditions immediately upon discovery.
  - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Consultant.

#### **3.2 INSTALLATION**

- .1 Assemble enclosure in accordance with manufacturer's instructions and securely mount on building structure with channels, supports and fastenings.
- .2 Mount equipment in enclosure.
- .3 Label electrical cabinets and enclosure to Section 26 05 00 – Common Work Results for Electrical.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 REFERENCES**

- .1 CSA International:
  - .1 CSA C22.2 No.42-10, General Use Receptacles, Attachment Plugs and Similar Devices.
  - .2 CAN/CSA C22.2 No.42.1-00 (R2009), Cover Plates for Flush-Mounted Wiring Devices (Bi-national standard, with UL 514D).
  - .3 CSA C22.2 No.55-M1986 (R2008), Special Use Switches.
  - .4 CSA C22.2 No.111-10, General-Use Snap Switches (Bi-national standard, with UL 20).

### **1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Shop Drawings:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for wiring devices and include product characteristics, performance criteria, physical size, finish and limitations.

### **1.3 CLOSEOUT SUBMITTALS**

- .1 Submit in accordance with Section 01 78 00 – Closeout Submittals.
- .2 Operation and Maintenance Data: Submit operation and maintenance data for wiring devices for incorporation into manual.

## **PART 2 - PRODUCTS**

### **2.1 SWITCHES**

- .1 Single-pole, double-pole, three-way, or four-way switches to: CSA C22.2 No.55 and CSA C22.2 No.111.
- .2 Manually-operated general purpose AC switches with following features:
  - .1 Terminal holes approved for No. 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 Ivory toggle.
- .3 Toggle operated fully rated for tungsten filament and fluorescent lamps, and up to 85% of rated capacity branch circuit loads.
- .4 Switches of one manufacturer throughout project.

## **2.2 RECEPTACLES**

- .1 Duplex receptacles, CSA type 5-15 R, 125 V, 15 A, U ground, to: CSA C22.2 No.42 with following features:
  - .1 Ivory 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.
- .2 Single receptacles CSA Type 5-15 R, 125 V, 15 A, U ground with following features:
  - .1 Ivory urea moulded housing.
  - .2 Suitable for No. 10 AWG for back and side wiring.
- .3 Four (4) back wired entrances, 2 side wiring screws, other receptacles with ampacity and voltage as indicated.
- .4 GFCI receptacles as indicated on drawings, per Section 26 28 20 – Ground Fault Circuit Interrupters – Class A.
- .5 Receptacles of one manufacturer throughout project.

## **2.3 COVER PLATES**

- .1 Cover plates for wiring devices to: CSA C22.2 No.42.1.
- .2 Sheet steel utility box cover for wiring devices installed in surface-mounted utility boxes.
- .3 Stainless steel, 1 mm thick cover plates, thickness 2.5 mm for wiring devices mounted in flush-mounted outlet box.
- .4 Cast cover plates for wiring devices mounted in surface-mounted FS or FD type conduit boxes.
- .5 Weatherproof double-lift, spring-loaded cast aluminum cover plates, complete with gaskets for duplex receptacles as indicated.
- .6 Weatherproof spring-loaded cover plates complete with gaskets for single receptacles or switches.

## **2.4 SOURCE QUALITY CONTROL**

- .1 Cover plates from one manufacturer throughout project.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for wiring devices installation in accordance with manufacturer's written instructions.
  - .1 Visually inspect substrate in presence of Consultant.
  - .2 Inform Consultant of unacceptable conditions immediately upon discovery.
  - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Consultant.

#### **3.2 INSTALLATION**

- .1 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.
  - .3 Mount toggle switches at height in accordance with Section 26 05 00 - Common Work Results for Electrical, or as indicated.
- .2 Receptacles:
  - .1 Install receptacles in gang-type outlet box when more than one receptacle is required in one location.
  - .2 Mount receptacles at height in accordance with Section 26 05 00 – Common Work Results for Electrical as indicated.
  - .3 Where split receptacle has one portion switched, mount vertically and switch upper portion.
  - .4 Install GFI type receptacles as indicated.
- .3 Cover Plates:
  - .1 Install suitable common cover plates where wiring devices are grouped.
  - .2 Do not use cover plates meant for flush outlet boxes on surface-mounted boxes.

#### **3.3 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Protect stainless steel cover plate finish with paper or plastic film until painting and other work is finished.
- .3 Repair damage to adjacent materials caused by wiring device installation.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 REFERENCES**

- .1 Canadian Standards Association (CSA International):
  - .1 CAN/CSA C22.2 No.4-M89 (R2000), Enclosed Switches.
  - .2 CSA C22.2 No.39-M89 (R2003), Fuse holder Assemblies.

### **1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit product data in accordance with Section 01 33 00 – Submittal Procedures.

## **PART 2 - PRODUCTS**

### **2.1 DISCONNECT SWITCHES**

- .1 Fusible or non-fusible, horsepower-rated disconnect switch in CSA enclosure to CAN/CSA C22.2 No.4, size as indicated.
- .2 Provision for padlocking in on-off switch position.
- .3 Mechanically interlocked door to prevent opening when handle in ON position.
- .4 Quick-make, quick-break action.
- .5 ON-OFF switch position indication on switch enclosure cover.
- .6 For elevator applications provide disconnects with auxiliary contacts (micro switch) for controls.

### **2.2 EQUIPMENT IDENTIFICATION**

- .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Indicate name of load controlled on size 4 nameplate.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- .1 Install disconnect switches complete with fuses if applicable.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 REFERENCES**

- .1 CSA International:
  - .1 CSA C22.2 No.14-10, Industrial Control Equipment.
- .2 National Electrical Manufacturers Association (NEMA):
  - .1 NEMA ICS 1-2000(R2008), Industrial Control and Systems: General Requirements.

### **1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Shop Drawings:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for control devices and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2 Include schematic, wiring, interconnection diagrams.

### **1.3 QUALITY ASSURANCE**

- .1 Conduct tests in accordance with Section 26 05 00 – Common Work Results for Electrical.

### **1.4 CLOSEOUT SUBMITTALS**

- .1 Submit in accordance with Section 01 78 00 – Closeout Submittals.
- .2 Operation and Maintenance Data: Submit operation and maintenance data for control devices for incorporation into manual.

## **PART 2 - PRODUCTS**

### **2.1 AC CONTROL RELAYS**

- .1 Control Relays: to CSA C22.2 No.14 and NEMA ICS 1.
- .2 Convertible Contact Type: Contacts field convertible from NO to NC, electrically held. Coil and contact rating to suit circuit.
- .3 Universal Pole Type: electrically held with 2 DPDT poles, convertible from NO to NC by changing wiring connections. Coil rating and contact rating to suit circuit.

## **2.2 RELAY ACCESSORIES**

- .1 Standard contact cartridges: normally-open-convertible to normally-closed in field.

## **2.3 SEALED CONTACT OIL TIGHT LIMIT SWITCHES**

- .1 Lever type switches: roller operated, single pole, double throw. Contact rating to suit circuit.

## **2.4 OPERATOR CONTROL STATIONS**

- .1 Enclosure: CSA Type 4, surface mounting:

## **2.5 PUSHBUTTONS**

- .1 Heavy duty Oil tight. Operator extend type. Black, with 1-NO and 1-NC contacts sized to suit circuit, labels as indicated. Stop pushbuttons coloured red, provision for padlocking in depressed position.

## **2.6 SELECTOR SWITCHES**

- .1 Maintained, 2 or 3 position, heavy duty oil tight, operators standard wing lever, sized to suit circuit.

## **2.7 INDICATING LIGHTS**

- .1 Heavy-duty Oil-tight, full voltage, LED type, push-to-test, lens colour: as per shop drawing review, supply voltage: to suit circuit, labels as indicated.

## **2.8 CONTROL AND RELAY PANELS**

- .1 CSA Type 1 sheet steel enclosure with hinged pad-lockable access door, accommodating relays timers, labels, as indicated, factory installed and wired to identified terminals.

## **2.9 CONTROL CIRCUIT TRANSFORMERS**

- .1 Single phase, dry type.
- .2 Primary: 208 through 600 V as required, 60 Hz ac.
- .3 Secondary: 120 V, ac.
- .4 Rating: 150 VA minimum. Size to suit circuit plus 20%.
- .5 Secondary Fuse to suit.
- .6 Close voltage regulation as required by magnet coils and solenoid valves.

## **2.10 THERMOSTAT (LINE VOLTAGE)**

- .1 Wall mounted, for motor rated exhaust fan control.
- .2 Full Load Rating: to suit load requirements.
- .3 Temperature Setting Range: 0 degrees C to 40 degrees C.
- .4 Thermometer Range: -5 degrees C to 45 degrees C.
- .5 Markings in 5 degree increments.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for control devices installation in accordance with manufacturer's written instructions:
  - .1 Visually inspect substrate.
  - .2 Inform Consultant of unacceptable conditions immediately upon discovery.
  - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Consultant.

### **3.2 INSTALLATION**

- .1 Install pushbutton stations, control and relay panels, control devices and interconnections.

### **3.3 FIELD QUALITY CONTROL**

- .1 Perform tests in accordance with Section 26 05 00 – Common Work Results for Electrical.
- .2 Depending upon magnitude and complexity, divide control system into convenient sections, energize one section at a time and check out operation of section.
- .3 Upon completion of sectional test, undertake group testing.
- .4 Check out complete system for operational sequencing.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 REFERENCES**

- .1 International Electrotechnical Commission (IEC):
  - .1 IEC 947-4-1-2002, Part 4: Electromechanical contactors and motor-starters.
- .2 Motor Starter Control List.
- .3 Refer to individual mechanical specification sections for equipment requirements.

### **1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product Data:
  - .1 Provide manufacturer's printed product literature, specifications and datasheets and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
  - .1 Provide shop drawings: in accordance with Section 01 33 00 – Submittal Procedures.
  - .2 Provide shop drawings for each type of starter to indicate:
    - .1 Mounting method and dimensions.
    - .2 Starter size and type.
    - .3 Layout and components.
    - .4 Enclosure types.
    - .5 Wiring diagram.
    - .6 Interconnection diagrams.

### **1.3 CLOSEOUT SUBMITTALS**

- .1 Provide maintenance materials in accordance with Section 01 78 00 – Closeout Submittals.
- .2 Submit operation and maintenance data for each type and style of motor starter for incorporation into maintenance manual.
- .3 Extra Materials:
  - .1 Provide listed spare parts for each different size and type of starter.
    - .1 Contacts, stationary.
    - .2 Contacts, movable.
    - .3 Contacts, auxiliary.
    - .4 Control transformers.
    - .5 Operating coil.
    - .6 Fuses.
    - .7 10% indicating lamp bulbs used.

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS**

- .1 Starters: to IEC 947-4 with AC4 utilization category.

### **2.2 MANUAL MOTOR STARTERS**

- .1 Single or three phase manual motor starters of size, type, rating, and enclosure type as indicated, with components as follows:
  - .1 Switching mechanism, quick make and break.
  - .2 Overloads, manual reset, trip indicating handle.
  - .3 NEMA 1 enclosure, or as indicated.
- .2 Accessories:
  - .1 Toggle Local-Off Remote Switch, heavy duty, oil tight, labelled as reviewed on shop drawings.
  - .2 Indicating light: heavy duty, oil tight LED type and colour as reviewed on shop drawings.
  - .3 Locking tab to permit padlocking in "ON" or "OFF" position.

### **2.3 FULL VOLTAGE MAGNETIC STARTERS**

- .1 Combination magnetic starters of size, type, rating, and enclosure type as indicated with components as follows:
  - .1 Contactor solenoid operated, rapid action type.
  - .2 Motor overload protective device in each phase, manually reset from outside enclosure.
  - .3 Wiring and schematic diagram inside starter enclosure in visible location.
  - .4 Identify each wire and terminal for external connections, within starter, with permanent number marking identical to diagram.
  - .5 NEMA 1 enclosure, or as indicated.
- .2 Combination type starters to include fused circuit breaker with operating lever on outside of enclosure to control circuit breaker, and provision for:
  - .1 Locking in "OFF" position.
  - .2 Independent locking of enclosure door.
  - .3 Provision for preventing switching to "ON" position while enclosure door open.
- .3 Accessories:
  - .1 Toggle Local-Off-Remote Switch, heavy duty, oil tight, labelled as reviewed on shop drawings.
  - .2 Indicating light: heavy duty, oil tight LED type and colour as reviewed on shop drawings.
  - .3 1-N/O and 1-N/C spare auxiliary contacts unless otherwise indicated.

## **2.4 FRACTIONAL HORSEPOWER LOAD STARTERS**

- .1 Provide starter for double voltage relay in enclosure for control wiring interface complete with toggle switch for equipment and starter isolation.

## **2.5 CONTROL TRANSFORMER**

- .1 Single-phase, dry-type, control transformer with primary voltage as indicated and 120 V secondary, complete with secondary fuse, installed in with starter as indicated.
- .2 Size control transformer for control circuit load plus 20% spare capacity.

## **2.6 ACCESSORIES**

- .1 Pushbutton: heavy duty, oil tight as required.
- .2 Selector switches: heavy duty, oil tight as required.
- .3 Indicating lights: heavy duty, oil tight, type and colour as indicated.

## **2.7 FINISHES**

- .1 Apply finishes to enclosure in accordance with Section 26 05 00 - Common Work Results for Electrical.

## **2.8 EQUIPMENT IDENTIFICATION**

- .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Manual starter designation label, white plate, black letters, size 1, engraved as indicated.

# **PART 3 - EXECUTION**

## **3.1 INSTALLATION**

- .1 Install starters and control devices in accordance with manufacturer's instructions.
- .2 Install and wire starters and controls as indicated.
- .3 Ensure correct fuses installed.
- .4 Confirm motor nameplate and adjust overload device to suit.

## **3.2 FIELD QUALITY CONTROL**

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical and manufacturer's instructions.

- .2 Operate switches and contactors to verify correct functioning.
- .3 Perform starting and stopping sequences of contactors and relays.
- .4 Check that sequence controls, interlocking with other separate related starters, equipment, control devices, operate as indicated.

### **3.3 CLEANING**

- .1 Clean in accordance with Section 01 74 11 – Cleaning.
- .2 Remove surplus materials, excess materials, rubbish, tools, and equipment.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 SECTION INCLUDES**

- .1 Materials and installation for automatic load transfer equipment which can monitor voltage on all phases of normal power supply, initiate cranking of standby generator unit, transfer loads and shut down standby unit.

### **1.2 REFERENCES**

- .1 Canadian Standards Association (CSA International)
  - .1 CAN3-C13-M83-Latest Edition, Instrument Transformers.
  - .2 CSA C22.2 No.5-02, Moulded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures (Tri-national standard with UL 489, tenth edition, and the second edition of NMX-J-266-ANCE).
  - .3 CSA C22.2 No.178-1978-Latest Edition, Automatic Transfer Switches.
- .2 American National Standards Institute (ANSI)/National Electrical Manufacturers Association (NEMA)
  - .1 ANSI/NEMA ICS 2-Latest Edition, Industrial Control and Systems: Controllers, Contactors, and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC.

### **1.3 SYSTEM DESCRIPTION**

- .1 Automatic load transfer equipment to:
  - .1 Monitor voltage on phases of normal power supply.
  - .2 Initiate cranking of standby generator unit on normal power failure or abnormal voltage on any one phase below preset adjustable limits for adjustable period of time.
  - .3 Transfer load from normal supply to standby unit when standby unit reaches rated frequency and voltage pre-set adjustable limits.
  - .4 Transfer load from standby unit to normal power supply when normal power restored, confirmed by sensing of voltage on phases above adjustable pre-set limit for adjustable time period.
  - .5 Shut down standby unit after running unloaded to cool down using adjustable time delay relay.

### **1.4 SHOP DRAWINGS**

- .1 Submit shop drawings in accordance with Section 01 34 00 – Submittals.
- .2 Include:
  - .1 Make, model and type.
  - .2 Single line diagram showing controls and relays.
  - .3 Description of equipment operation including:
    - .1 Automatic starting and transfer to standby unit and back to normal power.
    - .2 Test control.
    - .3 Manual control.
    - .4 Automatic shutdown.

## **1.5 CLOSEOUT SUBMITTALS**

- .1 Provide operation and maintenance data for automatic load transfer equipment for incorporation into manual specified in Section 01 78 00 – Closeout Submittals.
- .2 Detailed instructions to permit effective operation, maintenance and repair.
- .3 Technical data:
  - .1 Schematic diagram of components, controls and relays.
  - .2 Illustrated parts lists with parts catalogue numbers.
  - .3 Certified copy of factory test results.

## **1.6 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate and recycle waste materials in accordance with Section 01 74 21 – Construction/Demolition Waste Management and Disposal.
- .2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard and packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.
- .4 Divert unused metal and wiring materials from landfill to metal recycling facility as approved by Consultant.

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS**

- .1 Instrument transformers: to CAN3-C13.

### **2.2 AUTOMATIC TRANSFER SWITCH**

- .1 Provide automatic transfer switch fully rated for resistive or inductive loads as noted on drawings. 347,600 V AC, 60 Hz, for use on a 3-phase, 4-wire system. Build to CASA-C22.2, No. 178-1978.
- .2 Provide the following transfer switches
  - .1 200A, 347,600V 3-pole transfer switch (ATS-LS).
  - .2 200A, 347,600V 3-pole transfer switch (ATS-NLS).

Transfer switch to be capable of withstanding 35,000 amperes or 25,000 amperes RMS symmetrical fault current(as indicated on drawings), without contact separation or contact welding. Main transfer contact to be protected by an approved arc disruption means, including separate arcing contacts. Operating time in either direction not to exceed one-sixth of a second. Switch to be capable of intercepting six times rated current at a power factor of 0.40 to 0.50. Test to be 50 cycles of operation at a rate of one operation per two minutes.

- .3 Transfer switch to be electrically operated, mechanically held. Obtain control and transfer power from source to which it is being transferred. Transfer switch to be operated by single solenoid mechanism so constructed that a neutral position is not possible under electrical operation and shall not have overlapping neutrals.

## 2.3 CONTROLS

- .1 Provide voltage sensing relays for full phase failure protection to initiate transfer of load to emergency power supply when voltage of normal supply drops to 70% on any phase and retransfer it to normal when that supply is restored to 90% on all phases.
- .2 Provide relay to prevent transfer to emergency source until frequency and voltage reach preset value.
- .3 All components and accessories to be front removable.
- .4 Provide one set of SPDT contacts on both normal and emergency supply breakers.
- .5 Provide four sets of NC contacts to open when switch operates in the emergency mode to drop out equipment not required on emergency.
- .6 Provide one set of NO contacts to close on loss of normal power for future wiring to elevator control panel and one spare NO contact.
- .7 Switch to include pilot lights to indicate whether switch is in "normal" or in "emergency" position.
- .8 Switch to include maintained test switch to simulate power failure.
- .9 An "in-phase" monitor to compare normal source voltage and frequency to generator voltage and frequency. Monitor to signal transfer switch to operate at an advance angle as determined by frequency difference between sources at time of transfer. Automatically adjust phase advance angle at which transfer operation is initiated to permit load to be reconnected, so that inrush currents are limited to not more than normal starting currents. Monitor to control transfer so that motor load inrush currents do not exceed normal starting currents and do not require external control of power sources. In-phase monitor to be specifically designed for and to be the product of the ATS manufacturer.
- .10 Transfer switch to include full capacity neutral contacts.
- .11 Selector switch – four position "Test", "Auto", "Manual", "Engine Start".
  - .1 Test position – Normal power failure simulated. Engine starts and transfer takes place. Return switch to "Auto" to stop engine.
  - .2 Auto position – Normal operation of transfer switch on failure of normal power; transfer on return of normal voltage and shuts down engine.
- .12 Control transformers: dry type with 120 V secondary to isolate control circuits from:
  - .1 Normal power supply.
  - .2 Emergency power supply.
- .13 Relays: continuous duty, industrial control type, with wiping action contacts rated 10 A minimum:
  - .1 Frequency sensing to prevent transfer from normal power supply until frequency of standby unit reaches preset adjustable values.

.14 Microprocessor Controller:

- .1 Controller's sensing and logic will be provided by a single built-in microprocessor for maximum reliability, minimum maintenance and the ability to communicate serially through an optional serial communication module.
- .2 Single controller to provide twelve selectable nominal voltages for maximum application flexibility and minimal spare part requirements. Voltage sensing to be true RMS type and to be accurate to +1% of nominal voltage. Frequency sensing to be accurate to +.2%. Panel to be capable of operating over a temperature range of -20 to 60°C and storage from -55 to +85°C.
- .3 Controller to be connected to the transfer switch by an interconnecting wiring harness. Harness to include a keyed disconnect plug to enable the controller to be disconnected from the transfer switch for routine maintenance. Sensing and control logic to be provided on multi-layer printed circuit boards. Interfacing relays to be industrial grade plug-in type with dust covers. Panel to be enclosed with a protective cover and be mounted separately from the transfer switch unit for safety and ease of maintenance. Protective cover to be mounted separately from the transfer switch unit for safety and ease of maintenance. Protective cover to include a built-in pocket for storage of the operator's manuals.
- .4 All customer connections to be wired to a common terminal to simplify wiring connections.

.15 Time Delays:

- .1 An adjustable time delay of 0 to 6 seconds to be provided to override momentary normal source outages and delay all transfer and engine starting signals. Capability to be provided to extend this time delay to 60 minutes by providing an external 24 VDC power supply.
- .2 A time delay will be provided on transfer to emergency, adjustable from 0 to 60 minutes for controlled timing of loads to emergency.
- .3 Two time delay modes (which are independently adjustable) to be provided on retransfer to normal. One time delay to be for actual normal power failures and the other for the test mode function. Time delays to be adjustable from 0 to 60 minutes. Time delay to be automatically bypassed if the emergency source fails and the normal source is acceptable.
- .4 A time delay will be provided on shut down of engine generator for cool down, adjustable from 0 to 60 minutes.
- .5 A time delay activated output signal will also be provided to drive an external relay(s) for selective load disconnect control. Controller to have the ability to activate an adjustable 0 to 5 minute time delay in any of the following modes:
  - .1 Prior to transfer only.
  - .2 Prior to and after transfer.
  - .3 Normal to emergency only.
  - .4 Emergency to normal only.
  - .5 Normal to emergency and emergency to normal.
  - .6 All transfer conditions or only when both sources are available.
- .6 All time delays will be adjustable in one second increments, except the extended parallel time, which will be adjustable in 0.1 second increments.
- .7 All time delays will be adjustable by using the LCD display and keypad or with a remote device connected to the serial communications port.

.16 Additional Features:

- .1 A three position momentary-type test switch to be part of the test/automatic/reset modes. The test position will simulate a normal source failure. The reset position will bypass the time delays on either transfer to emergency or retransfer to normal.

- .2 A SPDT contact, rated 5 amps at 30 VDC, will be provided for a low voltage engine start signal. The start signal will prevent dry cranking of the engine by requiring the generator set to reach proper output and run for the duration of the cool down setting, regardless of whether the normal source restores before the load is transferred.
- .3 Auxiliary contacts, rated 10 amps, 250 VAC to be provided consisting of one contact, closed when the ATS is connected to the normal source and one contact closed, when the ATS is connected to the emergency source.
- .4 LED indicating lights (16 mm industrial grade, Type 12) to be provided; one to indicate when the ATS is connected to the normal source (green) and one to indicate when the ATS is connected to the emergency source (red).
- .5 LED indicating lights (16 mm industrial grade, Type 12) to be provided and energized by controller outputs. Lights to provide true source availability of the normal and emergency sources, as determined by the voltage sensing trip and reset settings for each source.
- .6 The following features to be built-in to the controller but capable of being activated through keypad programming or the serial port only when required by the user.
- .7 Provide the ability to select "commit/no commit to transfer" to determine whether the load should be transferred to the emergency generator if the normal source restores before the generator is ready to accept the load.
- .8 Terminals to be provided for a remote contact that opens to signal the ATS to transfer to emergency and for remote contact that open to inhibit transfer to emergency and/or retransfer to normal. Both of these inhibit signals can be activated through the keypad or serial port.
- .9 Controller to be capable of accepting a normally open contact that will allow the transfer switch to function in a non-automatic mode using an external control device.
- .10 Engine Exerciser – controller to provide an internal engine exerciser. Engine exerciser to allow the user to program up to seven different exercise routines. For each routine, the user will be able to:
  - .1 Enable or disable the routine.
  - .2 Enable or disable transfer of the load during routine.
  - .3 Set the start time:
    - .1 Time of day
    - .2 Day of week
    - .3 Week of month (1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup>, 4<sup>th</sup>, alternate or every)
  - .4 Set the duration of the run.
- .11 At the end of the specified duration, the switch will transfer the load back to normal and run the generator for the specified cool down period. A ten year life battery that supplies power to the real time clock in the event of a power loss will maintain all time and date information.
- .12 System Status: Controller LCD display will include a "System Status" screen that will be readily accessible from any point in the menu by depressing the "ESC" key a maximum of two times. This screen will display a clear description of the active operating sequence and switch position. For example:

Normal Failed  
Load on Normal  
TD Normal to Emerg  
2 min 15 s.
- .13 Controllers that require multiple screens to determine system status or display "coded" system status messages, which must be explained by references in the Operator's Manual, are not permissible.
- .14 Self-Diagnostics – Operator shall contain a diagnostic screen for the purpose of detecting system errors. This screen to provide information on the status input signals to the controller which may be preventing load transfer commands from being completed.

- .15 Communications Interface – Controller to be capable of interfacing, through a serial communication module to suit Modbus controls protocol.
- .16 Data Logging – Controller to have the ability to log data and maintain the last 99 events, even in the event of total power loss. The following events will be time and date stamped and maintained in a non-volatile memory.
  - .1 Event Logging:
    - .1 Data and time and reason transfer normal to emergency.
    - .2 Data and time and reason for transfer emergency to normal.
    - .3 Data and time and reason for engine start.
    - .4 Data and time engine stopped.
    - .5 Data and time emergency source available.
    - .6 Data and time emergency source not available.
  - .2 Statistical Data:
    - .1 Total number of transfers.
    - .2 Total number of transfers due to source failure.
    - .3 Total number of days controller is energized.
    - .4 Total number of hours both normal and emergency sources are available.

## 2.4 ACCESSORIES

- .1 Pilot lights to indicate power availability normal and standby, switch position, green for normal, red for standby, mounted in panel.
- .2 Instruments:
  - .1 Data Monitor (Power Manager):
    - .1 Provide data monitors shown to monitor all functions specified below.
    - .2 The Data Monitors shall be listed to UL 3111-1, CSA, CE Mark, and industrially rated for an operating temperature range of -20°C to 60°C.
    - .3 The Data Monitor shall be accurate to 1% measured, 2% computed values and display resolution to .1%. Voltage and current for all phases shall be sampled simultaneously to assure high accuracy in conditions of low power factor or large waveform distortions (harmonics).
    - .4 The Data Monitor shall be capable of operating without modification at nominal frequencies of 45 to 66 Hz and over a control power input range of 20 – 32 VDC.
    - .5 Each Data Monitor shall be capable of interfacing with an optional communications module to permit information to be sent to central location for display, analysis, and logging.
    - .6 The Data Monitor shall accept inputs from industry standard instrument trans-formers (120 VAC secondary PTs and 5A secondary CTS.) Direct phase voltage connections, 600 VAC and under, shall be possible without the use of PTs.
    - .7 The Data Monitor shall be applied in three & four wire circuits. A fourth CT input shall be available to measure neutral or ground current.
    - .8 All setup parameters required by the Data Monitors shall be stored in non-volatile memory and retained in the event of a control power interruption.
    - .9 Data Monitor Input/output Options:
      - .1 Data Monitors shall be equipped with the following I/O:
      - .2 Provide (8) solid state status inputs.
      - .3 Provide four (4) relay output contacts.

- .10 The Data Monitor shall flush mount to an enclosure.
  - .1 The Data Monitors shall be equipped with an optional continuous duty, long-life, 4 line x 20 character LCD backlit display to provide local access to the following metered quantities:
    - .1 Current, per phase RMS and neutral (if applicable).
    - .2 Current Unbalance %
    - .3 Voltage, phase-to-phase and phase-to-neutral
    - .4 Voltage Unbalance %
    - .5 Real power, per phase and 3-phase total
    - .6 Apparent power, per phase and 3-phase total
    - .7 Reactive power, per phase and 3-phase total
    - .8 Power factor, 3-phase total & per phase
    - .9 Frequency
    - .10 Accumulated Energy, (MWH, MVAH, and MVARH)
  - .2 Displaying each of the Data Monitor quantities shall be accomplished through the use of menu scroll buttons.
  - .3 For ease in operator viewing, the display shall remain on continuously, with no detrimental effect on the life of the Data Monitor.
  - .4 Set-up for system requirements shall be allowed from the front of the Data Monitor. Set-up provisions shall include:
    - .1 CT rating
    - .2 PT rating
    - .3 System type 3 and 4 wire
    - .4 Communication parameters
  - .5 All reset and setup functions shall have a means for protection against unauthorized/accidental changes.

## **2.5 EQUIPMENT IDENTIFICATION**

- .1 Provide equipment identification in accordance with Section 26 05 01 - Common Work Results - Electrical.
- .2 Control panel:
  - .1 For selector switch and manual switch: nameplates.
  - .2 For meters, indicating lights, minor controls: equipment nameplate.
  - .3 Nameplates to include: equipment name plate with multiple power sources.

## **2.6 APPROVED MANUFACTURERS**

- .1 ASCO.

## **2.7 SOURCE QUALITY CONTROL**

- .1 Complete equipment, including transfer mechanism, controls, relays and accessories factory assembled and tested in presence of Consultant.
- .2 Notify Consultant in advance of date of factory test.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- .1 Locate, install and connect transfer equipment.
- .2 Check relays, solid state monitors and adjust as required.
- .3 Install and connect control cables for interface with generator control panel.
- .4 Provide and connect power feeders for normal, emergency and load as indicated on drawings.
- .5 Provide control cables for power loss (ATS call to start), Generator trouble, generator loss of power from each Transfer switch to the respective generator control panel.

### **3.2 FIELD QUALITY CONTROL**

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Energize transfer equipment from normal power supply.
- .3 Set selector switch in "Test" position to ensure proper standby start, running, transfer, retransfer. Return selector switch to "Auto" position to ensure standby shuts down.
- .4 Set selector switch in "Auto" position and open normal power supply disconnect. Standby should start, come up to rated voltage and frequency, and then load should transfer to standby. Allow to operate for 10 minutes, then close main power supply disconnect. Load should transfer back to normal power supply and standby should shutdown.
- .5 Repeat, at one hour intervals, complete test with selector switch in each position, for each test.

### **3.3 TESTS**

- .1 Operate equipment both mechanically and electrically to ensure proper performance.
- .2 Check selector switch in modes of operation; Test, Auto, Manual, Engine Start and Record Results.
- .3 Check voltage sensing and time delay relay settings.

- .4 Check:
  - .1 Automatic starting and transfer of load on failure of normal power.
  - .2 Retransfer of load when normal power supply resumed.
  - .3 Automatic shutdown.
  - .4 In-phase monitor operation.
- .5 Additional testing shall be carried out as NETA standards by the Commissioning Agent.

### **3.4 TESTS AND CERTIFICATION**

- .1 The complete ATS will be factory tested to ensure proper operation of the individual components and correct overall sequence of operation and to ensure that the operating transfer time, voltage, frequency and time delay settings are in compliance with the specification requirements.
- .2 Upon request, the manufacturer will provide a notarized letter certifying compliance with all of the requirements of this specification, including compliance with the above-referenced codes and standards and withstand and closing ratings.
- .3 The certification will identify, by serial number(s) the equipment involved. No exceptions to the specifications, other than those stipulated at the time of the submittal, will be included in the certification.
- .4 The ATB manufacturer will be certified to ISO 9001 International Quality Standard and the manufacturer will have third party certification verifying quality assurance in design/development, production, installation, and servicing in accordance with ISO 9001.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 SECTION INCLUDES**

- .1 Equipment and installation for secondary lighting arresters.

### **1.2 REFERENCES**

- .1 Institute of Electrical and Electronics Engineers (IEEE):
  - .1 IEEE C62.1, Gapped Silicon-carbide Surge Arresters for AC Power Circuits;
  - .2 IEEE C62.11, Metal-oxide Surge Arresters for AC Power Circuits;
  - .3 IEEE C62.41, Surge Voltages in Low Voltage AC Power Circuits;
  - .4 IEEE C62.45, Recommended Practice on Surge Testing for Equipment Connected to Low Voltage AC Power Circuits.
- .2 Underwriters Laboratories (UL):
  - .1 UL 1449-2006 – 3rd Edition, Transient Voltage Surge Suppressors;
  - .2 UL 1283-2005, Electromagnetic Interference Filters.
- .3 International Electrotechnical Commission (IEC):
  - .1 IEC 61643-1, 2005, Low Voltage Surge Protective Devices.
- .4 Canadian Standards Association (CSA):
  - .1 CSA 22.2, all applicable parts.
- .5 International Organization for Standardization (ISO):
  - .1 The product must be manufactured by the vendor at its own facility, which is certified in conformance with ISO 9001 standards.

### **1.3 SUBMITTALS**

- .1 Submit product data in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data: Provide catalog sheets showing voltage, physical size, IEEE measured limiting voltage for each waveform listed, UL1449 latest revision, latest edition, voltage protection ratings, dimensions showing construction, lifting and support points, enclosure details, per mode and per phase peak surge current, modes of discrete suppression circuitry, warranty period and replacement terms, conductor size, conductor type and lead length.
- .3 Submit product data for all components and accessories.
- .4 Manufacturer's Installation 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. Indicate maximum size of circuit breaker or fuse to be connected for each unit.
- .5 List and detail all protection systems such as fuses, disconnecting means and protective features.
- .6 Provide verification that the SPD device complies with the required UL1449 latest edition, latest revision, CSA or ETL approvals.

- .7 Provide actual let through voltage test data in the form of oscillograph results for the ANSI/IEEE C62.41 Category C3 & C1 (combination wave) and A1 (ringwave) tested in accordance with ANSI/IEEE C62.45.
- .8 Provide spectrum analysis of each unit based on MIL-STD-220A test procedures between 10 kHz and 100 kHz verifying the devices noise attenuation equals or exceeds 40 dB at 100 kHz.
- .9 Provide test report from a recognized independent testing laboratory verifying the suppressor components can survive published surge current rating on a per mode basis using the IEEE C 62.41, 8x20 microsecond current wave. Test data must be on a complete SPD with internal fusing in place. Test data on an individual module is not acceptable.

#### **1.4 QUALITY ASSURANCE AND WARRANTY**

- .1 The panel mounted SPD and supporting components shall be guaranteed by the manufacturer to be free of defects in material and workmanship for a period of thirty (30) years from the date of substantial completion of service and activation of the system to which the suppressor is attached. Additionally, during the applicable warranty period, any SPD which fails due to any electrical anomaly, including lightning, shall be repaired or replaced by the manufacturer without charge. Special or optional warranties in excess of the unit's standard warranty for purposes of this bid are not acceptable.
- .2 Since "Acts of Nature" or similar statements typically include the threat of lightning to which the SPDs shall be exposed, any such clause limiting warranty responsibility in the general conditions of this specification shall not apply to this particular section. That is, the warranty must specifically provide for unlimited free replacements of the SPD in the event of failure caused by the effects of lightning and all other electrical anomalies. The warranty shall cover the entire device, not just various components, such as modules only.

#### **PART 2 - PRODUCTS**

- .1 Performance:
  - .1 General:
    - .1 The SPD shall be listed by ETL, UL, or other nationally recognized test laboratory to UL's 1283 and UL's 1449 standards (3rd edition, latest revision), and not merely the components or modules. All SPD's shall be Type 1 for use in Type 1 and Type 2 locations.
    - .2 The SPD shall 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 4 modes are not acceptable. In delta systems, line-to-ground-to-line protection is not acceptable where line-to-line is specified.
    - .3 Obtain all surge suppression devices through one source from a single manufacturer.
    - .4 The maximum continuous operating voltage (MCOV) of all components shall not be less than 125% for a 120V system and 120% for 220 and 240V systems, and 115% for 347 and 600V systems.
    - .5 All SPD's shall be equipped with a comprehensive monitoring system which shall include a visual LCD panel display providing information on unit status and phase loss/protection loss.

- .6 No unit will be accepted as an "approved equal" unless it meets the warranty, strength, safety features, IEEE let-through levels, modes of discrete suppression circuitry, fusing, independent NEMA LS-1 per mode surge testing, and all other requirements of this specification.
  - .7 If a disconnect switch is specified, the disconnect switch and the SPD as a system shall be capable of interrupting up to a 200kA symmetrical fault current with 600 VAC applied.
  - .8 Each design configuration shall have the maximum single pulse surge current capacity per mode verified through testing at an independent, nationally recognized test laboratory. To be considered for approval, the manufacturer must submit a test report on a unit which was tested with internal over current fusing in place. The test shall include a UL1449 Second Edition surge defined as a 1.2 X 50  $\mu$ sec 6000V open circuit voltage waveform and an 8 X 20  $\mu$ sec 500A short circuit current waveform to benchmark the unit's suppression voltage, followed by a single pulse surge of maximum rated surge current magnitude with an approximated 8 X 20  $\mu$ sec waveform. To complete the test, another UL1449 surge shall be applied to verify the unit's survival. Compliance is achieved if the suppression voltage found from the two UL1449 surges does not vary by more than +10%. Test data on an individual module is not acceptable.
- .2 Main Switchboard 600V:
- .1 SPD for this location shall be as indicated on project drawings. SPD shall be separate from panelboard. Integral SPD shall not be acceptable. SPD's shall be certified to UL 1283 and UL1449 Third Ed. Type 1 for use in Type 1 and Type 2 locations.
  - .2 Main Switchboard (600 V) BP1, shall be protected by a panel mounted SPD, model TK-ST300-3Y600-L for 347/600 wye (4W+G) volt panels or switchboards.
  - .3 The manufacturer shall provide written specifications showing let-through voltage of the unit with six inches of lead length (at the module or at the lug data is not acceptable as it does not represent true "as installed" performance) pursuant to ANSI/IEEE C62.41 and C62.45, 2002, categories B3/C1 and C3 bi-wave, 90 degree phase angle, positive polarity, measurements in peak voltage from the zero reference, all dynamic tests except N-G, and UL suppressed voltage ratings, all of which shall be no higher than:  
  
ANSI/IEEE C62.41-1991 Measured Limiting Voltage  
B3/C1 Impulse (6kV, 3kA)  

Voltage	L-N	L-G	L-L	N-G
347/600	1273V	1281V	2161V	1295V

  
C3 Impulse (20kV, 10kA)  

Voltage	L-N	L-G	L-L	N-G
347/600	1573V	1707V	2473V	1800V

  
UL Voltage Protection Ratings  

Voltage	L-N	L-G	L-L	N-G
347/600	1500V	1500V	2500V	1500V
  - .4 The unit shall have a peak surge current of no less than 300kA/phase, 150kA/mode, 8 X 20  $\mu$ s waveform, single impulse, verified by third party test reports.
  - .5 Internal Fusing - Overcurrent Protection:
    - .1 Each Metal Oxide Varistor, or other primary suppression component, shall be individually fused for safety and performance to allow the SPD to withstand the full rated single pulse peak surge capacity per mode without the operation or failure of the fuses. Overcurrent fusing that limits the listed peak surge current of the SPD is not acceptable. Replaceable cartridge type per phase or per mode overcurrent fusing is not acceptable where there is more than one MOV per mode.

- .2 For arc quenching capability, minimization of smoke and contaminants in the event of a failure, and to ensure the safest possible design, all surge components, current carrying paths and fusing shall be packed in fuse grade silica sand.
- .3 Fusing shall be present in every mode, including Neutral-to-Ground.
- .4 The fusing shall be capable of interrupting up to a 200kA symmetrical fault current with 600VAC applied.
- .6 The SPD shall come standard with not less than a Thirty Year Warranty, and the warranty shall include unlimited free replacements of the unit if destroyed by lightning or other transients during the warranty period. Special or optional warranties in excess of the unit's standard warranty for purposes of this bid are not acceptable.
- .7 The suppressor shall include Form C dry contacts (N.O. or N.C.) for remote monitoring capability, and shall have at minimum a Nema 4 steel enclosure.
- .8 Provide 100A 3P breaker in Main Switchboard BP1.
- .3 DP2E, DP2X, Emergency Panel 120/208V, Panel BP2.
  - .1 SPD for this location shall be as indicated on project drawings. SPD shall be separate from panelboard. Integral SPD shall not be acceptable. SPD's shall be certified to UL 1283 and UL1449 Third Ed. Type 1 for use in Type 1 and Type 2 locations.
  - .2 Emergency Panel shall be protected by a panel mounted SPD, model TK-ST120-3Y208-L for 120/208 wye (4W+G) volt panels or switchboards.
  - .3 The manufacturer shall provide written specifications showing let-through voltage of the unit with six inches of lead length (at the module or at the lug data is not acceptable as it does not represent true "as installed" performance) pursuant to ANSI/IEEE C62.41 and C62.45, 2002, categories B3/C1 and C3 bi-wave, 90 degree phase angle, positive polarity, measurements in peak voltage from the zero reference, all dynamic tests except N-G, and UL suppressed voltage ratings, all of which shall be no higher than:

ANSI/IEEE C62.41-1991 Measured Limiting Voltage

B3/C1 Impulse (6kV, 3kA)

Voltage	L-N	L-G	L-L	N-G
120/208	651V	640V	1041V	646V

C3 Impulse (20kV, 10kA)

Voltage	L-N	L-G	L-L	N-G
120/208	960V	1010V	1310V	860V

UL Voltage Protection Ratings

Voltage	L-N	L-G	L-L	N-G
120/208	700V	700V	1200V	700V

- .4 The unit shall have a peak surge current of no less than 120kA/phase, 60kA/mode, 8 X 20 us waveform, single impulse, verified by third party test reports.
- .5 Internal Fusing - Overcurrent Protection:
  - .1 Each Metal Oxide Varistor, or other primary suppression component, shall be individually fused for safety and performance to allow the SPD to withstand the full rated single pulse peak surge capacity per mode without the operation or failure of the fuses. Overcurrent fusing that limits the listed peak surge current of the SPD is not acceptable. Replaceable cartridge type per phase or per mode overcurrent fusing is not acceptable where there is more than one MOV per mode.
  - .2 For arc quenching capability, minimization of smoke and contaminants in the event of a failure, and to ensure the safest possible design, all surge components, current carrying paths and fusing shall be packed in fuse grade silica sand.

- .3 Fusing shall be present in every mode, including Neutral-to-Ground.
  - .4 The fusing shall be capable of interrupting up to a 200kA symmetrical fault current with 600VAC applied.
  - .6 The SPD shall come standard with not less than a Thirty Year Warranty, and the warranty shall include unlimited free replacements of the unit if destroyed by lightning or other transients during the warranty period. Special or optional warranties in excess of the unit's standard warranty for purposes of this bid are not acceptable.
  - .7 The suppressor shall include Form C dry contacts (N.O. or N.C.) for remote monitoring capability, and shall have at minimum a Nema 4 steel enclosure.
  - .8 Provide 60A 3P breaker in DP2C, DP2X, Panel BP2.
- .4 DPE Emergency Generator Panel:
- .1 SPDs for these locations shall be as indicated on project drawings. SPD shall be separate from panelboard. Integral SPD shall not be acceptable. SPD's shall be certified to UL 1283 and UL1449 Third Ed. Type 1 for use in Type 1 and Type 2 locations.
  - .2 Emergency Generator Panel: panels shall be protected by a panel mounted SPD, model TK-ST120-600NN-L for 600 delta (3W+G) volt panels.
  - .3 The manufacturer shall provide written specifications showing let-through voltage of the unit with six inches of lead length (at the module or at the lug data is not acceptable as it does not represent true "as installed" performance) pursuant to ANSI/IEEE C62.41 and C62.45, 2002, categories B3/C1 and C3 bi-wave, 90 degree phase angle, positive polarity, measurements in peak voltage from the zero reference, all dynamic tests except N-G, and UL suppressed voltage ratings, all of which shall be no higher than:
- |   |       |        |
|---|-------|--------|
| ANSI/IEEE C62.41-1991 Measured Limiting Voltage |       |        |
| B3/C1 Impulse (6kV, 3kA)                        |       |        |
| Voltage   | L-G   | L-L    |
| 600 delta                                       | 2202V | 2217V  |
| C3 Impulse (20kV, 10kA)                         |       |        |
| Voltage   | L-G   | L-L    |
| 600 delta                                       | 2420V | 24107V |
| UL Voltage Protection Ratings                   |       |        |
| Voltage   | L-G   | L-L    |
| 600 delta                                       | 2500V | 2500V  |
- .4 The unit shall have a peak surge current of no less than 120kA/phase, 60kA/mode, 8 X 20 us waveform, single impulse, verified by third party test reports.
  - .5 Internal Fusing - Overcurrent Protection:
    - .1 Each Metal Oxide Varistor, or other primary suppression component, shall be individually fused for safety and performance to allow the SPD to withstand the full rated single pulse peak surge capacity per mode without the operation or failure of the fuses. Overcurrent fusing that limits the listed peak surge current of the SPD is not acceptable. Replaceable cartridge type per phase or per mode overcurrent fusing is not acceptable where there is more than one MOV per mode.
    - .2 For arc quenching capability, minimization of smoke and contaminants in the event of a failure, and to ensure the safest possible design, all surge components, current carrying paths and fusing shall be packed in fuse grade silica sand.
    - .3 Fusing shall be present in every mode, including Neutral-to-Ground.
    - .4 The fusing shall be capable of interrupting up to a 200kA symmetrical fault current with 600VAC applied.

- .6 The SPD shall come standard with not less than a Thirty Year Warranty, and the warranty shall include unlimited free replacements of the unit if destroyed by lightning or other transients during the warranty period. Special or optional warranties in excess of the unit's standard warranty for purposes of this bid are not acceptable.
- .7 The suppressor shall include Form C dry contacts (N.O. or N.C.) for remote monitoring capability, and shall have at minimum a Nema 4 steel enclosure.
- .8 Provide 60A 3P breaker for each SPD.

## **2.2 ENCLOSURE**

- .1 The SPD is to be separately enclosed and not integral to any switchboard or branch panel. The TVSS enclosure must be metallic NEMA 1 or 4 rated, standard finish.
- .2 All components must be installed within the enclosure and shop assembled by the manufacturer before shipping to site.
- .3 Enclosure must be:
  - .1 Tamper resistant to limit access to internal components; or
  - .2 If easily opened, must come complete with a CSA rated, local disconnect to ensure power to the TVSS is removed from its internal components prior to opening the enclosure door.
- .4 Must be identified with applicable warnings and CSA ratings/approvals.

## **2.3 GROUNDING**

- .1 Provide a separate insulated bond wire, sized as per manufacturer's recommendations and to meet minimum requirements of the Ontario Electrical Safe Authority.
- .2 Bond wire is to be run directly and as short as practical to the ground bus.

## **2.4 OPERATION DESIGN REQUIREMENTS**

- .1 General:
  - .1 The SPD shall not generate any appreciable magnetic fields and shall be suitable for direct use within computer rooms.
  - .2 The SPD shall not generate any appreciable noise.
  - .3 Each MOV module of the TVSS shall not contain any combustible materials.
  - .4 Failure mode of the SPD shall not create any safety hazard, including smoke, flame, or arch flash.
  - .5 Operation of the SPD shall not cause an interruption of normal power to the protected loads.
  - .6 EMI and RFI noise rejected by the TVSS operation is to be in compliance with NEMA LS1.
  - .7 Electrically isolated dry contacts shall be available which can be connected to a remote alarming system.
  - .8 Bond wire is to be run directly and as short as practical to the ground bus.

- .2 Testing Documentation:
  - .1 Single Pulse Current Capacity:
    - .1 SPD systems are to be single pulse surge current tested in all modes at rated surge currents by an industry recognized independent test laboratory.
    - .2 Test methods are to be shown to be conducted as per NEMA LS1 and UL 1449 surge testing procedures and shall not demonstrate more than 10% variance in the protected side rated voltage.
  - .2 Minimum Repetitive Surge Current Capacity:
    - .1 SPD systems are to be repetitive surge current capacity tested in all modes by an industry recognized independent test laboratory.
    - .2 Test methods are to be shown to be conducted as per IEEE C62.41 and IEEE C62.45 testing procedures and shall not demonstrate performance degradation or more than 10% variance in the protected side rated voltage.

## **2.5 MANUFACTURERS**

- .1 Manufacturers for SPDs shall be as follows:
  - .1 Total Protection Solutions
  - .2 Current Technology TransGuard TG Series
  - .3 Liebert SI Series.
- .2 Acceptable Manufacturers:
  - .1 NOTE: Listing of a manufacturer's name does not indicate acceptance of the manufacturer's product line. The specifications must be met for the product to be accepted.)

## **PART 3 - EXECUTION**

- .1 Installation:
  - .1 Install each SPD as close as possible to the distribution equipment it is meant to protect.
  - .2 Coordinate and provide breakers in panel board for SPD devices.
  - .3 SPDs installed in Panel boards are NOT acceptable.
  - .4 Cable and ground wire lengths are to be direct as possible.
    - .1 Install the SPD's with the conductors as short and straight as practically possible.
    - .2 Follow the SPD manufacturer's recommended installation practice as outlined in the equipment installation manual. The electrical contractor shall 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.
    - .3 The installing contractor shall comply with all applicable codes.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 REFERENCES**

- .1 American National Standards Institute (ANSI)/Institute of Electrical and Electronics Engineers (ANSI/IEEE):
  - .1 ANSI/IEEE C62.41-1991, Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits.
- .2 ASTM International Inc.:
  - .1 ASTM F 1137-00(2006), Standard Specification for Phosphate/Oil and Phosphate/Organic Corrosion Protective Coatings for Fasteners.
- .3 Canadian Standards Association (CSA International).
- .4 ICES-005-07, Radio Frequency Lighting Devices.
- .5 Underwriters Laboratories of Canada (ULC).

### **1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product Data:
  - .1 Provide manufacturer's printed product literature, specifications and data sheets and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2 Provide complete photometric data prepared by independent testing laboratory for luminaires where specified, for approval by Consultant.
- .3 Quality Assurance Submittals: provide the following in accordance with Section 01 45- 00 – Quality Control.
  - .1 Manufacturer's Instructions: provide manufacturer's written installation instructions and special handling criteria, installation sequence and cleaning procedures.

### **1.3 QUALITY ASSURANCE**

- .1 Provide mock-ups in accordance with Section 01 45 00 – Quality Control.

### **1.4 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 – Common Product Requirements.
- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Divert unused metal materials from landfill to metal recycling facility.
- .4 Disposal and recycling of fluorescent lamps as per local regulations.
- .5 Disposal of old PCB filled ballasts.

## **PART 2 - PRODUCTS**

### **2.1 LAMPS**

- .1 LED as noted on drawings.

### **2.2 FINISHES**

- .1 Light fixture finishes and construction to meet ULC listings and CSA certifications related to intended installation.

### **2.3 OPTICAL CONTROL DEVICES**

- .1 As indicated in luminaire schedule.

### **2.4 LUMINAIRES**

- .1 As indicated in luminaire schedule.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- .1 Locate and install luminaires as indicated.
- .2 Provide adequate support to suit ceiling system.

### **3.2 WIRING**

- .1 Connect luminaires to lighting circuits:
  - .1 Install flexible or rigid conduit for luminaires as indicated.

### **3.3 LUMINAIRE SUPPORTS**

- .1 For suspended ceiling installations, support luminaires independently of ceiling.

### **3.4 LUMINAIR ALIGNMENT**

- .1 Alight luminaires mounted in continuous rows to form straight uninterrupted line.
- .2 Align luminaires mounted individually parallel or perpendicular to building grid lines.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 REFERENCES**

- .1 CSA International:
  - .1 CSA C22.2 No.141-10, Emergency Lighting Equipment.

### **1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for emergency lighting and include product characteristics, performance criteria, physical size, finish and limitations.

### **1.3 CLOSEOUT SUBMITTALS**

- .1 Submit in accordance with Section 01 78 00 – Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for emergency lighting for incorporation into manual.

### **1.4 WARRANTY**

- .1 For batteries in this section - 26 52 00 – Emergency Lighting, 12 months warranty period is extended to 120 months.

## **PART 2 - PRODUCTS**

### **2.1 EQUIPMENT**

- .1 Emergency lighting equipment: to CSA C22.2 No.141.
- .2 Supply voltage: 120 V, ac.
- .3 Output voltage: 24 V, dc.
- .4 Operating time: 120 minutes.
- .5 Battery: sealed, maintenance free, with sufficient capacity to provide 91% voltage after 30 minutes operation with connected load plus 50 W.
- .6 Charger: solid state, multi-rate, voltage/current regulated, inverse temperature compensated, short circuit protected with regulated output of plus or minus 0.01 V for plus or minus 10% input variations.
- .7 Solid state transfer circuit.
- .8 Low voltage disconnect: solid state, modular, operates at 80% battery output voltage.
- .9 Signal lights: solid state, for 'AC Power ON' and 'High Charge'.

- .10 Lamp heads: integral on unit, 345 degrees horizontal and 180 degrees vertical adjustment. Lamp type: LED and lumen minimum output as indicated on drawings.
- .11 Cabinet: suitable for direct or shelf mounting to wall and complete with knockouts for conduit. Removable or hinged front panel for easy access to batteries.
- .12 Auxiliary equipment:
  - .1 Ammeter.
  - .2 Voltmeter.
  - .3 Test switch.
  - .4 Time delay relay.
  - .5 Battery disconnect device.
  - .6 AC input and DC output terminal blocks inside cabinet.
  - .7 Mounting bracket
  - .8 Cord and plug connection for AC.
  - .9 RFI suppressors.

## **2.2 WIRING OF REMOTE HEADS**

- .1 Conduit: in accordance with Section 26 05 34 – Conduits, Conduit Fastenings and Conduit Fittings.
- .2 Conductors: in accordance with Section 26 05 21 – Wires and Cables (0-1000 V), sized as indicated in accordance with manufacturer's recommendations.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for emergency lighting installation in accordance with manufacturer's written instructions.
  - .1 Visually inspect substrate in presence of Consultant.
  - .2 Inform Consultant of unacceptable conditions immediately upon discovery.
  - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Consultant.

### **3.2 INSTALLATION**

- .1 Install unit equipment in main Electrical Room in front of transfer switches.

### **3.3 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by emergency lighting installation.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 REFERENCES**

- .1 Canadian Standards Association (CSA International):
  - .1 CSA C22.2 No.141-10, Unit Equipment for Emergency Lighting.
  - .2 CSA C860-01-Latest Edition, Performance of Internally-Lighted Exit Signs.
- .2 National Fire Protection Association (NFPA):
  - .1 NFPA 101-Latest Edition, Life Safety Code.

### **1.2 SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures and items below.
- .2 All pictogram exit lighting sign shop drawings are to be submitted for review and comment prior to issuing to Engineer for review. All comments and transmittal documents to be attached to shop drawings being issued to Engineer.
- .3 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications and data sheets and include product characteristics, performance criteria, physical size, finish and limitations.
- .4 Submit WHMIS MSDS - Material Safety Data Sheets in accordance with Section 01 35 29 – Health and Safety Requirements and manufacturer's instructions.
- .5 Quality Assurance Submittals: Submit following in accordance with Section 01 45 00 – Quality Control.
  - .1 Instructions: Submit manufacturer's installation instructions and special handling criteria, installation sequence, cleaning procedures.

## **PART 2 - PRODUCTS**

### **2.1 STANDARD UNITS**

- .1 Exit Lights: to CSA C22.2 No.141 and CSA C860.
- .2 Housing: cold rolled steel minimum 1.0 mm thick, satin aluminum enamel finish.
- .3 Face and back plates: cast aluminum alloy.
- .4 Lamps: LED-12W, 120V, over 500,000 hours.
- .5 Letters: as detailed on Drawings.
- .6 Faceplate to remain captive for relamping.

## **2.2 DESIGN TYPES**

- .1 Single-Face Pictogram X1: (Running man in doorway) for mounting above or beside egress doors.
- .2 Single-Face Pictogram X2: (Running man in doorway with progress left and/or right 90 degree directional arrow) for egress routing through corridors and spaces.
- .3 Double-Face Pictogram X3: (Running man in doorway with progress left and/or right 90 degree directional arrow's) for egress routing through corridors and spaces.
- .4 Single-Face Pictogram X4: (Running man in doorway with progress down to the left and/or down to the right 45 degree directional arrow) for egress routing through corridors and spaces at open stairs and ramps.
- .5 Double-Face Pictogram X5: (Running man in doorway with progress down to the left and/or down to the right 45 degree directional arrow's) for egress routing through corridors and spaces at open stairs and ramps.
- .6 Single-Face Pictogram X6: (Running man in doorway with progress up to the left and/or up to the right 45 degree directional arrow) for egress routing through corridors and spaces at open stairs and ramps.
- .7 Double-Face Pictogram X7: (Running man in doorway with progress up to the left and/or up to the right 45 degree directional arrow's) for egress routing through corridors and spaces at open stairs and ramps.

## **2.3 DESIGN**

- .1 Universal mounting.
- .2 Single Double face with die-cast face plate to remain captive for re-lamping.
- .3 Arrow: as indicated on drawings.

## **PART 3 - EXECUTION**

### **3.1 MANUFACTURER'S INSTRUCTIONS**

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.

### **3.2 INSTALLATION**

- .1 Install exit lights to manufacturer's recommendations, listing requirements, NFPA standard and local regulatory requirements.
- .2 Connect fixtures to exit light circuits.
- .3 Connect emergency lamp sockets to emergency circuits.
- .4 Ensure that exit light circuit breaker is locked in on position.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 RELATED SECTIONS**

- .1 Division 00 – Front End Documents.
- .2 Division 01 – General Requirements.
- .3 Division 26 – Electrical.
- .4 Division 27- Communications.
- .5 Division 28 – Electronic Safety and Security.

### **1.2 SECTION INFORMATION**

- .1 This section covers background information and scope of work for the Division.
- .2 Division 27 Contractor responsible for executing this section must be a Contractor on the University's Contractor Vendor Record List:
  - .1 BNR Electric Inc.
  - .2 Demarcation Point
  - .3 Electri-Tech Services Inc.
  - .4 PhoneMaster Services Ltd.
  - .5 Roberts Onsite Inc.
  - .6 Vollmer Inc.
- .3 The Video CAPture system (VCAP) vendor will be chosen by the University and paid by the University but must be a sub-contractor to the GC.
- .4 Division 27 Contractor installing the overhead paging must be Valcom certified.

### **1.3 BACKGROUND INFORMATION**

- .1 Building 46 at the University of Guelph, also known as the VMI Building, is undergoing renovations with an upgrade to the facility.
- .2 The building is located at 50 College Avenue West, Guelph, Ontario, Canada.
- .3 The building is split up into three (3) separate wings: Wing A, Wing B and Wing C.
- .4 Currently Wings B and C are undergoing demolition and construction.
- .5 In this construction, the current Main Communications Room is going to be transitioned to a different room.
- .6 Within Wing B, two (2) new communications systems are being installed, as well as an access control and video surveillance system.
- .7 The first system is a Video Capture System (VCAP) and the second is the Student/Administration Network; Computing and Communications Services (CCS).

## 1.4 SCOPE OF WORK

- .1 Wing B:
  - .1 The Division 26 Contractor is responsible for supplying and installing new pathways within the wing.
  - .2 These pathways include a shared main horizontal distribution wire basket tray system, conduit systems, pull boxes and outlet boxes to end devices as required for the structured cabling system.
  - .3 The Division 27 Contractor is responsible for supplying and installing connectivity from the CCS Room to network end devices.
  - .4 The Division 27 Contractor is responsible for supplying and installing connectivity from the Room 117 Vestibule Room to the access control and video surveillance end devices.
  - .5 All Pathways installed by the Division 26 Contractor are to be bonded to ground on the main communications grounding bus bar located in the CCS Room by the Division 27 Contractor.
  - .6 VCAP System:
    - .1 The Division 26 Contractor is responsible for the pathways and the Division 27 Contractor is responsible for the fibre backbone for this system.
    - .2 This includes the shared wire basket tray system, conduit pathways and pull boxes to the end devices as required for a structured cabling system.
    - .3 The Division 27 Contractor will also be responsible for supplying, installing, labelling, terminating and testing of a fibre back bone from the VCAP Room on the first floor to the VCAP Room on the second floor.
    - .4 This Division 27 Contractor is responsible for supplying, installing, grounding and labelling the fibre patch panel in the existing rack in each room. Rack supplied by other.
  - .7 CCS Network:
    - .1 The Division 26 Contractor is responsible for the pathways. The Division 27 Contractor is responsible for copper horizontal cabling and connectivity for this system.
    - .2 This includes the shared wire basket tray system, conduit pathways, pull boxes and outlet boxes as required for a structured cabling system.
    - .3 The Division 27 Contractor is responsible for supplying, installing labelling and testing all of the copper horizontal cabling, patch panel, terminations and connectivity to all end devices from the CCS Room.
    - .4 The Division 27 Contractor is also responsible for all racks and passive equipment in the CCS Room.
    - .5 This includes racks, cable management, fibre patch panels, copper patch panels, fire rated backboard, BIX10A mounts and grounding and bonding kits.
  - .8 Access Control and Video Surveillance:
    - .1 The Division 26 Contractor is responsible for the pathways and the Division 27 Contractor is responsible for the copper horizontal cabling and connectivity for this system.
    - .2 This includes the shared wire basket tray system, conduit pathways, pull boxes and outlet boxes as required for a structured cabling system.
    - .3 The Division 27 Contractor is responsible for supplying, installing labelling and testing all of the copper horizontal cabling and connectivity to all end devices from the Electrical Room.
- .2 Wings C and A:
  - .1 Division 27 Contractor to identify and record on a spreadsheet with pictures all low voltage cabling for security, voice, data and other systems in the demolition area and provide to Consultant for review. The spreadsheet will include a list of end devices, if remaining that are attached to the cables.

- .2 Division 27 Contractor to pull back and tag all cables required to support demolition cables to centre hallway of ceiling space just outside the demolition space. Care will be taken not to damage the ceiling in the hallway. Should the hallway not be suitable, Contractor to advise the Consultant. Any damage to the hallway ceiling will be repaired by the Contractor at their cost.
- .3 At completion of the demolition, Contractor to pull all cables back to their original condition and locations.
- .4 Where cables cannot be pulled back to their original locations due to obstructions, Contractor to issue an RFI for review by Consultant.
- .5 Note: Under no condition will cable splicing be allowed without the prior written approval from the Consultant.
- .6 The Consultant will then review and decide whether the Contractor is to reinstate or abandon the cable.

## 1.5 SUBMITTALS

- .1 Shop Drawings, Product Data and Samples:
  - .1 The Owner's approval shall be obtained for all equipment and material before delivery to the job site. Delivery, storage or installation of equipment or material which has not had prior approval will not be permitted at the job site.
- .2 All submittals shall include adequate cut sheets, shop drawings, descriptive literature and other data necessary for the consultant to ascertain that the proposed equipment and materials comply with specification requirements.
- .3 Each Submittal shall be in pdf format and have an individual component or equipment's, information. Submittals with multiple components or unclear as to which component is being accessed will not be considered for approval and will be asked to be resubmitted.
- .4 Submittals shall include the following:
  - .1 Information that confirms compliance with contract requirements. Include the manufacturer's name, model or catalogue numbers, catalogue information, technical data sheets, shop drawings, pictures, nameplate data and test reports as required.
  - .2 Elementary and interconnection wiring diagrams for communication and signal systems, control system and equipment assemblies. All terminal points and wiring shall be identified on wiring diagrams.
  - .3 Parts list which shall include those replacement parts recommended by the equipment manufacturer, quantity of parts, current price and availability of each part.
- .5 Manuals:
  - .1 Maintenance and Operation Manuals: Submit as required for systems and equipment specified in the technical sections. Furnish four copies, bound in hardback binders, (manufacturer's standard binders) or an approved equivalent. Furnish one complete manual as specified in the technical section but in no case later than prior to performance of systems or equipment test and furnish the remaining manuals prior to contract completion.
  - .2 Inscribe the following identification on the cover: the words "MAINTENANCE AND OPERATION MANUAL," the name and location of the system, equipment, building, name of Contractor, and contract number. Include in the manual the names, addresses, and telephone numbers of each subcontractor installing the system or equipment and the local representatives for the system or equipment.
  - .3 Provide a "Table of Contents" and assemble the manual to conform to the table of contents, with tab sheets placed before instructions covering the subject. The instructions shall be legible and easily read, with large sheets of drawings folded in.

- .4 The manuals shall include:
  - .1 Internal and interconnecting wiring and control diagrams with data to explain detailed operation and control of the equipment.
  - .2 A control sequence describing start-up, operation, and shutdown.
  - .3 Description of the function of each principal item of equipment.
  - .4 Installation and maintenance instructions.
  - .5 Safety precautions.
  - .6 Diagrams and illustrations.
  - .7 Testing methods.
  - .8 Performance data.
  - .9 The list shall indicate sources of supply, recommended spare parts, and name of servicing organization.
  - .10 Appendix: list qualified permanent servicing organizations for support of the equipment, including addresses and certified qualifications.

## **1.6 AS-BUILT DRAWINGS**

- .1 Contractor is required to maintain one set of correct and accurate red-line drawings on-site at all times. These drawings are to be made available to the engineer for periodical review covering the course of the project
- .2 Contractor is required to provide red line drawings of the cable installation for all drawings included in this specification. All drawings are to be provided to Engineer at the end of the project for any changes due to on-site conditions.
- .3 The as-built drawings are to include, but not be limited to, the following:
  - .1 Cable numbers on the floor plans.
  - .2 End device tag numbers on floor plans.
  - .3 Changes on the floor plans.
  - .4 Access Closet elevation drawings.
  - .5 Backboard elevation drawing.
  - .6 Conduit routing.
  - .7 Riser Routing Drawing.
  - .8 Cable routing on the floor plans.
- .4 All documentation must be submitted to the Engineer before substantial performance is granted.

## **PART 2 - PRODUCTS**

### **2.1 NOT USED**

- .1 Not Used.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- .1 Field Measurements: Verify dimensions in areas of installation by field measurements before fabrication and indicate measurements on shop drawings.

#### **3.2 CLEANING**

- .1 Work areas will be kept in a broom clean condition throughout the duration of the installation process.
- .2 Remove all unnecessary tools and equipment, unused materials, packing materials, and debris from each area where Work has been completed unless designated for storage.
- .3 The Contractor will damp clean all surfaces prior to final acceptance.

#### **3.3 COMPLIANCE TO CODE AND STANDARDS**

- .1 Install all equipment and material in accordance with the standards mentioned in related sections.
- .2 Quality and workmanship shall be at the highest of professional tradesman levels to be accepted for completion.
- .3 All work shall also be performed in accordance with the latest BICSI installation standards.
- .4 Provide installers trained in all applicable codes, standards, regulations and installation standards.
- .5 All installers shall have successfully completed the approved manufacturer's installation training program. Provide written proof of such training at any time during the project. If such proof is not provided the Contractor will remove the installer from the site immediately and replace the installer within 24 hours.
- .6 Upon completion of all work, the Contractor's Project Manager shall sign off in writing that 100% of the installation meets the requirements specified herein.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 SYSTEM DESCRIPTION**

- .1 Telecommunications grounding and bonding system consists of grounding busbars, bonding backbones, and other bonding conductors.
- .2 Provides a common ground reference for the telecommunications systems within the building and a common bonding system back to the CCS room.
- .3 Metallic pathways, cable shields, conductors, and hardware within telecommunications spaces are bonded to telecommunications grounding and bonding system.
- .4 Product specifications, general design considerations and installation guidelines are provided in this section.
- .5 The Communications Contractor shall meet or exceed all requirements for the cable system described in this section.
- .6 Local electrical codes shall be adhered to.
- .7 Local building codes shall be adhered to.
- .8 All communications components including, entrance lugs, cable tray, metallic pathways, and other components noted on drawings shall be bonded to an independent grounding system and in accordance with local codes and standards, TIA-607-C, ANSI/TIA-942 and IEEE Std. 1100 and these specifications.
- .9 Labelling shall conform to ANSI/TIA-606-C-2017.
- .10 All grounding conductors and busbars shall be made of copper.
- .11 The grounding system shall be intentional, visually verifiable, adequately sized to handle expected currents safely, and direct these currents away from network equipment. As such, grounding shall be purposeful in its design and installation.
- .12 Lugs, HTAPs and grounding strips shall be UL Listed and CSA certified and made of premium quality tin-plated electrolytic copper that provides low electrical resistance while inhibiting corrosion. Antioxidant shall be used when making bonding connections in the field.

### **1.2 RELATED SECTIONS**

- .1 Section 26 05 28 – Grounding – Secondary.
- .2 Section 27 05 28 – Pathways for Communications Systems.
- .3 Section 27 15 13 – Communications Copper Horizontal Cabling.

### **1.3 REFERENCES**

- .1 American National Standards Institute (ANSI) and Telecommunications Industry Association (TIA):
  - .1 TIA-607-C-2016, Generic Telecommunications Grounding and Bonding (Earthing) for Customer Premises.

.2 ANSI/TIA-606-C-2017 Administration Standard for Commercial Telecommunications Infrastructure.

.2 Canadian Electrical Code (CEC) and Canadian Standards Association (CSA), C22.1-2012.

.3 Ontario Building Code (OBC).

.4 National Fire Code 2010 (NFC).

.5 In the event of conflict, the most stringent and recent requirements shall apply to the codes and standards above.

#### **1.4 LUGS**

.1 Two-hole lugs shall be used. All lugs shall be irreversible compression and meet NEBS Level 3 as tested by Telcordia. Lugs with inspection windows shall be used in all non-corrosive environments so that connections may be inspected for full conductor insertion (battery rooms are an exception where windowless lugs may be used).

.2 Die index numbers shall be embossed on all compression connections to allow crimp inspection.

#### **1.5 CABLE ASSEMBLIES**

.1 Cable assemblies shall be UL Listed and CSA Certified. Cables shall be a distinctive green or green/yellow in colour, and all jackets shall be UL, VW-1 flame rated.

#### **1.6 HEALTH AND SAFETY**

.1 Health and Safety Requirements: perform construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

#### **1.7 DELIVERY, STORAGE AND HANDLING**

.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

### **PART 2 - PRODUCTS**

#### **2.1 TELECOMMUNICATIONS BONDING CONDUCTOR (TBC)**

.1 Cable assemblies shall be UL Listed and CSA Certified and be a minimum of 6 AWG copper conductor, green insulated to: TIA-607-C-2016. It shall meet the length requirements in TBB Length in Linear Meters Table in 2.1.2.

.2 The gauge of the TBB, TBC shall be determined based on the table below:

TBC Length in Linear Meters (feet)	TBC Size AWG
(AWG) Less than 4 (13)	6
4-6 (14-20)	4
6-8 (21-26)	3
8-10 (27-33)	2
10-13 (34-41)	1
13-16 (42-52)	1/0
16-20 (53-66)	2/0
Greater than 20 (66)	3/0

- .3 Telecommunications Bonding Conductor Label Kits shall be supplied and installed by the Electrical Contractor at every rack and cabinet as well as one for the Telecommunications Grounding Busbar.
- .4 A #6 AWG Green jacketed cable will be bonded to all metallic structure, cables, trays, conduits in the CCS room.

## **2.2 WARNING LABELS**

- .1 Non-metallic warning labels in English and French to: TIA-607-C-2016.
- .2 Identify labels with wording, "If this connector is loose or must be removed, please call the building telecommunications manager."

## **2.3 GROUNDING CLAMPS**

- .1 Where a grounding conductor is routed through a metal conduit, the Communications Contractor shall use a #6 AWG copper conductor with green or green/yellow jacket to bond the conduit to the grounding conductor routed through the metal conduit. Grounding clamps shall be used to bond to the conduit HTAPs with clear cover shall be used to bond to the grounding conductor.

## **2.4 GROUNDING AND BONDING CONDUCTOR LABEL KIT**

- .1 Telecommunications Grounding and Bonding Conductor Label Kits shall be supplied and installed by the Communications Contractor at every rack and cabinet as well as one for every Telecommunications Grounding Busbar.

## **2.5 CODE CONDUCTOR, TWO-HOLE, LONG BARREL WITH WINDOW LUG**

- .1 Where lugs are required for bonding, the Communications Contractor shall supply and install Code Conductor, Two-Hole, Long Barrel with Window Lugs.
- .2 Code Conductor, Two-Hole, Long Barrel with Window Lugs shall be supplied and installed by the Communications Contractor as required.
- .3 Lugs shall be tin plated, irreversible compression, have NEMA hole sizes and spacing and shall meet NEBS Level 3.

## **2.6 GROUNDING CLAMP, U-BOLT, BRONZE**

- .1 Each conduit entering/leaving a telecommunications space/room shall be bonded to the grounding system using a Bronze U-Bolt Grounding Clamp.

## **2.7 WIRE BASKET TRAY GROUNDING**

- .1 Bonding network jumpers shall be supplied and installed by the Communications Contractor to bond each section of tray to the grounding system.

## **2.8 ANTIOXIDANT**

- .1 Antioxidant shall be used by the Communications Contractor when making bonding connections.

## **2.9 BONDING SCREWS**

- .1 Bonding screws shall have serrations on the bottom of screw to remove paint from patch panel to bond patch panel to rack or cabinet rails.
- .2 Bonding screws shall be thread-forming to remove paint from threaded rack or cabinet rail holes to bond patch panel to rack or cabinet rails.
- .3 The Communications Contractor shall supply and install four (4) screws for every patch panel (copper and optical fibre).

## **2.10 RACK GROUNDING**

- .1 Paint Piercing Washers:
  - .1 Paint piercing washers shall accommodate 3/8" stud size and shall have an outside diameter of 0.875".
  - .2 Paint piercing washer kits shall come complete with 0.16 oz (5cc) of antioxidant.
  - .3 Paint piercing washers shall be supplied and installed by the Communications Contractor where rack elements bolt together.
  - .4 Paint piercing washers shall be supplied and installed by the Communications Contractor where vertical cable managers are manufactured of metal.
  - .5 Two paint piercing washers shall be supplied and installed by the Communications Contractor for every nut/bolt set.
- .2 Rack Grounding Strip:
  - .1 Grounding strip shall be 78.65" long, 0.67" wide, 0.05" thick, have EIA Universal mounting hole pattern and shall be made of high conductivity, low resistance wrought copper and tin plated.
  - .2 Grounding strip kits shall come complete with 0.16 oz (5cc) of antioxidant and thread-forming screws.
  - .3 One rack grounding strip shall be supplied by the Communications Contractor for every two post rack. The rack grounding strip shall be mounted to the rear of the side rail of each rack.
- .3 Common Bonding Network Jumper:
  - .1 The Common Bonding Network Jumper shall be made of #6 AWG green or green/yellow jacketed copper conductor 96" long with one end factory terminated to lug.

- .2 The Common Bonding Network Jumper kits shall come complete with 0.16 oz. (5 cc) of antioxidant and thread forming screws.
- .3 One Common Bonding Network Jumper shall be supplied and installed for every rack. Do not bond racks serially.
- .4 Where a Common Bonding Network has not been specified the Communications Contractor shall supply and install a Code Conductor Two Hole Long Barrel with Window Lug to bond the Common Bonding Network Jumper directly to the Telecommunications Grounding Busbar.
- .4 Electrostatic Discharge Port:
  - .1 The Electrostatic Discharge Port shall accommodate a standard ESD wrist strap 4mm plug.
  - .2 The Electrostatic Discharge Port kits shall come complete with an ESD protection sticker, 0.16 oz (5 cc) of antioxidant and thread-forming screws.
  - .3 The Communications Contractor shall supply and install two Electrostatic Discharge Ports for every rack. One ESD port shall be mounted directly to the rack grounding strip on the back of the rack at approximately 48" AFF, and the other shall be mounted directly to the vertical mounting rail of the rack in the front at approximately 48" AFF.

### **PART 3 - EXECUTION**

#### **3.1 GENERAL**

- .1 Structured grounding kits shall be TIA-942 compliant, listed for their purpose with a nationally recognized testing laboratory, and RoHS compliant.
- .2 All components shall be bonded to the rails with paint piercing hardware.
- .3 All jumpers shall have green or green-and-yellow VW-1 rated insulation.
- .4 The Communications Contractor shall ensure a complete grounding system is installed for the project. If any portion of the system to be installed by Division 26 is incomplete it shall be the responsibility of the Communications Contractor to advise the Client.

#### **3.2 TELECOMMUNICATIONS MAIN GROUNDING BUSBAR (TMGB)**

- .1 Install appropriate AWG copper bonding conductor (per table in Section 2.2.2) from TMGB to alternating current equipment ground (ACEG) enclosure of serving electrical power panel (panelboard).

#### **3.3 BONDING CONDUCTOR FOR TELECOMMUNICATIONS (BCT)**

- .1 Install bonding conductor for telecommunications from TMGB to service equipment (power) ground.
- .2 Use exothermic welding, approved 2-hole compression lugs, 1-hole non-twisting lugs for connection to TMGB.

#### **3.4 LABELS**

- .1 Apply warning labels to telecommunications bonding and grounding conductors.
- .2 Apply additional administrative labels to in accordance with ANSI/TIA-606-C standards for labeling.

### **3.5 BONDING CONDUCTORS GENERAL**

- .1 When placed in ferrous metallic conduit or EMT longer than 1 m, bond to each end of conduit or EMT using 6 AWG copper conductor.

### **3.6 BONDING TO TMGB**

- .1 Bond metallic raceways in the CCS room to TMGB using 6 AWG green insulated copper conductor.
- .2 For cables within the CCS room having shield or metallic member, bond shield or metallic member to TMGB using 6 AWG green insulated copper conductor.
- .3 Bond all equipment racks/cabinets located in the CCS room to TMGB using 6 AWG green insulated copper conductor with a two hole lug at each end.

### **3.7 BONDING OF BASKET TRAY**

- .1 Bond each section of overhead cable tray above the floor and in the CCS and VCAP room locations using a #6 AWG ground wire and split copper but by the Communications Cabling Contractor.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 SYSTEM DESCRIPTION**

- .1 Empty telecommunications raceways system consists of outlet boxes, cover plates, wire basket trays, conduits, pull boxes/junction boxes, sleeves and caps, fish wires, service poles, service fittings, concrete encased ducts, modular poke-throughs.
- .2 The Division 26 Contractor shall be responsible for measuring and confirming cable pathways prior to installation of any cabling to ensure no cabling will exceed the specified distance limitations. Where the distance limitations are exceeded, the Contractor shall inform the Client prior to installation of cabling. No compensation for removal of cabling will be accepted if not adhered to.
- .3 A wire basket tray system will be utilized within the hallways, CCS and VCAP Rooms.
- .4 Conduits shall be rated per area by building classification.

### **1.2 RELATED SECTIONS**

- .1 Section 07 84 00 – Firestopping.
- .2 Section 26 05 28 – Grounding and Bonding.
- .3 Section 26 05 34 – Conduits, Conduit Fastenings and Conduit Fittings.
- .4 Section 26 05 36 – Cable Trays.
- .5 Section 27 05 26 – Grounding and Bonding for Communications Systems.

### **1.3 REFERENCES**

- .1 American National Standards Institute (ANSI), Telecommunication Industry Association (TIA) and Electronic Industries Alliance (EIA):
  - .1 TIA-569-B-2004, Commercial Building Standard for Telecommunications Pathways and Spaces
  - .2 ANSI/TIA-568-C.0, Generic Telecommunications Cabling for Customer Premises
  - .3 ANSI/TIA-568-C.1, Commercial Building Telecommunications Cabling Standard
  - .4 ANSI/TIA-568-C.2, Balanced Twisted-Pair Telecommunication Cabling and Components Standard
  - .5 ANSI/TIA-568-C.3, Optical Fiber Cabling Components Standard
  - .6 ANSI/TIA-568-C.4, Broadband Coaxial Cabling and Components Standard
  - .7 ANSI/TIA 607-C, Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises (2012) Standard
  - .8 ANSI/TIA 606-C, Administration Standard Telecommunications Infrastructure (2012) Standard
- .2 Canadian Electrical Code (CEC) and Canadian Standards Association (CSA):
  - .1 C22.1-15 Canadian Electrical Code, Part 1 (23rd Edition), Safety Standard for Electrical Installations
- .3 Ontario Building Code (OBC).
- .4 National Fire Code 2010 (NFC).

- .5 Contractors Association (NECA):
  - .1 NECA/BICSI 607-2016, Standard for Telecommunications Bonding and Grounding Planning and Installation methods for Commercial Buildings.
  - .2 ANSI/NECA/BICSI 568-2006, Standard for Installing Commercial Building Telecommunications Cabling.
  - .3 BICSI Telecommunications Distribution Methods Manual (TDMM) 13th edition.
  - .4 ANSI/BICSI 005-2013 Electronic Safety and Security (ESS) System Design Manual.
- .6 In the event of conflict, the most stringent and recent requirements shall apply to the codes and standards noted above.

#### **1.4 INDOOR CABLE DISTRIBUTION**

- .1 Ensure ANSI/TIA-568-C installation practices are followed for all indoor cable distribution.
- .2 The Contractor shall install and distribute cabling using sleeves, conduit, communications cable tray as indicated on drawings and as supplied and installed by Division 26.
- .3 The use of J-Hooks is not allowed for this installation.

### **PART 2 - PRODUCTS**

#### **2.1 MATERIALS**

- .1 Conduits: EMT type, in accordance with Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.
- .2 Junction Boxes, Cabinet Type: in accordance with Section 26 05 31 - Splitters, Junction, Pull Boxes and Cabinets.

#### **2.2 HOOK AND LOOP CABLE TIES (WRAP)**

- .1 Hook and loop cable ties (wrap) shall be supplied and installed to support and neatly bundle all cabling.
- .2 No nylon or plastic cable ties will be permitted on this project and will be removed and replaced at the expense of the Communications Contractor.
- .3 Hook and loop cable ties (wrap) shall match cable colours.

#### **2.3 CONDUITS AND FITTINGS**

- .1 All telecommunications cables shall be installed in home run conduits originating from the outlet to the cable tray system or to the VCAP room. The use of J hooks, brackets, cable ties and other attachment is not permitted.
- .2 The inside radius of a bend in a conduit shall be not less than six times the internal diameter when the conduit is less than 50 mm in diameter and ten times the internal diameter when conduit is 50 mm in diameter or larger.
- .3 All zone conduits shall be identified and labeled at both ends. Tags shall identify start and finish of conduit runs. Pull boxes shall be labeled on the exposed exterior.

- .4 All metallic parts of the cable distribution supporting system shall be bonded together mechanically, including at all transition points (i.e. distribution conduit not mechanically connected) using a 6 AWG green jacketed stranded copper ground wire. The metallic components of the cable distribution system shall be bonded together at the CCS and then bonded to their respective telecom ground bus bars.
- .5 All fittings, connectors and couplings are to be steel.
- .6 All conduits/sleeves that enter the CCS room shall be fitted with an approved ground bushing c/w ground lug and bonded together mechanically (one continuous piece preferred). This shall be connected to the approved building ground by means of a No. 6 AWG to the grounding bus bar.
- .7 All conduits entering or existing through the ceiling or walls of the CCS room shall protrude into the room 25-50 mm.
- .8 All conduit runs shall follow building grid lines and shall be concealed where possible.
- .9 All conduits shall be thin wall EMT, reamed and bushed at both ends and bonded to the distribution system. Rigid PVC or flexible metallic or PVC conduits are NOT acceptable.
- .10 All conduit runs shall be a maximum of 30 meters (100 ft.) in length with a maximum of two 90 degree bends between pull points, unless otherwise specified.
- .11 A pull box shall be placed in conduit runs where the sum of the bends exceeds 180 degrees, where the overall length of the conduit run is more than 30m, or if there is a reverse bend in the run.
- .12 Pull boxes shall be constructed and sized in accordance with Canadian Electrical Code and ANSI/TIA standards of code gauge steel and shall have a rust resistant finish.
- .13 In all instances pull boxes shall be placed in straight sections of conduit run and shall not be used in lieu of a bend. Corresponding ends of the conduit are to be aligned with each other. Conduit fittings shall not be used in place of pull boxes or bends.
- .14 Pull boxes shall be installed at a reasonable height, in an exposed location and such that access for installation of cables is not prohibited. Pull boxes shall not be placed in a fixed false ceiling space, unless immediately above a suitably marked and hinged access panel. Provide indicator decals on ceiling T-bar rail or ceiling tiles showing location of pull box or splice box. Refer to the Design Authority for details.
- .15 Conduit must enter the outlet boxes from the top or bottom.
- .16 All conduits shall be installed in accordance with Canadian Electrical Code, Part 1, Section 12, applicable building codes and TIA-569-D.
- .17 The minimum size (inside diameter) for EMT conduit running between the overhead cable tray and the Telecommunications outlet at an outlet location is twenty-five millimeters (25 mm).
- .18 The maximum horizontal cable run distance not to exceed 90 metres. The cable length from the mechanical termination in the CCS room to the Telecommunications outlet. Where the horizontal distance exceeds 90 meters, provide additional rooms as required.
- .19 Cable fill capacities of conduit, cable tray and raceways shall not be greater than 40%.
- .20 A pull cord or fish tape shall be installed in all conduits.
- .21 Place pull boxes in readily accessible locations only.
- .22 The use of LB, LL, LR, C and T type fittings or elbow fittings is not permitted.

- .23 Conduits ending in the vicinity of a cable tray shall be terminated at a height of no less than 100 mm or no more than 150 mm from the top of the cable tray conduits runs shall be not be punched through the cable tray.
- .24 Conduits: EMT type, in accordance with Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.
- .25 Junction boxes type: in accordance with Section 26 05 31 - Splitter, Junction, Pull Boxes and Cabinets.

## **2.4 WIRE BASKET CABLE TRAY**

- .1 Cable trays shall basket type wire mesh for horizontal distribution (hallways). All cable trays must be prefabricated structure. Basket cable trays shall be equipped with two side rails. Cable trays can be constructed with steel or aluminum. Tray can be painted, pre-galvanize or electro-zinc plated. Should aluminum trays be specified, during the grounding or bonding aspects of the installation, the contractor uses tin plated or zinc coated ground connectors.
- .2 See drawings for dimensions.
- .3 Spine type and centre hung cable trays are not authorized for use.
- .4 Each section of metal basket cable trays shall be bonded together and grounded to the TMGB or a TGB.
- .5 Shall be coated to prevent rust or galvanic action.
- .6 Accessories and fittings such as elbows, reducers, shall be manufactured by the cable tray manufacturer
- .7 Install cable trays at least 300 mm away from fluorescent luminaries and cross power cables at right angles. The minimum clearances for cable trays shall be in accordance with Canadian Electrical Code C22.1-09
- .8 300 mm vertical clearance from the top of cable trays to all ceilings, heating ducts, and heating equipment and 150 mm for short length obstructions and
- .9 600 mm horizontal clearance on one side of cable tray mounted adjacent to one another or to walls or other obstructions.
- .10 The Wire Basket Tray is to be installed within the corridors of the building.
- .11 The wire basket tray shall be 12-13 gauge, Straight sections shall be powder coated black with an average paint thickness of 1.2 mils (30 microns) to 3.0 mils (75 microns).
- .12 Tray shall be designed in such a way as to be secured to the following, but not limited to: wall, ceiling every four (4) feet
- .13 Splicing of trays shall be accomplished by using a single manufacturer supplied UL classified connector bolt or splice plate
- .14 Intersections shall be made from high strength steel, welded and plated in accordance with applicable standards.
- .15 Proper manufactured accessories and fittings such as elbows, reduces, crossovers, tees and riser shall be used for any change in direction, height or size of the cable basket tray

- .16 Support cable tray to suit loading and recommended support requirements in the Canadian Electrical Code Part II.
- .17 Materials bolted or riveted to the cable tray shall be free of burrs and or sharp edges.

## **2.5 LADDER RACK**

- .1 The ladder rack is to be installed within the CCS Room.
- .2 The ladder rack shall be 16 gauge, tubular steel.
- .3 Ladder rack shall be coated with a durable powder coat.
- .4 String dimension shall be 9.5 mm W x 38 mm H (0.375" W x 1.5" H) with a rung spacing of 228 mm (9.0").
- .5 The ladder rack shall have a minimum weight capacity of 67 kg/m (45 lbs/ft).
- .6 The ladder rack shall be 300 mm (12") wide.

## **2.6 FIRE-RATED PATHWAY**

- .1 All data, security, and communications cable bundles shall utilize an enclosed fire-rated pathway device wherever said cables penetrate rated walls.
- .2 The fire rated pathway shall contain a built-in fire sealing system sufficient to maintain the hourly fire rating of the barrier being penetrated.
- .3 The self-contained sealing system shall automatically adjust to the installed cable loading and shall permit cables to be installed, removed, or retrofitted without the need to remove or reinstall firestop materials.
- .4 The pathway shall be UL classified and tested to the requirements of ASTM E8 14 (UL 1479).
- .5 To be installed in fire rated walls between the corridors and CCS Room and/or where cable tray must penetrate fire rated walls.

## **2.7 COMMUNICATIONS OUTLET BOX**

- .1 Double gang, minimum 100 mm x 100 mm x 54 mm deep with a 12.5 mm single gang plaster ring or raised adapter plate, and shall not reduce the size of the outlet such that two additional outlets could not be added in the future.
- .2 Cover: Size to match outlet box.

## **2.8 JUNCTION BOXES (PULL BOXES)**

- .1 See Section 26 05 31 – Splitters, Junction Pull Boxes and Cabinets for general specifications.
- .2 See T100 for sizing information.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- .1 All pathways shall be installed to run parallel to access flooring system.
- .2 All conduit runs shall follow building grid lines and shall be concealed where possible.
- .3 Conduit runs that are feeding various locations on the 2nd and 1st floors need to be taken to the overhead due to ceiling obstructions (wood and drywall) in the hallway. (refer to drawings for obstruction areas).
- .4 Pathways shall be installed in coordination with other trades in order to minimize interferences and obstructions. The Electrical Contractor shall be responsible for relocating installed pathways at no cost to the Client.

#### **3.2 INDOOR CABLE DISTRIBUTION**

- .1 All pathways and cabling installation shall maintain clearances from all electrical and heat sources as outlined below:
  - .1 Fluorescent Fixtures: 30 cm.
  - .2 Electrical Distribution: 1.0 m cabling and conduits less than 1 KVA.
  - .3 Electrical Distribution Cabling: 3.0 m and conduits greater than 1 KVA.
  - .4 Transformers and Motors: 1.2 m.
  - .5 HVAC System including Ducts: 30 cm.
  - .6 Mechanical Piping: 15 cm.
- .2 Prepare all conduits and pathways prior to installation of cabling. This shall include bushing or reaming all conduit openings, pulling of wire brush and mandrel to clean out ducts and identifying any potential cause of damage to cabling during installation. Report all items to the Consultant immediately.

#### **3.3 GROUNDING**

- .1 For all grounding and bonding requirements refer to Section 27 05 26 - Grounding and Bonding for Communications Systems.

#### **3.4 FIRE STOPPING**

- .1 All fire stop systems shall be installed in accordance with the manufacturer's recommendations and installation guides and shall be available for inspection by the AHJ prior to acceptance.
- .2 All fire stopping must meet applicable federal, provincial and local building codes.
- .3 Supply and install non-permanent CSA approved intumescent fire stopping, cap all empty sleeves, slot and penetrations and around cabling passing through sleeves, cable trays, conduits, slots and penetrations located in the IT room location on both sides of the wall.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 SYSTEM DESCRIPTION**

- .1 Labeling and alphanumeric numbering criteria for all patch panels, and communication ports.
- .2 Telecommunications Identification for Communications Systems consists of mechanically produced (no handwritten markings) labels for indoor and outdoor usage.

### **1.2 RELATED SECTIONS**

- .1 Section 27 05 28 – Pathways for Communications Systems.
- .2 Section 27 13 23 – Communications Optical Fiber Backbone Cabling.
- .3 Section 27 15 13 – Communications Copper Horizontal Cabling.

### **1.3 REFERENCES**

- .1 American National Standards Institute (ANSI), Telecommunication Industry Association (TIA) and Electronic Industries Alliance (EIA):
  - .1 ANSI/TIA-606-B, Administration Standard Telecommunications Infrastructure (2012) Standard
- .2 Canadian Electrical Code (CEC) and Canadian Standards Association (CSA):
  - .1 C22.1-15 Canadian Electrical Code, Part 1 (23rd Edition), Safety Standard for Electrical Installations
- .3 Ontario Building Code 2010 (OBC).
- .4 National Fire Code 2010 (NFC).
- .5 Building Industry Consulting Service International (BICSI) and National Electrical Contractors Association (NECA):
  - .1 ANSI/NECA/BICSI 568-2006, Standard for Installing Commercial Building Telecommunications Cabling
- .6 BICSI Telecommunications Distribution Methods Manual (TDMM) 13th edition.
- .7 In the event of conflict, the most stringent and recent requirements shall apply to the codes and standards noted above.

### **1.4 CABLE LABELING**

- .1 All cabling runs shall be labeled in four (4) locations including at each end of the cable, on the corresponding faceplate and at the patch panel or IDC mount.
- .2 All cabling runs that form part of the circuit between the Data Switch and DC Distribution Power Supply and the surveillance camera shall be labeled. This includes every termination including patch cables, distribution cables, copper and fiber patch panels.

### **1.5 DATA PATCH PANEL LABELING**

- .1 Patch panels will be sequentially tagged (A, B, C, etc.).
- .2 Ports will be sequentially numbered from the first to the last port within a single patch panel. (1-48).  
Note: cumulative numbering between patch panels is not permitted.

## **1.6 FACEPLATE LABELING**

- .1 All data cabling shall be identified by an alphanumeric code that will coincide with the associated patch panel and port as follows:
- .2 All information jacks shall be labeled of the form:
  - .1 F = floor identifier
  - .2 S = space identifier
  - .3 A = patch panel identifier
  - .4 N = patch panel port
- .3 Example 1A-B22 represents CCS room on the first floor, CCS room A, patch panel B (the second patch panel), and port 22 on patch panel B

## **PART 2 - PRODUCTS**

### **2.1 CABLE, FACEPLATE AND PATCH PANEL**

- .1 All products shall meet UL 969 standards and be rated for indoor or outdoor use as applicable to the installation.
- .2 Cable labels shall be self-laminating, vinyl with white printing area and sized to allow label to wrap around 2.5 times minimum. Labels also shall be sized to suit the labeling requirement maintaining a minimum 10pt. font size.
- .3 Faceplate and Patch Panel labels shall be adhesive style made of polyester with a white printing area and sized to suit the designated label location. Labels shall be printed with a minimum 10pt. font size.
- .4 Patch Panel labels shall be adhesive style made of polyester with a white printing area and sized to suit the designated label location. Labels shall be printed with a minimum 6 mm (1/4") high font.

### **2.2 LABEL MANUFACTURERS**

- .1 Panduit or equivalent.

## **PART 3 - EXECUTION**

### **3.1 GENERAL**

- .1 All labels shall be laser-printed. No handwritten labels shall be accepted.

### **3.2 CABLE LABELS**

- .1 Cable labels shall be installed on clean and dry cable and mounted within 100mm or 4" of each end of each cable.
- .2 Labels on all faceplates and patch panels shall be mounted on a clean dry surface and aligned accurately.
- .3 Labels for cables and patch panel ports shall be a minimum 10 point font.
- .4 Labels on all patch panels shall be mounted on a clean dry surface and aligned accurately.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 SYSTEM DESCRIPTION**

- .1 The work covered by this section of the Specifications includes all labour necessary to perform and complete the commissioning (testing) of the communications copper and fiber cabling. The work of this section shall include, but is not limited to, the following:
- .2 Cable testing for fiber optic cables.
  - .1 Cable testing for copper communications cables
  - .2 Providing testing results in accordance with the strictest manufacturer written recommendations.

### **1.2 RELATED SECTIONS**

- .1 Section 27 00 03 - General Specification and Scope for Communications.
- .2 Section 27 05 28 - Pathways for Communications Systems.
- .3 Section 27 05 53 - Identification for Communications Systems.

### **1.3 REFERENCES**

- .1 ANSI/TIA 569-D Telecommunications Pathways and Spaces (April 2015) Standard
- .2 ANSI/TIA 568-C.0 Generic Telecommunications Cabling for Customer Premises (2009) Standard
- .3 ANSI/TIA-568-C.1, Commercial Building Telecommunications Cabling Standard (2009) Standard
- .4 ANSI/TIA-568-C.2, Balanced Twisted-Pair Telecommunication Cabling and Components (2009) Standard
- .5 ANSI/TIA-568-C.3, Optical Fiber Cabling Components (2008) Standard
- .6 ANSI/NECA/BICSI 568-2006, Standard for Installing Commercial Building Telecommunications Cabling
- .7 ANSI/TIA 607-B Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises (2012) Standard
- .8 NECA/BICSI 607-2011, Standard for Telecommunications Bonding and Grounding Planning and Installation methods for Commercial Buildings
- .9 ANSI/TIA 606-B Administration Standard Telecommunications Infrastructure (2012) Standard
- .10 BICSI Telecommunications Distribution Methods Manual (TDMM) 13th ed.
- .11 UTM Communications Cabling Standards Version 1.0 (April 2015)

## **1.4 SUBMITTALS**

- .1 Provide Proof of Calibration within the past year for all equipment (instrumentation) used for the purposes of testing and commissioning.

## **PART 2 - PRODUCTS**

### **2.1 COPPER TEST EQUIPMENT**

- .1 Acceptable Testers
  - .1 JDSU: Certifier40G
  - .2 Fluke: DSX-5000 Cable Analyzer
  - .3 Or approved equivalent

### **2.2 FIBRE OPTIC TEST EQUIPMENT**

- .1 Acceptable testers are as follows:
  - .1 Fluke DTX-1800
  - .2 Fluke DSX 5000
  - .3 Corning OTS-600
  - .4 Corning OV-MINI/OV1000
  - .5 Or approved equivalent

## **PART 3 - EXECUTION**

### **3.1 COPPER TESTING**

- .1 The consultant must approve the testing procedure prior to testing commencing and may request to be present during the initial testing.
- .2 Test all UTP cables as specified below and correct deficiencies: provide record of results as hard copy electronic record on USB.
- .3 Provide record of results as hard copy electronic record on USB to: ANSI/TIA-568-C Standards.
- .4 Upon completion of the testing by the Contractor, the consultant may ask the Contractor to perform a random test of up to 10% of the cables. A penalty deducted from the Contract amount for each cable that fails to pass the random test.
- .5 All deficiencies must be corrected before the consultant will provide a certificate to release the Holdback on the project.
- .6 The Contractor is to use a minimum of Level III tester that is capable of testing the specified cable to the performance level(s) indicated in this document. The tester is to use the latest version of firmware and software to test the UTP cabling system.
- .7 Test patch cords to portable tester must be designed for testing by the manufacturer. Field assembled patch cords are not acceptable. Field testers must use the appropriate jack/tester adapter specified for use with the cabling jack(s) specified within this document.

- .8 Testing of horizontal cables is to be completed in accordance with the following test criteria. The testing must be completed on the Permanent Link Level. Testing is to be completed from both ends of the installed cable. Testing of the cabling must conform to the ANSI/TIA-568-C Standards.
  - .1 Testing of all 4 pairs of the horizontal cable (as specified in this document) is to include but not be limited to the following:
    - .1 Wire Map including; end to end continuity, open and shorts, pair polarity
    - .2 Cable length
    - .3 Attenuation
    - .4 NEXT/FEXT
    - .5 ACR
    - .6 Return Loss
    - .7 ELFEXT, PSELFEXT
    - .8 Propagation Delay, Delay skew
    - .9 PSNEXT, PSACR.
  - .2 Contractor to produce a test report based on the cable schedules. The report should indicate for each cable, when it was tested successfully and the signature of the technician that performed the test, location, cable type, cable number and tester make and model.
  - .3 A copy of the test report must be submitted to the consultant for approval. The entire report must be signed by an authorized person for the Contractor at the end of the project.

### 3.2 FIBRE TESTING

- .1 All fibre cabling runs shall be 100% tested for defects in installation and to verify cabling system performance under installed conditions according to the requirements found in the TIA/EIA-568-C series of standards. All strands in each installed cable shall be verified prior to system acceptance. Any defect in the cabling system installation, including (but not limited to) cables, connectors, and cordage shall be repaired or replaced in order to ensure 100% usability of all installed runs.
- .2 Acceptable testers are as follows:
  - .1 Fluke DTX-1800
  - .2 Fluke DSX 5000
  - .3 Corning OTS-600
  - .4 Corning OV-MINI/OV1000
  - .5 Or approved equivalent
- .3 All fibre tests are to be performed using one of the approved testers equipped with the most recent version of its firmware and in accordance to ANSI/EIA/TIA-568-C series of standards.
- .4 Tester to be calibrated within one year of testing date.
- .5 Contractor must have up to date training for one of the approved testers being used to test the multi-mode fibre including all necessary launch cables and connectors.
- .6 Testing Method shall be Tier 1 and test for the following parameters:
  - .1 Link Insertion Loss (attenuation).
  - .2 Continuity.
  - .3 Connector Polarity.
  - .4 Length.

- .7 Testing of all fibre strands shall be completed using the 1 jumper method as stated in the EIA/TIA 568-C standard (1 jumper).
- .8 The maximum overall attenuation loss from end to end shall be less than 3dB.
- .9 The contractor shall have access to an OTDR for trouble shooting issues during the project.
- .10 All installed fibres and connectors must meet or exceed the minimum specifications of the manufacturer. Any fibres or connectors failing to meet these specifications to be promptly replaced or repaired by contractor at no additional cost.
- .11 All installed fibres and connectors shall maintain a maximum total optical attenuation of <0.5 dB through any installed strand pair. Any fibres or connectors failing to meet these specifications to be promptly replaced or repaired.
- .12 All testing and repairing must be completed at least six weeks prior to the area move-in date or system cut-over date.
- .13 All fibre tests results/reports to be submitted to the consultant contact or an outside 3rd party for review and comments back to the client at least four weeks prior to any move in date.
- .14 Failure to provide test results upon request will require the Contractor to retest all fibre strands with no cost to the client.
- .15 Provide adequate personnel for immediate on-site problem determination and correction during the cutover by the client and for a reasonable period of time thereafter.
- .16 All defects and deficiencies which originate or become evident during the warranty period to be repaired or replaced without additional expense to the client within 24 hours (1 day). All such work must be performed at a time which is acceptable to the client who may be outside regular working hours.
- .17 Submit complete test results and formal written certification that the communications cabling system is installed and operating in accordance with this and the manufacturers' specifications.
- .18 Contractor to provide manufacturer's preliminary certification number within 1 month of contract award.
- .19 Contractor to provide a letter of certification within 2 weeks of substantial completion. This letter shall include: notification of the multimode installation, verification of performance of the installed system, manufacturers certification number, identification of installation by location and project number and a copy of the warranty certification request form.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 SYSTEM DESCRIPTION**

- .1 Backbone cabling shall be installed in pathways indicted on drawings and as per Section 27 05 28 of this specification.
- .2 All cables shall be neatly bundled and installed as per the manufacturer's guidelines or the standards in these specifications; whichever is more stringent.
- .3 The Communications Contractor shall be responsible for a complete backbone cabling installation including and not limited to, termination fibre connector, adaptor plates, cabling, ty-wraps, patch panels and labelling.
- .4 All Fibre Optic cabling shall be installed in dedicated conduit.

### **1.2 RELATED SECTIONS**

- .1 Section 27 00 03 – General Specifications and Scope.
- .2 Section 27 05 28 – Pathways for Communications Systems.
- .3 Section 27 05 26 – Grounding and Bonding for Communications Systems.
- .4 Section 27 08 00 – Commissioning of Communications.

### **1.3 REFERENCES**

- .1 Canadian Standards Association (CSA) and Canadian Standards Association (CSA):
  - .1 CSA-C22.2 No. 214-02, Communications Cables (Binational Standard with UL 444)
  - .2 CSA-C22.2 No. 232-M1988 (R2004), Optical Fibre Cables
- .2 American National Standards Institute (ANSI) and Telecommunications Industry Association (TIA):
  - .1 ANSI/TIA-568-C.0, Generic Telecommunications Cabling for Customer Premises.
  - .2 ANSI/TIA-568-C.1, Commercial Building Telecommunications Cabling Standard, Part 1: General Requirements.
  - .3 ANSI/TIA-568-C.2, Commercial Building Telecommunications Cabling Standard, Part 2: Balanced Twisted-Pair Cabling Components.
  - .4 ANSI/TIA-568-C.3, Optical Fiber Cabling Components Standard.
  - .5 ANSI/TIA-606-B-2012, Administration Standard for the Commercial Telecommunications Infrastructure.
  - .6 TIA-598-C-(2005), Optical Fiber Cable Colour Coding.
- .3 National Fire Code 2010 (NFC).
- .4 Treasury Board Information or Technology Standard (TBITS):
  - .1 TBITS 6.9, Canadian Open Systems Application Criteria (COSAC), Telecommunications Wiring System in Government-Owned and Leased Buildings- Implementation Criteria
- .5 In the event of conflict, the most stringent and recent requirements shall apply to the codes and standards noted above.

## **PART 2 - PRODUCTS**

### **2.1 MULTIMODE DISTRIBUTION SERIES OPTICAL FIBRE CABLE**

- .1 As per University standard:
  - .1 Commscope Part No. P-012-DS-5L-FSUAQ.

### **2.2 FIBRE PATCH PANEL**

- .1 As per University standard:
  - .1 Commscope Part No. FL2-24TS525.

### **2.3 ADAPTER PANELS**

- .1 As per University standard:
  - .1 Commscope Part No. FL2-6P6JC603R.

### **2.4 FIBRE OPTIC SPLICE TRAY PANELS**

- .1 As per University standard:
  - .1 Commscope Part No. FST-DRS12-HS.

### **2.5 LC CONNECTORS**

- .1 As per University standard:
  - .1 Commscope Part No. MFC-LFC-09-5X.

### **2.6 FIBRE PATH CORDS**

- .1 As per University standard:
  - .1 Commscope Part No. FEWLCSC42.

## **PART 3 - EXECUTION**

### **3.1 MULTIMODE DISTRIBUTION SERIES OPTICAL FIBRE CABLE**

- .1 Fibre backbone to be installed from VCAP room on the first floor to VCAP room on the second floor
- .2 Fibre optic cabling shall be installed in conduit as per manufacturer's instructions.
- .3 Fibre optic cabling in racks and cabinets shall be neatly dressed using Velcro cable ties.
- .4 All cables shall continuous with no splices other than those that may be identified on drawings.
- .5 Provide a minimum of 3.0 m (10'-0") of slack at the patch panel end of each fibre optic cable. Neatly coil slack in cabinet and fasten with Velcro cable ties.

- .6 All strands of fibre optic cabling shall be terminated on the appropriate rack mounted fiber patch panel using adapter strips with LC connectors.
- .7 Clean all cabling of pulling lubricants prior to termination and labelling.
- .8 Terminate, test, label and document all strands as specified.

### **3.2 BEND RADIUS**

- .1 Do not kink or exceed the cable minimum bend radius for all cabling. Maintain a minimum of ten (10) times the cable diameter or 30 mm (1.2") whichever is larger for a bend radius.

### **3.3 CABLE LUBRICANT**

- .1 Where there is the potential for excess stress on a cable(s) when pulling through conduit systems, apply a non-corrosive quick drying lubricant to the cable to facilitate pulling.
- .2 Completely remove all cable lubricant from cable jacket as cable exits the conduit system prior to termination and labelling.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 SYSTEM DESCRIPTION**

- .1 Horizontal cabling shall be installed in pathways indicated on drawings and as per Section 27 05 28 – Pathways for Communications Systems of this specification.
- .2 All cables shall be neatly bundled and installed as per the manufacturer's guidelines or the standards in these specifications; whichever is more stringent.
- .3 Ensure that all cables are sufficiently long to allow for slack, vertical runs, wastage, connectorization and future moves.
- .4 VCAP System conduit pathways only, no horizontal cabling required (refer to conduit drawings).

### **1.2 RELATED SECTIONS**

- .1 Section 27 00 03 – General Specifications and Scope.
- .2 Section 27 05 28 – Pathways for Communications Systems.
- .3 Section 27 05 26 – Grounding and Bonding for Communications Systems.

### **1.3 REFERENCES**

- .1 Canadian Standards Association (CSA) and Canadian Standards Association (CSA):
  - .1 CSA-C22.2 No. 214-02, Communications Cables (Binational Standard with UL 444).
  - .2 CSA-C22.2 No. 232-M1988 (R2004), Optical Fibre Cables.
- .2 American National Standards Institute (ANSI) and Telecommunications Industry Association (TIA):
  - .1 ANSI/TIA-568-C.0, Generic Telecommunications Cabling for Customer Premises.
  - .2 ANSI/TIA-568-C.1, Commercial Building Telecommunications Cabling Standard, Part 1: General Requirements.
  - .3 ANSI/TIA-568-C.2, Commercial Building Telecommunications Cabling Standard, Part 2: Balanced Twisted-Pair Cabling Components.
  - .4 ANSI/TIA-568-C.3, Optical Fiber Cabling Components Standard.
  - .5 ANSI/TIA-606-B-2012, Administration Standard for the Commercial Telecommunications Infrastructure.
  - .6 TIA-598-C-(2005), Optical Fiber Cable Colour Coding.
- .3 National Fire Code 2010 (NFC).
- .4 Treasury Board Information or Technology Standard (TBITS):
  - .1 TBITS 6.9, Canadian Open Systems Application Criteria (COSAC), Telecommunications Wiring System in Government-Owned and Leased Buildings- Implementation Criteria.
- .5 In the event of conflict, the most stringent and recent requirements shall apply to the codes and standards noted above.

## 1.4 MANUFACTURERS WARRANTY

- .1 Qualification of System:
  - .1 The installed horizontal cabling system shall be covered by the Manufacturer's Certification, issued by the successful manufacture and delivered by the Communications Cabling Contractor to the consultant.
  - .2 The installed horizontal cabling system shall conform to all applicable local building and electrical codes.
  - .3 The manufactures representative shall attend the site, as appropriate, in order to inspect the installation of the various phases of the project and to confirm that the installation is being performed in accordance with the manufacturer's installation guidelines. The manufacture shall provide documentation, if required, evidencing the date and time that such inspections were performed and the results of such inspections.
- .2 25-Year Component Warranty:
  - .1 The manufacture shall provide a minimum twenty five (25) year warranty for all manufactured passive components used in the installation of the 250MHz and copper tie backbone cabling system. Defective and/or improperly installed products shall be replaced and/or reinstalled at no cost to the client.
- .3 Certification:
  - .1 To qualify for System Certification, the manufacture of the 250MHz and copper tie backbone system shall be designed, installed, and tested by the Certified Communications Cabling Contractor for this project.
  - .2 To qualify for System Certification, the installed cabling system shall fully comply with all relevant manufacturer design and applications guidelines, including any pre-approved deviations as specified in the latest release of the manufacture Certification Guide.
  - .3 To qualify for System Certification, only products made or approved by the cabling manufacturer shall be used to ensure the end-to-end performance of the manufacturer's cabling system. The manufacturer's minimum 25-Year Component Warranty and Lifetime Application Assurance can only be provided to installations consisting of products supplied by the manufacture of the cabling system.
  - .4 The successful manufacturer will not provide certification or warranty coverage for products manufactured by other entities.
  - .5 The Communications Cabling Contractor will provide a pre-approved draft of the manufacturer's Letter of Certification within two weeks of award of this project. The document must include the following:
    - .1 Verification of the performance of the installed cabling system.
    - .2 Manufacturer's Certification Number.
    - .3 Identification of the Installation by location and project number.
- .4 Owner Responsibility:
  - .1 The Communications Cabling Contractor shall provide a cabling system user manual to the owner of the cabling system. This document describes essential system elements and specifies the owner's responsibilities for maintaining the integrity of the installed cabling system over time. The cabling user manual contains guidelines for cabling system modifications (e.g., relocations, additions, changes to services), in addition to labeling and record-keeping maintenance requirements.
  - .2 The Owner of the cabling system accepts that the benefits offered by System Certification are revoked if non-approved products are introduced to the installed cabling System. To regain System Certification in such cases, a certified cabling contractor must apply and validate all corrective modifications deemed necessary by the cabling manufacturer.

## **PART 2 - PRODUCTS**

### **2.1 CATEGORY 6 FOUR-PAIR 100 OHM BALANCED PLENUM TWISTED PAIR CABLE**

- .1 As per University standard:
  - .1 CommScope Part No. UN874049914/10 | CS34P BLU C6 4/23 U/UTP CPK 1KFT.

### **2.2 CATEGORY 6 48 PORT PATCH PANEL**

- .1 As per University standard:
  - .1 CommScope Part No. 760117366 | 360-PM-GS3-2U-48P.

### **2.3 RJ45 MODULE**

- .1 As per University standard:
  - .1 CommScope Part No. 760237778 | UNJ600-BL.

### **2.4 4 PORT FACEPLATES**

- .1 As per University standard:
  - .1 CommScope Part No. 108168550 | M14L-246.

### **2.5 CUSTOM FACEPLATES**

- .1 As per University standards:
  - .1 Part No. NSP12W.
  - .2 Part No. SFHC14W.
  - .3 Part No. HDH15BK.

### **2.6 BLANKS**

- .1 As per University standard:
  - .1 CommScope Part No. 107067860 | M20AP-246.

### **2.7 4 CONDUCTORS 18 AWG CABLE**

- .1 4 Conductors 18 AWG copper cable.
- .2 Cable to be used for duress alarm.

### **2.8 ACCESS CONTROL ALL IN ONE CONDUCTOR CABLE**

- .1 Banana peel style cable for access control.
- .2 Card Reader (Orange) 22 AWG.
- .3 Door Contact (white) 22 AWG.
- .4 REX/Spare (Blue) 22 AWG.
- .5 Lock Power (Grey) 18 AWG.

## **2.9 CAT 6 PATCH CORDS**

- .1 As per University standards:
  - .1 CommScope Part No. UC1BBB2-0ZF007.
  - .2 CommScope Part No. UC1BBB2-0ZF010.

## **2.10 RACKS**

- .1 As per University standard:
  - .1 R.F Mote Part No. RFM-1944-RB.

## **2.11 CABLE MANAGEMENT**

- .1 As per University standards:
  - .1 R.F Mote Part No. RFM-FMS-8.
  - .2 R.F Mote Part No. RFM-FMS-12.

# **PART 3 - EXECUTION**

## **3.1 HORIZONTAL DISTRIBUTION CABLING**

- .1 The horizontal distribution cabling system is the portion of the telecommunications cable system that extends from the work area outlet to the CCS room. The horizontal distribution cabling system includes the outlet, the mechanical termination cross-connections for the horizontal distribution cables at the outlet and in the CCS room. The horizontal distribution cabling shall comply with the following:
- .2 The horizontal distribution cabling shall be configured in a star topology wherein each outlet shall be connected directly to the CCS room by a continuous cable. Transition points, cable splices or cross connect points are not permitted.
- .3 The maximum horizontal distance shall be 90 metres. This is the cable length from the mechanical termination in the CCS room to the Telecommunications outlet. In establishing maximum distance, an allowance was made for three (3) additional metres from the outlet to the workstation and six (6) metres for patch cords.
- .4 CAT 6 cable, 4 pair, 100 ohm, 23/24 AWG, thermoplastic insulated, solid copper conductor unshielded twisted pair (UTP), formed into four individually twisted pairs and enclosed by a thermoplastic jacket, sheath colour, CSA certified as CMP (FT6) shall be installed for all voice and data requirements. At a minimum, two (2) CAT 6 UTP cables must be installed at each workstation outlet. (Refer to drawings for quantities and locations).
- .5 No cable shall be bent on a radius of less than eight (8) times the cable diameter.
- .6 Cables shall be loosely bundled and secured using Velcro cable ties or another similar product. Cable bundles must not be stressed or over cinched. Cables terminating at the patch panel shall be dressed-in following standard craft practice. Bundle cables separately for identification purposes when applicable.
- .7 When terminating UTP data cables, the length of cable twist (twist/cm) shall be identical to that of the remainder of the cable. This twist shall be maintained up to 13mm (1/2") from the termination point of the cable at the patch panel and the outlet jacks.

- .8 UTP cabling shall be terminated as per manufacturer's guidelines and remove only enough cable jacket to perform termination. When terminating UTP cable, the maximum length of sheath removed shall be 13mm.
- .9 Provide a minimum of 3.0 m (10'-0") of slack at both ends of each cable. Neatly coil slack and attach to cable tray or provide independent support in ceiling. Slack for workstation outlets shall be located at the cable tray. Provide no slack at the patch panel, to be terminated to measure.
- .10 Provide a minimum of 10.0m (33'-0") of slacks at WAP location for future relocation Neatly coil slack and attach to cable tray to provide independent support in ceiling Provide no slack at the patch panel, to be terminated to measure.
- .11 Ensure that all cables are of sufficient length to allow for slack, vertical runs, wastage, connectorization and future moves.
- .12 Comply with manufacturer's recommended bundling practices for installation. Ensure that excess pressure is not placed on the cable at any point that may result in the compression or deformation of the cable jacket and internal pair/conductor geometry.
- .13 Cables shall not be scrapped, dented or otherwise damaged before, during or after installation. All damaged cabling shall be replaced at no extra cost to the Client.
- .14 Cables should be the following colour for each system:

System	Colour
CCS Network	Blue
Security	Green
Paging	Orange

### 3.2 CABLE ROUTING

- .1 Make all necessary adjustments to cable route(s) / pathway(s) to accommodate architectural, structural, mechanical and/or electrical conditions.
- .2 All pathways shall be parallel to building lines. If it is necessary to route cables otherwise to accommodate cable length written permission shall be obtained from the Contractor prior to installation.
- .3 Any deviation from cable routing shown on drawings (where shown) shall be approved in writing by the Contractor prior to installation and shall be documented on record drawings.

### 3.3 BEND RADIUS

- .1 Do not kink or exceed the cable minimum bend radius for all cabling. For all copper cabling maintain a minimum of (4) times cable diameter as bend radii if the manufacturer specifies no bend radius.
- .2 Where there is the potential for excess stress on a cable(s) when pulling through conduit systems, apply a non-corrosive quick drying lubricant to the cable to facilitate pulling.
- .3 Completely remove all cable lubricant from cable jacket as cable exits the conduit system prior to termination and labelling.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 SYSTEM DESCRIPTION**

- .1 This section covers the supply and installation of the overhead paging system in the plant.
- .2 The scope of work for this section includes but is not limited to the following:
  - .1 Speakers, horns, volume controls and paging controllers.
  - .2 Backbone cabling, connectors and terminations.
  - .3 Pathways for the paging system.
  - .4 Paging system power requirements.
  - .5 Paging system access closets.
  - .6 Safety wires for all fixed system equipment.
  - .7 Miscellaneous paging equipment.
  - .8 Commissioning and testing.
  - .9 Operations staff training.

### **1.2 RELATED SECTIONS**

- .1 Section 27 08 00 – Commissioning of Communications.
- .2 Section 27 15 13 – Communications Copper Horizontal Cabling.

### **1.3 SUBMITTALS**

- .1 Submit the following shop drawings for review:
  - .1 All Valcom part to be installed
  - .2 All BIX connectors, frames, label strips and miscellaneous equipment.
  - .3 Cabling, cross-connect wire and miscellaneous connectors.
- .2 Commissioning plan:
  - .1 Test plan/procedure

### **1.4 OPERATIONS AND MAINTENANCE MANUALS**

- .1 Provide the following information in the Operations and Maintenance Manuals:
  - .1 All approved shop drawings.
  - .2 Technical literature on all components.
  - .3 Installation and maintenance manuals on all components.
  - .4 Excel file that list all of the components provided in this section, related serial number, electrical information such as voltage and wattage, manufacturer contact address and telephone number and local supplier address and telephone number.

### **1.5 WARRANTY**

- .1 Provide a two year parts and labour warranty on all installed products.

## **PART 2 - PRODUCTS**

### **2.1 CEILING SPEAKERS (PAGING)**

- .1 Speaker, amplifier and volume control unit mounted in 8" round speaker:
  - .1 Watt amplifier built in.
  - .2 Baked enamel finish.
  - .3 Valcom Part No. V-1020C (or equivalent).

### **2.2 CEILING SPEAKER MOUNT (PAGING)**

- .1 Bridge and back plate:
- .2 Valcom Part No. V-9916-M (or equivalent).

### **2.3 SIP BASED PAGING SERVER (PAGING)**

- .1 Enables to engage paging and phone to phone communications over an IP-based LAN/WAN.
- .2 Up to four zones.
- .3 Valcom Part No. VIP-204A (or equivalent).

### **2.4 POWER SUPPLY (PAGING)**

- .1 Power supply for speakers.
- .2 Valcom Part No. VP-1124D (or equivalent).

## **PART 3 - EXECUTION**

### **3.1 PAGING EQUIPMENT/CABLE INSTALLATION**

- .1 Cables shall be dressed and terminated in accordance with:
  - .1 Standards-based recommendations.
  - .2 The manufacturer's recommendations and installation guides.
  - .3 Industry best practices
- .2 The horizontal paging cabling shall be white, Cat6 4 pair CMP cable.
- .3 At each speaker location leave a 30 foot coil for future relocation.
- .4 Maximum number of seven speakers per cable runs.
- .5 The speaker cabling and other paging cabling will terminate using BIX type hardware (1A4's, 20a and labels) on plywood within the CCS room.
- .6 The cabling contractor to supply and install one 2U high by a minimum of 10" deep wall mount bracket on the plywood beside the BIX 10A mount.

- .7 Supply and install lay-in ceiling speakers with 1 bar strips (Valcom Part No. V-TBAR or equivalent) to properly support the speakers at the locations indicated on the drawings
- .8 Supply and install the SIP Based Paging Server (or equivalent) in the 2U high wall mount bracket on the plywood in the CCS room (exact location to be determined at a later date).
- .9 Cross-connect the power and audio power supply for all speakers.
- .10 Cross-connect the power for the VIP 204A unit.
- .11 The pair untwist at the termination point shall not exceed 13 mm (0.4 in.)
- .12 Each cable shall be clearly labeled on the cable jacket within 4inches of the termination behind the speaker terminals. Labels obscured from view will not be acceptable and will be replaced by the Communications Cabling Contractor at no cost to the client
- .13 Cabling Contractor to terminate all horizontal cabling, paging hardware cabling and test with the client IT department representative to ensure all speakers are working and have been volume adjusted for the area it serves.
- .14 Cabling contractor to supply and install the RJ45 patch cord from the FXO port on the client's network switch to the VIP-204A unit.
- .15 Client to provide a radio with an RCA cord to audio for connection to the VIP204A unit.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 SECURITY SCOPE OF WORK**

- .1 The document covers the scope of work with regard to security subsystems, as part of the VMI Building Renovations for the College of Social and Applied Human Sciences. The areas of security this project will touch include the Access Control system, the Video Surveillance system, the Universal Bathroom security system, and the Duress Alarm system. The general scope for each area is outlined below. All equipment supplies shall be new unused equipment. All enclosure supplied shall be lockable, and shall be outfitted with a keyed lock native to the enclosure.

### **1.2 ACCESS CONTROL SYSTEM**

- .1 All access control hardware around the door shall be as set out in the door hardware schedule.
  - .1 The contractor shall supply the hardware as indicated in addition to sufficient V100 Access Control Units, CloudLink modules, V200 and V300 to incorporate the scheduled hardware into the University's Genetec Access control system, to allow for proper operation all doors.
  - .2 Where Electromagnetic locks are utilized, the installation shall conform to the prevailing code, and/or the direction of the Authority Having Jurisdiction, with regard to install, operation and fire and emergency trigger disconnect.
  - .3 The security contractor shall coordinate with fire contractor with regards to cross-connections to between components of the two systems.
- .2 All Access Control Unit hardware shall be housed a 24x24 lockable can, as per the drawing.
  - .1 All electrified hardware is to be powered by the appropriate Securitron power supply equipped with 16 independently controlled power limited outputs, as outlined in the specification and/or drawings.
  - .2 All power supplies shall be housed in individuals enclosure as indicated by the specification and/or drawings.
  - .3 All power supplies shall be backed up by 2 (two) 7-AMP Sealed lead acid batteries, having a typical life of 3 to 5 years
  - .4 All request-to-exit (REX) sensors, shall shunt the door forced alarm only, and shall not in any way change the strike to being in an open position. All hardware installation, and wiring shall conform with the drawings, specifications, university standards and the manufacturer's best practices, (whichever is stricter).
- .3 This deployment will also require elevator access control, with restrictions to call the elevator by credential holders/groups, and restricted floor/door access by credential holders/groups. The Contractor will be required to coordinate with the University's elevator contractor to coordinate this install. In some instances, the Contractor will simply need to bring the wiring to the elevator control room, (room 231), with the elevator contractor doing final tie-in in the elevator control room. In other instances, such as readers to permit access/operation of the elevator call buttons, it will be the responsibility of the security Contractor. The access control for the elevators, shall accommodate full elevator tracking and reporting.

### 1.3 DURESS ALARM SYSTEM

- .1 This project involves the installation of a Duress alarm system, with panic button installed in the interview rooms, a light outside each interview room, and an annunciator panel in each reception area. Alarm conditions will be communicated to the annunciator panel, and transmitted via a POTS line, to campus police, who will receive the alarm through Onyxworks Command interface, and take the appropriate action.
- .2 The Duress system will consist of a DSC Maxsys PC4020 Control Panel, DSC Maxsys PC4612 keypad, DSC Maxsys PC4632 32-point Graphic Annunciators and sufficient DSC Maxsys PC4116 16 zone hardwire zone expanders and/or DSC Maxsys PC4108A 8 zone hardware zone expanders, and DSC Maxsys PC4204 Power Supply/Relay Output Modules, plus sufficient strobe lights and panic buttons to populate each room location.
  - .1 A Maxsys PC4632 32-point Graphic Annunciator console shall be place at the reception desk of each floor, and also in the second-floor hallway near the entry way outside room 201.
  - .2 All Graphic Annunciator console shall be installed recessed into the wall. A 2-stage light shall be place outside each interview room; the light shall turn on when the room is occupied and shall flash when the panic button for the corresponding room is activated.
  - .3 When the interview room is unoccupied, the light shall be unilluminated.
  - .4 The panic button shall have a local key reset. Each panic button must be fully supervised with end-of-line resistors to detect zone faults, zone tamper, violated and restored zones. All panic buttons shall be programed as 24-hour zones.
- .3 All hardware installation, and wiring shall conform with the drawing, specification, university standards and the manufacturer's best practices, (whichever is stricter). All power supplies shall be housed in individual enclosures as indicated by the specification and/or drawings. All power supplies shall be backed up by 2 (two) 7-AMP Sealed lead acid batteries, having a typical life of 3 to 5 years.

### 1.4 UNIVERSAL WASHROOM

- .1 The Universal Washroom door system shall be the Camden Control CX-WC16 "Touchless Switch" Restroom System, with a failsafe strike as dictated by the door hardware specification. The kit shall comprise the CX-33 Advanced Logic Relay, The CM-331/42WS-SGLR Double Gang Illuminated Touchless Switch, light ring and sign, a CM-331/43S-SGLR Single Gang Illuminated Touchless Switch, light ring and sign, and the CM-325/42WS Double Gang Touchless Switch. A recessed door contact will be supplied and installed by the contractor, instead of the CX-MDA supplied with the kit.
- .2 The CX-33 shall connect the above hardware as well as to the Automatic Door Operator. The functionality shall be as follows:
- .3 Waving at the exterior SureWave™ touchless switch shall open an unlocked door. Once inside and the door is closed, waiving at the illuminated "Wave to Lock" SureWave™ touchless switch changes the colour to red and locks the door. To exit, wave at interior "Wave to Open" SureWave™ touchless switch to unlock the door and reset the system. The "Wave to Lock" SureWave™ switch illuminated ring turns green and the exterior "Wave to Open" SureWave™ light ring turns green. If the door is opened manually to exit the restroom, the magnetic contact switch installed on the door resets the system.
- .4 All hardware installation, and wiring shall conform with the drawing, specification, university standards and the manufacturer's best practices, (whichever is stricter).

## **1.5 VIDEO SURVEILLANCE**

- .1 All cameras shall be IP HD cameras as detailed in specification 28 21 13.
  - .1 The cameras shall connect to the existing Genetec VMS, and shall function at their full resolution.
  - .2 All other recording and viewing setting shall be inherited from the server settings.
  - .3 The camera identified in specification 28 21 13-3, shall be setup in panoramic corner mode, so that the camera has a 90° by 90° field of view horizontally and vertically respectively.
- .2 All cameras shall be installed following the installation guidelines of the manufacturer.
  - .1 Cameras installed in drop ceiling, shall use the proper drop ceiling accessory, manufactured specifically for the installed model of camera, manufactured by the same camera manufacturer.
  - .2 Wall mounted, ceiling or parapet mounted cameras are to have the proper mounting bracket(s), camera backbox, conduit bracket, pendant cap, etc., as dictated by the camera mounting position as per the manufacturer's installation instructions.
  - .3 All best practices with regard to camera setup shall be observed, including password security and stream bandwidth optimization.
  - .4 Once mounted and connected, camera lens covers are to be left in a clean state, devoid of any debris, fingerprints or other contaminants that will obstruct the camera view.
- .3 All hardware installation, and wiring shall conform with the drawings, specification, university standards and the manufacturer's best practices, (whichever is stricter).

## **1.6 LABELING**

- .1 All wiring shall be clearly labeled following the specification outlined in specification 27 05 53, detailing end point locations in the labeling nomenclature. All labels shall be mechanically printed, on white background with a black font.

## **PART 2 - PRODUCTS**

- .1 Not used.

## **PART 3 - EXECUTION**

- .1 Not used.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 SWITCHING POWER SUPPLY – SINGLE VOLTAGE**

- .1 Power Supply is to be UL listed, supervised single voltage switching power supply with a dedicated battery charging circuit.
- .2 Power Supply to provide 10 A power at 24 VDC to 16 independently controlled power limited outputs.
- .3 Power Supply to provide typical output of 25.0 VDC, with ripple at 130 mV PTP.
- .4 Power Supply to be capable of handling either 120 VAC or 240 VAC input power.
- .5 Power Supply outputs are Class 2 limited when used with 4, 8 or 16 output distribution boards with PTC fuses.
- .6 Power Supply to be capable of being expanded to 16 independently controlled limited outputs.
- .7 Power Supply to accommodate configurable access control input/outputs with fire trigger in either PTC or with fuse/dry contact option, fire relay only or configurable outputs with fire relay input. LED indicators and for "C" contacts for supervision.
- .8 Power Supply to support two sealed gel, AGM or wet lead acid batteries.
- .9 Power Supply to be housed in a 14" x 14" x 4 ¾" enclosure and suitable to operate within a -20C to +50C environment.
- .10 Specified Manufacturer: Securitron AQS2410

## **PART 2 - PRODUCTS**

- .1 Not used.

## **PART 3 - EXECUTION**

- .1 Not used.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 SWITCHING POWER SUPPLY – SINGLE VOLTAGE**

- .1 Power Supply is to be UL listed, supervised single voltage switching power supply with a dedicated battery charging circuit.
- .2 Power Supply to provide 10 A power at 12 VDC to 16 independently controlled power limited outputs.
- .3 Power Supply to provide typical output of 12.5 VDC, with ripple at 168 mV PTP.
- .4 Power Supply to be capable of handling either 120 VAC or 240 VAC input power.
- .5 Power Supply outputs are Class 2 limited when used with 4, 8 or 16 output distribution boards with PTC fuses.
- .6 Power Supply to be capable of being expanded to 16 independently controlled limited outputs.
- .7 Power Supply to accommodate configurable access control input/outputs with fire trigger in either PTC or with fuse/dry contact option, fire relay only or configurable outputs with fire relay input. LED indicators and for "C" contacts for supervision.
- .8 Power Supply to support two sealed gel, AGM or wet lead acid batteries.
- .9 Power Supply to be housed in a 14" x 14" x 4 ¾" enclosure and suitable to operate within a -20C to +50C environment.
- .10 Specified Manufacturer: Securitron AQS1210

## **PART 2 - PRODUCTS**

- .1 Not used.

## **PART 3 - EXECUTION**

- .1 Not used.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 SWITCHING POWER SUPPLY – DUAL VOLTAGE**

- .1 Power Supply is to be UL listed, supervised field selectable dual voltage switching power supply with a dedicated battery charging circuit.
- .2 Power Supply to provide 6 A power at 12 VDC or 24 VDC to 16 independently controlled power limited outputs.
- .3 Power Supply to provide typical output of 12.5 VDC or 25.0 VDC, with ripple at 240 mV PTP.
- .4 Power Supply to be capable of handling either 120 VAC or 240 VAC input power.
- .5 Power Supply outputs are Class 2 limited when used with 4, 8 or 16 output distribution boards with PTC fuses.
- .6 Power Supply to be capable of being expanded to 16 independently controlled limited outputs.
- .7 Power Supply to accommodate configurable access control input/outputs with fire trigger in either PTC or with fuse/dry contact option, fire relay only or configurable outputs with fire relay input. LED indicators and for “C” contacts for supervision.
- .8 Power Supply to support two sealed gel, AGM or wet lead acid batteries.
- .9 Power Supply to be housed in a 14” x 14” x 4 ¾” enclosure and suitable to operate within a -20C to +50C environment.
- .10 Specified Manufacturer: Securitron AQD6

## **PART 2 - PRODUCTS**

- .1 Not used.

## **PART 3 - EXECUTION**

- .1 Not used.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 FLUSHMOUNT ENCLOSURE FOR POWER SUPPLY – ACCESS CONTROL**

- .1 Standards:
  - .1 The enclosure shall comply with UL 50 Type 1, CSA Type 1, NEMA Type 1, and IEC 60529, IP20 standards.
- .2 Construction
  - .1 Three-piece assembly consisting of a base, wrapper, and door.
  - .2 Components are attached and secured with metal screws.
  - .3 14-gauge reverse formed base provides clearance for mounting hardware.
  - .4 Punched for left or right hinging of the door and ease of assembly.
  - .5 Wrapper is formed from 16-gauge steel, with no knock-outs in the sides.
  - .6 Flush mounting door assembly formed from 16-gauge steel.
  - .7 Door is fastened with a slotted quarter turn latch.
  - .8 A bonding stud is provided on the door and a grounding screw is provided for the enclosure.
- .3 Finish:
  - .1 Base, wrapper and door are finished in ANSI 61 gray powder coating.
- .4 Dimensions:
  - .1 Size H x W x D: 508 mm x 406 mm x 102 mm (20.00 in x 16.00 in x 4.00 in).

## **PART 2 - PRODUCTS**

- .1 Not used.

## **PART 3 - EXECUTION**

- .1 Not used.

END OF SECTION

## **PART 1 - SYNERGIS CLOUD LINK**

### **1.1 GENERAL**

- .1 The Synergis Cloud Link is an open architecture embedded computer who allow a symmetric hybrid cloud architecture, its task is also to manage one or more access controlled doors. It offers Additional tasks such as:
  - .1 Manage downstream reader interface modules, door controllers, input/output modules and wireless/PoE locks.
  - .2 Monitor one or more input points (zones).
  - .3 Log all access control and IO events in a database.
  - .4 Send real-time event reporting to an Access Control System (ACS).
- .2 The IMC shall be supported by the following security systems:
  - .1 Genetec Security Center unified security platform.
  - .2 Genetec Synergis access control system (ACS).
- .3 Downstream device management
  - .1 The IMC shall control and program downstream devices.
  - .2 Shall be able to configure downstream modules in advance, without the IMC connected to the host software (SC).
  - .3 Shall support plug-and-play deployment with pre-wired kits with IMC, power supply, HID modules.
  - .4 Degraded mode: facility code only mode with HID.
  - .5 Supported devices shall include:
    - .1 Reader interface modules (IP- or RS485-based devices) with limited access control business logic.
    - .2 Advanced door controllers (IP- or RS485-based devices).
    - .3 Smart card readers.
    - .4 Input modules
    - .5 Output modules.
    - .6 Wireless locks
    - .7 PoE locks
- .4 Supported manufacturers of downstream devices are:
  - .1 HID VertX (RS-485 communications)
    - .1 V100 two-reader interface module.
    - .2 V200 16-input module.
    - .3 V300 12-output module.
  - .2 Mercury EP and SIO
    - .1 EP2500
    - .2 EP1501
    - .3 EP1502

- .4 EP4502
- .5 MR52
- .6 MR50
- .7 MR51e
- .8 MR16in
- .9 MR16out
- .3 Mercury M5 bridge
  - .1 M5-IC
  - .2 M5-8RP
  - .3 M5-2RP
  - .4 M5-2SRP
  - .5 M5-20IN
  - .6 M5-16DO
  - .7 M5-16DOR
  - .8 M5-COM
  - .9 M52000
- .4 Mercury ProWatch 6K
  - .1 PW6K1IC
  - .2 PW6K1R2
  - .3 PW6K1IN
  - .4 PW6K1OUT
- .5 Assa Abloy Aperio
  - .1 AH30 hub (up to 8 devices per hub)
  - .2 A100
  - .3 K100
  - .4 KS100
  - .5 R100
  - .6 AS100
  - .7 M100
  - .8 PR100
  - .9 IN100
  - .10 E100
  - .11 C100
  - .12 L100
- .6 Assa Abloy IP locks
  - .1 Sargent Passport 1000
    - .1 P1
    - .2 P2

- .2 Sargent Profile
  - .1 v.S1
  - .2 v.S2
- .3 Sargent IN120
- .4 Corbin Russwin Access 700
  - .1 PIP1
  - .2 PWI1
- .5 Corbin Russwin Access 800
  - .1 IP1
  - .2 WI1
- .7 Salto Sallis
  - .1 Sallis RS485 router
  - .2 Sallis PoE router
  - .3 Sallis mini-node
  - .4 Sallis node
  - .5 Sallis XS4 locks
- .8 DDS (RS-485 communications)
  - .1 AS34/TPL
  - .2 AS34/TPL-P4
- .9 Axis A1001
- .10 STid (RS-485 communications)
  - .1 W33 reader
  - .2 W35 reader
- .5 IMC shall be able to support multi-vendor deployments on the same (eg. Wireless locks, PoE locks, interface modules, etc.)
- .6 The IMC shall support third party electronic locks (wireless or other) without the need for a dedicated server or virtual machine

## 1.2 HARDWARE SPECIFICATIONS

- .1 The IMC shall be an Intel Atom-based dual core embedded computer.
- .2 The CPU speed shall be at least 1.33 GHz.
- .3 A minimum of 2 GB of SDRAM shall be available.
- .4 A minimum of 16 GB of compact flash memory shall be available to run the OS and the access control firmware.
- .5 The IMC shall have enough processing power to run a Windows embedded operating system, SQL database, and access control firmware (security business logic).
- .6 The IMC shall be power by a 12 VDC power supply.

- .7 The IMC shall support PoE+ (IEEE 8.2.3af)
- .8 Additional hardware features include:
  - .1 Minimum one (1) embedded USB 2.0 port.
  - .2 4 independent RS485 ports onboard
  - .3 Integrated heat sink.
  - .4 Onboard status LED.
- .9 The IMC shall be available in different kits
  - .1 4 readers pre-wired kit with one Synergis Cloud Link, 2 HID VertX V100 and a 6A power supply
  - .2 8 readers pre-wired kit with one Synergis Cloud Link, 4 HID VertX V100 and a 6A power supply
- .10 Accessories for the IMC kits shall be available
  - .1 6A Power Supply Kit for America. 6A power supply/charger board (110VAC/60Hz, 12 VDC @ 6A output); Screws & standoffs
  - .2 6A Power Supply Kit for EMEA. 6A power supply/charger board (220VAC/50Hz, 12 VDC @ 6A output); Screws & standoffs
  - .3 Small Enclosure Kit. 21x23 inches/53.34x58.42 cm
  - .4 Large Enclosure kit. 29x23 inches/73.66x58.42 cm

### 1.3 COMMUNICATIONS

- .1 TCP/IP (network)
  - .1 The IMC shall support TCP/IP communications natively.
  - .2 No additional network adapter shall be required to install the IMC on a TCP/IP network.
  - .3 The IMC shall support two (2) onboard Ethernet (LAN) controllers for network communications.
  - .4 The IMC can be configured with either a static or dynamic IP address.
- .2 Downstream device support
  - .1 It shall be able to interface with up to 32 downstream devices (or up to 64 readers connected to downstream devices).
  - .2 The IMC shall support communication with downstream devices over:
    - .1 TCP/ IP (networked).
    - .2 RS485 (serial).
  - .3 The same IMC device shall be able to support hybrid configurations with some downstream devices connected to the IMC over IP, while others are connected to it over a serial communications link (e.g. RS485).
  - .4 The IMC shall support up to 128 Assa Abloy IP locks in offline mode
  - .5 The IMC shall support up to 64 wireless locks such as Aperio or Salto Sallis
- .3 Access Control System (ACS) communications
  - .1 The ACS system shall enroll one or more IMCs. The IMC shall be configured and programmed by the ACS software.

- .2 The ACS shall synchronize configuration data to each and every IMC it is connected to.
- .3 The ACS shall synchronize and download the following data to an IMC:
  - .1 Credentials (cardholders)
  - .2 Access rules
  - .3 Unlocking schedules
  - .4 IO linking rules
  - .5 Minimum access levels
  - .6 Cardholder's custom fields

#### 1.4 FEATURES

- .1 The intelligent controller shall execute all access control logic required to manage access door a secured door.
- .2 The intelligent controller shall:
  - .1 All access control grant/deny decisions and log events.
  - .2 Monitor downstream device status and events.
  - .3 Lock/unlock doors.
  - .4 Activate/deactivate unlocking schedules.
  - .5 Monitor inputs (door sensors, REX inputs, etc.).
  - .6 Set output states.
  - .7 Set downstream device settings and parameters.
  - .8 Download credentials (cardholders) to downstream intelligent controllers for offline operation.
- .3 All events shall be pushed to the ACS in real-time. No polling of the intelligent controller shall be required.
- .4 Degraded modes of operation
  - .1 Should the IMC lose connectivity with the ACS software (offline mode), the intelligent controller shall continue to perform its activities and log events in an offline buffer.
  - .2 When communication with the ACS software is restored, the intelligent controller will push offline events to the ACS software.
  - .3 Double degraded mode:
    - .1 The IMC shall also support a double degraded mode of operation with intelligent downstream door controllers.
    - .2 The IMC shall synchronize the (credential) cardholder database to the IMC.
    - .3 Should the downstream controller lose connectivity with the IMC, access requests will be processed by the downstream controller without interruption.
- .5 Capacities per IMC include :
  - .1 150,000 credentials (cardholders).
  - .2 150,000 offline events.
  - .3 unlimited access rules per cardholder
  - .4 Unlimited schedule configuration.

- .6 Pre-staging capabilities:
  - .1 Pre-configuring downstream third party hardware through the SC portal without ACS host software installed
  - .2 Testing door configuration via the intelligent controller web page without ACS host software installed
- .7 The intelligent controller shall supports PIN length up to 15 digits
- .8 Double-swipe lock toggle function
- .9 The intelligent controller shall support the concept of security clearances mapped to cardholders. The ACS software shall enabled a security clearance on an area when a Threat Level is activated, the intelligent controller shall respond within seconds and restrict access
- .10 Support the two-man rules and visitor escort natively
- .11 Support first person in to enable access rule for other cardholders or enable unlocking schedules
- .12 Reader compatibility
  - .1 Any reader compatible with a downstream device connected to the IMC shall be supported.
  - .2 Both standard 125 kHz proximity and 13.56 MHz smart card readers shall be compatible with the intelligent controller (if supported by the downstream device).
  - .3 Supported reader interfaces shall include Wiegand and Clock-and-Data (if supported by the downstream device).
  - .4 It shall be possible to connect a supported RS485-based reader directly to the IMC. The IMC shall process the card reads and trigger the appropriate door relays on a downstream device.
- .13 Credentials
  - .1 The IMC shall support multiple card formats at the same time.
  - .2 Card numbers up to 512 bits shall be supported (if supported by the downstream device).
- .14 Web-based IMC application
  - .1 A web-based application shall allow a user to connect to the IMC and monitor all events outside of the ACS.
  - .2 The web-based application shall also allow the configuration of the IMC parameters.
  - .3 Application shall be able to run on multiple web browsers including the following: Internet Explorer, Safari, and Firefox among others.
- .15 Additional functionalities supported by the IMC include:
  - .1 Antipassback (soft and hard)
  - .2 Global antipassback
  - .3 People counting
  - .4 Entry detection
  - .5 IO linking across multiple downstream devices (input and ouput modules)
  - .6 Card only, and card and PIN

END OF SECTION

## **PART 1 - GENERAL**

- .1 Not used.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- .1 Access control credentials, credential readers and networked door controllers and associated door and IO interface devices shall be as manufactured by HID Corporation, 15370 Barranca Parkway, Irvine, CA 92618.
- .2 Substitutions: No substitutions allowed.

### **2.2 ACCESS CONTROL NETWORKED ACCESS CONTROLLERS, CONTROLLER / DOOR INTERFACE, DOOR INTERFACE MODULES AND IO INTERFACE MODULES**

- .1 Controller Product Family Overview
- .1 Provide an open architecture family of interface devices that provides a complete and fully functional hardware/firmware infrastructure for access control software host systems.
- .2 The controllers shall communicate with a host system by using industry standard TCP/IP protocol, over 10/100 Mbps Ethernet, Internet, dial-up modem, or wireless modem.
- .3 The family of products shall consist of these major components:
- .1 A networked controller that supports up to 32 Reader, Input or Output interface units, and provides a TCP/IP connection to a Host system.
- .2 A reader interface module that supports two Wiegand or Clock and Data card / PIN readers.
- .3 An input monitor interface that supports 16 analog inputs, 2 non-latching output relays.
- .4 An output control interface that supports 12 latching output relays, 2 analog inputs.
- .5 A networked controller / reader interface that supports two Wiegand or Clock and Data card / PIN readers, and provides a TCP/IP connection to a Host system.
- .4 The family of products shall provide a flexible architecture which can be easily adapted to widely varying requirements including the following:
- .1 TCP/IP connections shall be used for high speed connection to host and connectivity to existing and new Ethernet network cabling.
- .2 RS-232 connections shall be used for connection to host via modem.
- .3 RS-485 connections shall be used for connection to field hardware devices, and offers less impact on network capacity and connectivity to exiting twisted pair cabling.
- .5 The family of products shall provide a complete, fully featured access control hardware and firmware infrastructure for host-based access control software applications.
- .6 The family of products shall not be a proprietary product of the manufacturer of the host access control software application, and must have the ability to migrate to an alternative manufacturer's host access control software application by remote reconfiguration or firmware upgrade and without intervention from the original controller manufacturer.

- .7 The family of products shall provide full distributed processing of all access control functions. The unit shall provide fully functional off line operation when not actively communicating with the host access control software application; performing all access decisions and event logging. Upon connection with the host access control software application, the networked door controller or networked controller/reader shall upload all buffered off-line transactions (minimum of 99,999) to the host software.
- .8 Transaction buffer storage is expandable to 1M transactions using USB flash drive.
- .9 The family of products shall provide diagnostics and configuration operations through connection to a local laptop computer. Installation webpages shall be interfaced using HTTPS and provide abilities to set product security including encryption keys.
- .10 The family of products shall be warranted against defects in materials and workmanship for 18 months.
- .11 Network discovery and update tools shall enable the discovery and queued update of multiple controllers on the network.
- .12 Compatibility
  - .1 The family of products shall be compatible with the following:
    - .1 Microsoft Windows 7, XP and any other Host System supporting TCP/IP networked interface
    - .2 TCP/IP (using applicable IEEE standards)
    - .3 Category 5 Cable, using RJ-45 connectors
    - .4 HID Wiegand Standard or Long Formats or C&D Output Readers (up to 128-bit data)
    - .5 ODBC Systems and any other data storage systems whose data can be translated for transport over TCP/IP interface.
    - .6 Host systems with HID web browser API or DLL software installed
- .13 Product Lifetime
  - .1 The family of products shall be designed to have a lifetime of ten years based on normal usage levels and environmental conditions. This shall include components such as batteries, real time clocks and non-volatile memory.
- .14 Regulatory Compliance
  - .1 UL Standards
    - .1 The family of products shall provide input monitoring and reporting functions shall meet applicable UL 1076 Proprietary Burglar Alarm System standards as a UL Recognized system component, including specific requirements for speed of reporting time, verifying communications with field hardware, detection of substitution of similar field hardware device, four-state alarm monitoring.
    - .2 The family of products shall provide shall meet applicable UL294 Access Control standards as a UL Recognized system component, including criteria for false accepts/rejects, attack resistance and electrical safety.
  - .2 CE Mark
    - .1 VertX shall meet European CE Mark standards for electrical safety and RF emissions.
- .15 The family of products shall be
  - .1 HID Global VertX EVO V1000, EVO V2000, V100, V200 and V300

- .2 Physical Configuration
  - .1 Physical Form Factor
    - .1 Each family product shall be available in a Printed Circuit Board Assembly (PCBA) mounted in a plastic housing.
  - .2 Housing Configuration
    - .1 Each family product shall consist of a plastic backplate and cover which is approximately 5.8" (14.7 cm) wide by 4.825" (12.6 cm) high and 1.275" (3.2 cm) deep.
    - .2 Applicable family products shall have right-angle Phoenix type removable screw terminal connectors for all reader, input and output connections, RJ-45 connectors for TCP/IP connections, and pin headers for other connections.
    - .3 Each family product shall contain nomenclature that is clearly marked housing cover.
  - .3 Communication Indicator
    - .1 Applicable family products shall have communications Indicator LEDs, which flash whenever communications occur between the interface unit and an upstream device. The communication LED flash codes are as follows:
      - .1 Communications TO the upstream device is green flashing.
      - .2 Communications FROM the upstream device is red flashing.
      - .3 Absence of one colour indicates that communications are occurring in one direction only.
      - .4 Absence of flashing indicates a communications failure.
    - .2 Output and input interfaces shall be capable of providing visual feedback via LED when communicating with the Networked Controller.
  - .4 DC Power Indicator
    - .1 The family of products shall have a voltage indicator LED on the interface unit, which shall indicate that sufficient DC voltage is being provided to the unit.
  - .5 Sounder
    - .1 The reader interfaces shall be capable of using beepers in the connected (HID and possibly other) readers to indicate door held/forced, PIN Retry Error, Tamper Alarm, Communications Failure, AC Power Failure, Battery Failure, etc.
  - .6 Tamper Input
    - .1 The family of products shall include a dedicated input for enclosure tamper configurable to be supervised or unsupervised.
  - .7 AC Fail and Battery Fail Inputs
    - .1 The family of products shall have configurable inputs for AC Failure and Low Battery/ Battery Presence, which are compatible with Supervised DC supplies which monitor the AC Input Voltage and Battery Voltage and report status using two dry contact relay outputs.
  - .8 Mounting
    - .1 The family of products shall be capable of mounting on any flat wall surface, using the appropriate fasteners. They shall be directly mountable in their standard plastic housings, or they shall be mountable in a stacked configuration on non-conductive standoffs inside a customer supplied utility box.
    - .2 The family of products shall be installed indoors, inside a secure area, such as in a utility closet or on a wall above a suspended ceiling.
    - .3 The family of products shall include 4 mounting screws and an installation manual.

- .9 Labeling
  - .1 Each family product shall include a label(s) that include model name and number, FCC warning label, any required agency approval labels.
  - .2 Wiring connections for each family product shall be clearly marked and visible on the top cover of the plastic housing or on a Mylar overlay.
- .10 Power Requirements
  - .1 The family of products shall require a customer-supplied 12VDC regulated Power Supply, with Battery Backup and Input Surge protection, and AC Failure and Battery Low contact outputs.
  - .2 The reader interfaces shall be capable of supplying 12VDC power to most card readers, but door locking hardware shall require separate power.
- .11 Operating Parameters
  - .1 The family of products shall be capable of operation from 0° to 50° C (32° to 120° F), 0-95% RH, Non-condensing.
  - .2 The family of products shall be capable of installation in an indoor environment, or otherwise protected in a NEMA-4 Rated Enclosure.
- .3 General Functional Description
  - .1 The family of products shall control cardholder access to secured areas.
  - .2 The family of products shall monitor and report access control activity.
  - .3 The family of products shall monitor and report input status changes pertaining to intrusion alarms.
  - .4 The family of products shall monitor and report the integrity of all network devices, circuits and communications.
  - .5 The family of products shall control various electrical and annunciation devices.
  - .6 The family of products shall enable a host system to allow a human operator to acknowledge and respond to alarm conditions.
  - .7 The family of products shall enable a host system to allow a human operator to configure the network and obtain configuration and historical reports.
  - .8 The family of products shall enable a host system to allow an operator to manually unlock and lock doors, and to shunt or unshunt input points.
- .4 Functional Description for Access Control
  - .1 Access Schedules and Holidays
    - .1 The family of products shall provide access control based on access groups, which shall consist of groups of readers and schedules which can be named and assigned to cardholders.
    - .2 The family of products shall allow cardholder to have one or more access control schedules consisting of a valid time period for valid days of the week, for a given reader (or group of readers).
    - .3 The family of products shall provide a time schedule for each week day (Sunday through Saturday) and the cardholder shall also have a time schedule for up to 255 Holiday Groups, allowing Holidays to be assigned different schedules than those normally used for a given day of the week.

- .4 The family of products shall allow a list of Holiday calendar dates and types to be entered into the networked controller.
- .5 The family of products shall allow any card to have a start and end date in addition to access groups such that the card shall be denied access outside the start-end period.
- .6 The family of products shall allow Schedules to be assigned to other functions such as input group suppression or output group activation.
- .2 Door Monitoring and Control
  - .1 The reader interface products shall provide configurable inputs to monitor and report door position to the host.
  - .2 The reader interface products shall suppress door monitor input alarm reporting during a valid access transaction for the duration of the lock relay time plus the alarm shunt time.
  - .3 The reader interface products shall interpret Door Forced and Door Held Open as two distinct alarm conditions.
  - .4 The reader interface products shall send status change data to the Host in real time, if the Door Monitor senses a forced door (a door opened without using a card, PIN, REX or Host command), and, if configured as a Forced Door Alarm, the local Aux Relay shall be activated until turned off from the Host (even if the door is re- closed).
  - .5 The reader interface products shall maintain a forced door alarm until cancelled by the host.
  - .6 The reader interface products shall have a configurable delay for door forced reporting.
  - .7 The reader interface products shall send a Door Held status change to the Host, if the Door Monitor senses a door held open beyond the relay + shunt time + reporting delay time, and (if configured as a Door Held Alarm) the local Aux Relay shall be triggered and latched until the door is re-closed. VertX shall provide a user defined reporting delay time to reduce false alarms.
  - .8 The reader interface products shall have a configurable delay for door held reporting.
- .3 Local Relays
  - .1 The reader interface products shall have one relay per reader, which defaults to be a door lock relay, but shall be configurable as a general purpose relay.
  - .2 The reader interface products shall have a second relay per reader, which can be configured for one of the following functions: off, door forced alarm; door held alarm, door forced and door held alarm, communication failure alarm, or general purpose.
  - .3 The reader interface products shall allow the Aux Relay to be configured to control an annunciator for both Door Held and Door Forced conditions by providing two different default annunciation patterns: for Door Held the relay shall be activated 100ms every 2 seconds, and for Door Forced the relay shall be activated for ½ second on, ½ second off.
  - .4 The reader interface products shall allow the Aux Relay to be configured as a Shunt relay, such that it shall bypass a door contact connected to a separate alarm system during the Access/Alarm shunt time period.
- .4 Extended Access Time
  - .1 The reader interface products shall be capable of providing configurable normal and extended access times.
  - .2 The family of products shall be configurable such that any designated card may have extended access time at readers also configured to provide extended access times. A second relay may also be actuated to control a powered door opener.

.5 Reader Beeper Control

- .1 The reader interface products shall be capable of causing the HID or certain other readers to beep upon detecting a door forced or door held condition.
- .2 The reader interface products shall be capable of causing the HID or certain other readers to emit a distinctive beep upon denial of access.
- .3 The reader interface products shall be capable of causing the HID or certain other readers to emit a distinctive beep upon entry of an invalid PIN.
- .4 The reader interface products shall be capable of using the HID or certain other readers' beeper and LED to annunciate AC Failure, Battery Failure, and Enclosure Tamper alarm states.

.6 Parity Checking

- .1 The family of products shall perform parity checking on card data, and shall notify the network device on parity failure.

.7 PIN Processing

- .1 The family of products shall allow any HID or certain other Card/PIN readers to be configurable to require Card+PIN, PIN only, Card or PIN, or Card only.
- .2 The family of products shall provide PIN Suppression schedules, so that an HID or certain other PIN/Card readers can operate in Card-only mode on a scheduled basis, such as during the day when higher security is not required.
- .3 The family of products shall be capable of signaling the cardholder with an alternating red/green LED on an HID or certain other card readers when a Card is presented and PIN is also required.
- .4 The family of products shall invoke a configurable PIN Error lockout period of up to 99 seconds, which shall prevent the reader from being used after a configurable number of incorrect PINs have been attempted.

.8 Anti-Tailgating

- .1 The family of products shall be capable of invoking the Relay Timer and Alarm Shunt timer to be cancelled 100 ms after the Door Monitor input senses that the door is closed.

.9 Facility Code Only

- .1 The reader interface products shall be configurable to provide access on the basis on facility code only when communications with the network interface are lost; alternately the reader interface shall be configurable to deny access to all when communications with the network interface are lost.

.10 REX Processing

- .1 The reader interface products shall include a Request to Exit (REX) Input for each controlled door, which is used to suppress the Door Monitor alarm, and optionally, unlock the lock for an authorized entrance or exit without the use of a card.
- .2 The reader interface products shall allow the Green LED at the associated reader to be suppressed during REX activation, to avoid alerting potential intruders when the door has been unlocked from the inside.

.11 Anti-Passback

- .1 The family of products shall allow Anti-Passback to be implemented in one of two modes: Real and Timed.

- .2 When implemented in Real mode:
  - .1 The family of products shall provide that when Real Antipassback is implemented, each cardholder's APB status can be defined as IN, OUT, UNDEFINED and EXEMPT.
  - .2 The family of products shall allow an area to be defined by reader-controlled entrances and exits. Readers may be designated as IN or OUT readers.
  - .3 The family of products shall deny access to a card which is re-used at an IN reader prior to badging at an OUT reader. Alternatively, the family of products can be configured to grant access while logging an Anti-Passback violation at an IN reader, subsequently denying access when the cardholder attempts to exit the Anti-Passback area at an OUT reader.
- .3 When implemented in Timed Anti-Passback mode:
  - .1 The family of products shall provide timed antipassback, which prevents a card from being used in a reader (or group of readers) until a configurable timer expires.
  - .2 The family of products shall allow any cardholder to be designated exempt from Anti-passback.
- .12 Area Control
  - .1 The family of products shall provide Area Control, such that readers which control cardholder access or egress to a contiguous area and/or perimeter are logically associated in software.
  - .2 The family of products shall keep track of which cardholders have entered or left an area.
  - .3 The family of products shall be capable of denying access based on incorrect progression of cardholders through controlled areas.
- .13 Card Formats
  - .1 The family of products shall be capable of accepting multiple card formats, allowing multiple existing card populations to be merged into the same network.
  - .2 The family of products shall be able to accept card format files downloaded from the host.
- .14 Visitor Control
  - .1 The family of products shall allow cardholders to be designated as visitor cards, which shall be assigned to an escort card such that badging by visitors shall also require an escort badging to obtain access.
- .15 Elevator Control
  - .1 The family of products shall provide Elevator Control by using a Card/PIN reader to control relays, which in turn can enable or disable elevator floor call buttons. This shall be accomplished by assigning output control relays to be to specific floors, and by allowing cardholders to be configured for access to specified floors and schedules.
  - .2 The family of products shall defined elevator control components as
    - 1. A designated reader located in the Elevator Cab.
    - 2. A reader interface device.
    - 3. One or more Output Control Devices, with relay outputs connected to logic inputs of the elevator control equipment.
    - 4. Designated cardholder with an associated predefined group of output relays.
  - .3 The family of products shall allow card badging to invoke timed relay closures which enable the floor call buttons in the elevator, allowing the user to press the desired floor call button(s).
  - .4 The family of products shall have the reader located in the elevator cab, and the Output Control Devices located in the Elevator Machine Room.

- .5 The family of products shall allow Elevator Control to be implemented on a schedule, such that certain floors shall be configured for public access during normal business hours, and a card shall not be required to use them. Some or all floor call buttons may be restricted at night and/or on weekends, so that a card is required to use them. Certain floors shall always require a card for access.
- .6 The family of products shall allow Elevator Control access privileges to be assigned to cardholders for specific Floors.
- .16 Elevator Control
  - .1 The family of products shall allow biometric readers to be used, where the biometric template is recorded on a smart card, and the biometric reader compares the stored template with a live biometric read. If the live read compares with the stored template, the reader sends access control data from the card to the VertX reader interface.
- .17 Card Control
  - .1 The family of products shall allow keypad commands to lock or unlock the door –through command entry.
- .5 Functional Description for Input Point Monitoring
  - .1 Overview
    - .1 The family of products shall provide Input Points to monitor switch contact status changes. All inputs shall be capable of being supervised, with a specified resistor value wired both in series and parallel with the switch and a voltage applied to the circuit, allowing an input to be reported in any of three states: Normal, Off-Normal and Alarm.
    - .2 The family of products shall also provide two-state inputs that report either OPEN or SHORT as the active state.
  - .2 Input Point Groups
    - .1 The family of products shall provide input points that can be logically grouped in software to allow simultaneous control.
    - .2 The family of products shall enable input reporting of any point or group of input points to be suppressed on a Scheduled basis. For example, this can be used to disarm intrusion or door-open detectors during the day.
  - .3 Input Point Status
    - .1 The family of products shall provide input points that shall be configurable such that the normal or off normal state of any given input can be set for NO or NC devices.
    - .2 The family of products shall provide input points that shall be configurable to match the EOL resistance used with any input.
    - .3 The family of products shall allow the host system to query the digital representation of the DC voltage present at any input.
    - .4 The family of products shall allow status changes to be reported to the Host in 0.5 Seconds or less. (This may be subject to Network conditions.)
  - .4 Input/Output Linking
    - .1 The family of products shall allow the status of any input to be linked to any output, or any predefined group of outputs, such that the outputs shall reflect the status of the input in one of the following ways:
      - .1 Track with the input status
      - .2 Reverse track

- .3 Latch
  - .4 Reverse Latch
  - .5 Latch for a configurable time period
  - .2 If the output group is latched, the family of products shall allow it to be cleared from the Host or by an existing time-scheduled reset.
  - .3 If an input is linked to an output on the same interface unit, the family of products shall allow the link to be active even if the network communications fail.
  - .4 The family of products shall allow an Output Relay Group to be defined as a named list of output points which can be activated or reset as a group. It can be associated with an input point or a schedule.
- .6 Functional Description for Communications
  - .1 Network Communications
    - .1 The networked controller shall have 3 communication channels, TCP/IP and serial ports. Each channel shall be configurable as a primary or fallback communications channel.
    - .2 The combined networked controller / door interface module shall communicate by TCP/IP only.
    - .3 Both networked controller models shall send a periodic "I'm Alive" message to the host at configurable intervals.
    - .4 Both networked controller models shall have a firewall which can be used to restrict access thru the TCP/IP port.
    - .5 The networked door controller shall be capable of deploying AES 256 with symmetrical key encryption for all communications between the controller and host(s) system(s).
    - .6 The networked door controller shall be capable of supporting custom encryption ciphers implemented using libtomcrypt open source cryptography mechanisms for all communications between the controller and host(s) system(s).
    - .7 The networked door controller shall support 802.1X authentication.
  - .2 RS-485 Communications
    - .1 The networked controller shall be capable of supporting up to 32 interface devices on four RS-485 serial ports.
    - .2 The family of products shall use CRC validation and calculation on all RS-485 messages.
    - .3 The reader interface, input monitor and output control devices shall have a local indicator LED to report state of RS-485 connection with the networked controller.
    - .4 The family of products shall be able to detect and respond to any change of local addressing at a reader interface, output control interface or input interface.
    - .5 The family of products shall log and notify the host of interface loss.
  - .3 Reader Supervision
    - .1 The reader interface products shall be capable of monitoring a periodic Reader Supervision message from a reader with this capability, and shall send a reader offline message to the Host, if the message is not received in the event of reader failure or tampering.
  - .4 Clock Synchronization
    - .1 The family of products shall allow all networked controllers to be synchronized with the Host. Time Sync shall be sent automatically at regular intervals.

.5 Host Control Commands

- .1 The family of products shall be able to execute operator or system commands received via the Network from the Host, including:
  - .1 Open Door – specify door name – unlocks door, shunts associated alarm, for locally programmed unlock times -- door relocks automatically when timers expire -- overrides any restrictions
  - .2 Open a Group or list of doors – same as open door – specify door group or list
  - .3 Open all Doors – same as above
  - .4 Unlock Door (or group/list, or All doors)– specify door(s) – unlocks doors indefinitely -- usually used in an emergency situation -- overrides any restrictions
  - .5 Lock Door (or group/list, or All Doors) – resets Unlock Door --overrides any current/pending “door unlock by time schedule” controlled at the interface level
  - .6 Set Output Relay – latch a relay, or group/list of relays indefinitely
  - .7 Reset Output Relay (or group/list)
  - .8 Suppress Input Point (or group/list) – disable reporting/logging from a specified input points
  - .9 Un-suppress Input Point (or group/list)
  - .10 Reset Various Local Alarm conditions (as annunciated by aux relay or reader beeper) including:
    - .1 PIN Code error count
    - .2 Door Held
    - .3 Door Forced
- .2 The family of products shall allow the Host System to query any local database for status or configuration information.
- .3 The family of products shall contain persistent application and data storage, allowing them to be reprogrammed from the Host if necessary.
- .4 The family of products shall be capable of receiving a command from the Host system operator which shall manually override any locally-invoked relay condition, in either latched or timed mode.
- .5 The family of products shall be capable of receiving a command from the Host system operator which shall manually override the condition of any Aux relay. It shall also be capable of enabling, disabling or resetting any individual alarm.
- .6 The reader interfaces shall be capable of receiving a command from the Host system operator which shall manually activate or release the Hold line on any connected reader having the Hold feature.
- .7 The family of products shall allow the Host system to query any reader, output or input interface as to the application file revision, EEPROM file revision, ID number, and type.
- .8 The family of products shall allow the Host to set time of day on all Network Gateways, to view add or modify card records, to control outputs, to get input or output status, to write to the EEPROM, to read local memory, to get A/D values, to upload the current messages or all messages in the Event log, to clear the event file, to reload the card database, to reload access configuration files, to get or set I/O linker inputs, to reboot any interface.
- .9 The family of products shall report the current state of each input and output upon query from the host.

.6 Event Logger

- .1 The family of products shall be capable of sending the following event messages to the host system:
  - .1 Access Granted
  - .2 Access Granted PIN only
  - .3 Extended Access Granted
  - .4 Deny Access Card not found
  - .5 Deny Access Door Schedule Not Valid
  - .6 Deny Access Unknown Reader
  - .7 Deny Access Card Deleted from database
  - .8 Deny Access PIN not found
  - .9 Deny Access PIN deleted from database
  - .10 Deny Access Wrong PIN used
  - .11 Deny Access Timed Antipassback violation
  - .12 Deny Access Real Antipassback violation
  - .13 Deny Access Real Antipassback violation at Exit Reader
  - .14 Deny Access Area Violation
  - .15 Deny Access Area Violation at Exit Reader
  - .16 Deny Card Access – Not in Door Group
- .2 The family of products shall be capable of sending the following alarm messages to the host system:
  - .1 Door Forced
  - .2 Door Held
  - .3 Tamper Failure
  - .4 Tamper Alarm
  - .5 Battery Failure
  - .6 Battery Alarm
  - .7 AC Failure
  - .8 AC Alarm
  - .9 REX Door Bit
  - .10 REX Door Alarm
- .3 The family of products shall have configurable command priorities for each event type.
- .4 The family of products shall optionally be encrypted to prevent data from being intercepted or simulated by an intruder.

.7 Networked Controller Device

- .1 The networked controllers shall connect to the Host via TCP/IP (with Modem backup to the Host) and shall connect to downstream interface devices, include door interface, input monitor interface and output control interface.
- .2 The networked door controller shall incorporate a 32-bit 200 MHz ARM9 processor running the Linux operating system

- .3 The networked door controller shall provide on-board Flash memory to allow program updates to be downloaded directly via the network. The networked door controller or network controller/reader shall provide the following minimum memory:
  - .1 128 MB on-board Flash memory
  - .2 64 MB RAM
- .4 The networked controller shall support and communicate any combination of up to 32 V100s, V200s, V300 and VertX Aperio Hub interfaces.
- .5 The networked controller shall store a complete access control and configuration database for any combination of up to 32 downstream devices.
- .6 The networked controller shall process access control decisions for all connected devices.
- .7 The networked controller shall process input/output linking for all RS-485 connected devices.
- .8 The networked controller shall store a transaction history for all RS-485 connected devices.
- .9 The networked controller shall connect to the Host and to other devices on the TCP/IP network
- .10 The networked controller shall be capable of supporting cardholder databases of 250,000 cardholders (without database changeover) and 125,000 cardholders (with database changeover).
- .11 The networked controller shall provide the ability to backup connect to a host via dial-up or wireless modem.
- .12 The networked controller shall report all activity to the host.
- .13 The networked controller shall receive and drive execution of all real time commands from the host.
- .14 The networked controller shall allow local connection of a laptop computer for diagnostics, verification, display or change of card database, configuration database, and transaction history via the TCP/IP or diagnostic port.
- .15 The networked controller shall control and communicate with all RS-485 connected devices when offline with the host.
- .16 The networked controller shall upload all buffered transactions to the Host when communications are restored.
- .17 The networked controller shall have the following IO connections
  - .1 RJ-45 connector for Ethernet TCP/IP
  - .2 Four RS-485 connections to Reader, Input or Output Interface Units
  - .3 Two configurable analog inputs for general purpose applications
  - .4 Two non-latching output relays for local alarm annunciation
  - .5 AC Fail (if provided by power supply) monitor input
  - .6 Battery Fail (if provided by power supply) monitor input
  - .7 Enclosure Tamper Monitor input
- .18 The networked controller shall have two RS-232 ports, which shall allow fallback communications with the host system in the event of loss of the network (TCP/IP Ethernet) by means of dialup modem or wireless modem.
- .19 The networked controller shall provide on-board persistent memory to allow program updates to be downloaded directly via the network.

.8 Reader Interface Device

- .1 The reader interface device shall perform all of the basic input / output and access control functions for two doors (or one door with entry and exit readers).
- .2 The reader interface device shall connect to a networked controller via an RS-485 network, and shall have a rotary address switch (Range: 0 - 15).
- .3 The reader interface device shall have the following IO connections:
  - .1 Two (2) Readers, in one of the following configurations:
    - .1 Two (2) Wiegand interface readers with or without PIN keypads
    - .2 Two (2) Clock-and-Data readers
    - .3 Two (2) Keypad readers
  - .2 Two (2) Door Monitor switch/contact inputs
  - .3 Two (2) Request-to-Exit device inputs
  - .4 AC Fail (if provided by power supply) Monitor input
  - .5 Battery Fail (if provided by power supply) Monitor input
  - .6 Enclosure Tamper Monitor input
- .4 The reader interface device shall have non-latching relay outputs for the following:
  - .1 Two (2) door locking devices (configurable)
  - .2 Two (2) auxiliary devices (door held/forced alarm, alarm shunt, communication failure, or general purpose)
- .5 The reader interface device shall have local processing capabilities as follows:
  - .1 Alarm Shunt and Strike relay timing and latching functions
  - .2 Access control decisions based on facility code (degraded mode)
  - .3 Simple input/output linking on the same V100
  - .4 LED / Beeper control during Card + PIN and other transactions

.9 Input Monitor Device

- .1 The input monitor device shall connect to a networked controller via RS-485.
- .2 The input monitor device shall support sixteen (16) input circuits, configurable for unsupervised or 2/4-state supervised monitoring.
- .3 The input monitor device shall support two (2) auxiliary relay outputs.
- .4 The input monitor device shall be capable of performing simple input / output linking locally on itself using inputs 1 & 2 and aux outputs 1 & 2 when offline.

.10 Output Control Device

- .1 The output control device shall connect to a networked controller via RS-485.
- .2 The output control device shall support twelve (12) form C latching output circuits.
- .3 The output control device shall support two (2) auxiliary input circuits, configurable for unsupervised or 2/4 state supervised monitoring.
- .4 The output control device shall be capable of performing simple input / output linking locally on itself using aux inputs 1 & 2 and outputs 1 & 2 when offline.

.11 Networked Controller / Reader Interface Device

- .1 The networked controller / reader interface device shall combine the transaction processing and host interface functions of the networked controller and the reader/door interface functions of the reader interface device, supporting all of the input / output functions for two card readers, as well as being able to make access control decisions and report all transactions to the Host.
- .2 The networked door controller shall incorporate a 32-bit 200 MHz ARM9 processor running the Linux operating system.
- .3 The networked controller / reader interface device shall store a complete access control and configuration database for its local reader interface of up to 2 readers.
- .4 The networked controller / reader interface device shall process access control decisions for all connected devices.
- .5 The networked controller / reader interface device shall process input/output linking for all on-board IO.
- .6 The networked controller / reader interface device shall store a transaction history all events generated on locally connected door devices.
- .7 The networked controller / reader interface device shall connect to the Host and to other devices on the TCP/IP network
- .8 The networked controller shall be capable of supporting cardholder databases of 250,000 cardholders (without database changeover) and 125,000 cardholders (with database changeover).
- .9 The networked controller / reader interface device shall provide on-board persistent memory to allow program updates to be downloaded directly via the network.
- .10 The networked controller / reader interface device shall be capable of supporting the following:
  - .1 Two Wiegand interface readers with or without PIN keypads
  - .2 Two Clock and Data readers
  - .3 Two Keypad readers

**PART 3 - EXECUTION**

- .1 Not used.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 SECTION INCLUDES**

- .1 Automatic door controls for restrooms.
- .2 Emergency call systems for universal and barrier free restrooms.
- .3 Automatic door relay controls.
- .4 Automatic door activation.
- .5 Automatic door wireless activation.

### **1.2 RELATED SECTIONS**

- .1 Section 08 71 53 - Security Door Hardware.
- .2 Section 26 05 00 - Common Work Results for Electrical.
- .3 Division 16 - Electrical: Emergency power scheduled for automatic restroom egress doors to comply with building code requirements.

### **1.3 REFERENCES**

- .1 ANSI A117.1 - Accessible and Usable Buildings and Facilities.
- .2 ANSI A156.19 - Standard for Power Assist and Low Energy Power Operated Doors.

### **1.4 SUBMITTALS**

- .1 Submit under provisions of Section 01 30 00 - Administrative Requirements.
- .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: Electrical schematic, device mounting requirements and rough-in for recessed devices.
- .4 Verification Samples: For each finish product specified, two samples, minimum size 6 inches (150 mm) square representing actual product, colour, and patterns.

### **1.5 QUALITY ASSURANCE**

- .1 Manufacturer Qualifications: Minimum 5 year experience manufacturing similar products.

- .2 Installer Qualifications: Minimum 2 year experience installing similar products.
- .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 Rework mock-up area as required to produce acceptable work.

## **1.6 PRE-INSTALLATION MEETINGS**

- .1 Convene minimum two weeks prior to starting work of this section.

## **1.7 DELIVERY, STORAGE, AND HANDLING**

- .1 Deliver and store products in manufacturer's unopened packaging bearing the brand name and manufacturer's identification until ready for installation.
- .2 Handling: Handle materials to avoid damage.

## **1.8 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 recommended limits.

## **1.9 SEQUENCING**

- .1 Ensure that products of this section are supplied to affected trades in time to prevent interruption of construction progress.

## **1.10 WARRANTY**

- .1 Manufacturer's Warranty: Provide manufacturer's warranty for defective parts for a three year period from date of Substantial Completion.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- .1 Acceptable Manufacturer: Camden Door Controls, which is located at: 5502 Timberlea Blvd.; Mississauga, ON, Canada L4W 2T7; Toll Free Tel: 877-226-3369; Tel: 905-366-3377; Email: [marketing@camdencontrols.com](mailto:marketing@camdencontrols.com); Web: [www.camdencontrols.com](http://www.camdencontrols.com)
- .2 Substitutions: Not permitted.
- .3 Requests for substitutions will be considered in accordance with provisions of Section 01 60 00 - Product Requirements.

## 2.2 AUTOMATIC DOOR CONTROLS FOR RESTROOMS

- .1 Performance:
  - .1 Automatic door controls shall comply with Americans with Disability Act.
    - .1 Regulatory compliance with Accessibility Guidelines (ADAAG) and the Uniform Federal Accessibility Standard (UFAS) as required by Authority Having Jurisdiction (AHJ).
  - .2 Automatic door controls shall comply with National Building Code of Canada.
  - .3 Automatic door controls shall comply with NFPA National Fire Code or International Fire Code for restroom doors acting as egress doors as required by Authority Having Jurisdiction (AHJ).
- .2 Product: Surewave Touchless Restroom Control System - CX-WC16 as manufactured by Camden Door Controls.
  - .1 Operation:
    - .1 The door is normally closed and either locked or unlocked. Waving a hand in front of the exterior 'Wave to Open' Surewave switch opens the door. Once inside and the door is closed, waving a hand in front of the 'Wave to Lock' Surewave switch, changes the colour to red and locks the door. To exit, wave a hand in front of the interior 'Wave to Open' switch to unlock the door and reset the system. The 'Wave to Lock' Surewave™ switch illuminated outer ring turns green and the exterior 'Wave to Open' Surewave™ switch illuminated outer ring turns green. If the door is opened manually to exit the restroom, the overhead magnetic contact switch resets the system.
    - .2 Status: Normally locked. Fail secure electric strike.
    - .3 Status: Normally unlocked. Fail safe electric strike.
  - .2 Components:
    - .1 The following items are part of the CX-WC16 equipment package:
      - .1 CX-33 Advanced Logic Control Relay with 14 modes of operation, secured and unsecured restroom control modes, (3) 3 form 'C' relay outputs rated 3 Amp. @ 30VDC and surge protection.
      - .2 CM-331/43S-SGLR single gang mount 2 – ¾ x 4 – ½ inches (70mm x 114 mm) activation (wall) switch, stainless steel construction, N/O contacts rated 3 Amps @ 30VDC and permanently laser etched 'Wave to Lock' graphics, LED light ring, Green/Red, with selectable 12/24V, AC/DC, built-in 85db sounder, max 60mA current draw, and CM-SE1 double sided sign 'LOCKED WHEN RED'.
      - .3 CM-331/42WS-SGLR single gang mount 4-1/2 inches (114 mm) activation (wall) switch, stainless steel construction, and 'Wave to Open' permanently laser etched graphics, LED light ring, Green/Red, with selectable 12/24V, AC/DC, built-in 85db sounder, max 60mA current draw and form 'C' contact rated 3 Amp @ 30VDC and CM-SE1 sign 'OCCUPIED WHEN RED' / 'VACANT WHEN GREEN'
      - .4 CM-325/42WS double gang mount 4 -1/2 inches (114mm) activation (wall) switch, stainless steel construction, and 'Wave to Open' permanently laser etched graphics, 12/24V AC/DC operation, built-in 85db sounder, max 60mA current draw and form C contacts rated at 5 Amps @ 30 VDC.
      - .5 CX-MDA N/C surface mount Door Contact.
    - .2 The following items are required, but not included in CX-WC16 equipment package:
      - .1 Door Operator (by others)
      - .2 CX-ED2079 Electric Strike, grade 2 'universal' strike for cylindrical locksets c/w 3 faceplates, 12/24V AC/DC, selectable fail safe/fail secure. The strike shall have horizontal faceplate adjustment.
      - .3 CX-PS13 12/24V linear power supply and CX-TRX-4024 UL listed 40VA transformer.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- .1 Do not begin installation until substrates have been properly prepared.
- .2 If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

#### **3.2 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.

#### **3.3 INSTALLATION**

- .1 Install in accordance with manufacturer's instructions. Test for proper operation and adjust until satisfactory results are obtained.

#### **3.4 DEMONSTRATION AND TRAINING**

- .1 Manufacturer's representative shall provide on-site training of staff and maintenance of operation, maintenance and "trouble/error" detection/correction.

#### **3.5 PROTECTION**

- .1 Protect installed products until completion of project.
- .2 Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 ACCESS CONTROL CARD READER**

- .1 Read Only Contactless smart card and Mobile ID readers with the following:
  - .1 Guaranteed compatibility to read all HID data formats and ensuring card-to-reader interoperability in multi-location installations and multi-card and reader populations when used with Genuine HID products.
  - .2 Simultaneously support of BLE Mobile Devices, NFC Mobile Devices, 13.56MHz and 125Khz contactless credentials. The contactless smart card reader shall read Mobile IDs powered by the Seos standard based software application or applet technology.
  - .3 The contactless smart card reader must support the following 2 modes of interaction with BLE credentials:
    - .1 Tap Mode: The mobile device must be brought very close to or touching the reader (a similar user experience to that observed using Prox cards)
    - .2 Twist and Go: The mobile device holder must initiate the read by twisting the mobile device in using a sharp 90° rotation in either direction.
  - .4 Contactless smart card reader shall support the following communications interface options:
    - .1 Bidirectional communication in compliance with v2 of the SIA OSDP (Open Supervised Device Protocol) standard. 4-conductor #24 AWG
    - .2 Wiegand or Clock & Data: 5-conductor #22 AWG

## **PART 2 - PRODUCTS**

- .1 Acceptable Products
  - .1 HID Contactless Multiclass card reader shall be Genuine HID Global iCLASS SE Mobile-Enabled Readers available in the following form factors:
    - .1 Model RP10 Mini-mullion Reader 1.9" x 4.1" x 0.9" ( Part # 900PMNTEKEA003),
    - .2 Model RP40 Switch plate Reader 3.3" x 4.8" x 1.0" (Part # 920PMNTEKEA003)
- .2 Substitutions: No substitutions allowed.

## **PART 3 - EXECUTION**

- .1 Not used.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 SYSTEM DESCRIPTION**

- .1 General Requirements
  - .1 The specified unit shall be of manufacturer's official product line, designed for commercial and/or industrial 24/7/365 use.
  - .2 The specified unit shall be based upon standard components and proven technology using open and published protocols.
- .2 Sustainability
  - .1 The specified unit shall be manufactured in accordance with ISO 14001.
  - .2 The specified unit shall be compliant with the EU directives 2011/65/EU (RoHS) and 2012/19/EU (WEEE).
  - .3 The specified unit shall be compliant with the EU regulation 1907/2006 (REACH).

### **1.2 CERTIFICATIONS AND STANDARDS**

- .1 General abbreviations and acronyms
  - .1 AGC: Automatic gain control
  - .2 API: Application Programming Interface
  - .3 Aspect ratio: A ratio of width to height in images
  - .4 Bit Rate: The number of bits/time unit sent over a network
  - .5 Bonjour: Enables automatic discovery of computers, devices, and services on IP networks.
  - .6 DHCP: Dynamic Host Configuration Protocol
  - .7 DNS: Domain Name System
  - .8 EIS: Electronic Image Stabilization
  - .9 FPS: Frames per Second
  - .10 FTP: File Transfer Protocol
  - .11 H.264 (Video Compression Format)
  - .12 IEEE 802.1x: Authentication framework for network devices
  - .13 IP: Internet Protocol
  - .14 IR light: Infrared light
  - .15 JPEG: Joint Photographic Experts Group (image format)
  - .16 LAN: Local Area Network
  - .17 LED: Light Emitting Diode
  - .18 Lux: A standard unit of illumination measurement
  - .19 MBR: Maximum Bit Rate
  - .20 MPEG: Moving Picture Experts Group
  - .21 Multicast: Communication between a single sender and multiple receivers on a network

- .22 NTP: Network Time Protocol
  - .23 NTSC: National Television System Committee – a color encoding system based on 60Hz
  - .24 ONVIF: Global standard for the interface of IP-based physical security products
  - .25 PAL: Phase Alternating Line – a color encoding system based on 50Hz
  - .26 PoE: Power over Ethernet (IEEE 802.3af/at) standard for providing power over network cable
  - .27 Progressive scan: An image scanning technology which scans the entire picture
  - .28 PTZ: Pan/Tilt/Zoom
  - .29 QoS: Quality of Service
  - .30 SIP: Session Initiation Protocol
  - .31 SMTP: Simple Mail Transfer Protocol
  - .32 SMPTE: Society of Motion Picture and Television Engineers
  - .33 SNMP: Simple Network Management Protocol
  - .34 SSL: Secure Sockets Layer
  - .35 TCP: Transmission Control Protocol
  - .36 TLS: Transport Layer Security
  - .37 Unicast: Communication between a single sender and single receiver on a network
  - .38 UPnP: Universal Plug and Play
  - .39 UPS: Uninterruptible Power Supply
  - .40 VBR: Variable Bit Rate
  - .41 VMS: Video Management System
  - .42 WDR: Wide dynamic range
- .2 The specified unit shall carry the following EMC approvals:
- .1 EN55022 Class A, EN55024, EN61000-6-1, EN61000-6-2
  - .2 FCC Part 15 - Subpart B Class A
  - .3 VCCI: 2014, Class A, ITE
  - .4 C-tick AS/NZS CISPR22 Class A
  - .5 ICES-003 Class A
  - .6 KCC KN22 Class A, KN24
- .3 The specified unit shall meet the following product safety standards:
- .1 IEC/EN/UL 60950 -1
  - .2 IEC/EN/UL 60950-22
- .4 The specified unit shall meet relevant parts of the following video standards:
- .1 SMPTE 296M (HDTV 720p)
- .5 The specified unit shall meet the following standards
- .1 MPEG-4:
    - .1 ISO/IEC 14496-10 Advanced Video Coding (H.264)

- .2 Networking:
  - .1 IEEE 802.3af/802.3at (Power over Ethernet)
  - .2 IEEE 802.1X (Authentication)
  - .3 IPv4 (RFC 791)
  - .4 IPv6 (RFC 2460)
  - .5 QoS – DiffServ (RFC 2475)
- .3 Network video
  - .1 Relevant ONVIF profile as defined by the ONVIF Organization.
- .4 Mechanical Environment:
  - .1 IEC/EN 60529 IP66 & IP67
  - .2 NEMA 250 Type 4X
  - .3 IEC/EN 62262 IK08
  - .4 IEC 60068-2-6
  - .5 IEC 60068-2-27

### 1.3 QUALITY ASSURANCE

- .1 The Contractor or security sub-contractor shall be a licensed security Contractor with a minimum of five (5) years' experience installing and servicing systems of similar scope and complexity and evidence that is completed at least three (3) projects of similar design and is currently engaged in the installation and maintenance of systems herein described.
- .2 All installation, configuration, setup, program and related work shall be performed by electronic technicians thoroughly trained by the manufacturer in the installation and service of the equipment provided.
- .3 The contractor or designated sub-contractor shall submit credentials of completed manufacturer certification, verified by a third party organization, as proof of the knowledge.
- .4 The Contractor shall provide four (4) current references from clients with systems of similar scope and complexity that became operational in the past three (3) years.
- .5 The specified unit shall be manufactured in accordance with ISO9001.

### 1.4 WARRANTY

- .1 All security system components and labor furnished by the contractor including wiring, software, hardware and custom parts shall be fully warranted for parts, materials, labor and travel expenses for a minimum of three (3) years from date of the final acceptance of the Video Surveillance System.
- .2 The manufacturer shall provide warranty and optional extended warranty for the camera for a total period of maximum five years. If enacted as part of the contract, the contractor will repair or replace parts and/or labor per the warranty for the length of this warranty at no cost to the client.

## **PART 2 - PRODUCTS**

### **2.1 GENERAL**

- .1 Network door stations shall be IP-based and comply with established network and video standards.
- .2 Network door stations shall be powered by the switch utilizing the network cable. Power injectors (midspans) shall be provided by the contractor when required for proper operation.
- .3 Network door stations shall be fully supported by an open and published API (Application Programmers Interface), which shall provide necessary information for integration of functionality into third party applications.
- .4 Network door stations shall comply with relevant ONVIF profile as defined by the ONVIF Organization.

### **2.2 VIDEO SURVEILLANCE SCHEDULE**

- .1 Network door station types listed below describing various resolutions, form-factor and features shall be supplied by a single Network door station manufacturer.
- .2 The Network door station manufacture and model numbers will be as follows:
  - .1 Network door station shall be AXIS A8004-VE

### **2.3 VIDEO SURVEILLANCE CAMERAS**

- .1 Network door station
  - .1 The door station shall meet or exceed the following design specifications:
    - .1 The door station shall operate on an open source; Linux-based platform, and including a built-in web server.
    - .2 The door station shall be equipped with a progressive scan megapixel sensor.
    - .3 The door station shall provide a horizontal viewing angle of at least 97°
    - .4 The door station shall provide local video storage utilizing a microSD/microSDHC/microSDXC UHS-I memory card expansion, supporting memory up to 64 GB.
    - .5 The door station shall be manufactured with an IP66/67 and NEMA 250 4X-rated aluminum enclosure with stainless steel front.
    - .6 The door station shall support both wall mount and recessed mount.
    - .7 The door station shall attach to a standard three-gang electrical box for flush or surface mounted applications.
  - .2 The network door station shall meet or exceed the following performance specifications:
    - .1 Illumination
      - .1 The door station shall meet or exceed the following illumination specifications:
        - .1 0.04 lux without LED illumination active

.2 Resolution

- .1 The door station shall be designed to provide at least two video streams in HDTV 720p (1280x720) at up to 30 frames per second (60Hz mode) or 25 frames per second (50Hz mode) using H.264 or Motion JPEG.
- .2 The door station shall support video resolutions including:
  - .1 1280x960
  - .2 1280x720 (HDTV 720p)
  - .3 800x600

.3 Video encoding

- .1 The door station shall support the following video encoding algorithms:
  - .1 Motion JPEG encoding in a selectable range from 1 up to 25/30 frames per second in all resolutions.
  - .2 Baseline Profile H.264 encoding with motion estimation in up to 25/30 frames per second.
  - .3 Main Profile H.264 encoding with motion estimation and context-adaptive binary arithmetic coding (CABAC) in up to 25/30 frames per second.
  - .4 Support High Profile H.264 encoding with motion estimation up to 50/60 frames per second.
- .2 The door station shall provide independently configured simultaneous H.264 and Motion JPEG streams.
- .3 The door station shall support both Constant Bit Rate (CBR) and Variable Bit Rate (VBR) in H.264.
- .4 The door station shall provide configurable compression levels.
- .5 Support standard baseline profile H.264 with motion estimation.
- .6 Support motion estimation in H.264/MPEG-4 Part 10/AVC.

.4 Transmission

- .1 The door station shall allow for video to be transported over:
  - .1 HTTP (Unicast)
  - .2 HTTPS (Unicast)
  - .3 RTP (Unicast & Multicast)
  - .4 RTP over RTSP (Unicast)
  - .5 RTP over RTSP over HTTP (Unicast)
- .2 The door station shall support Quality of Service (QoS) to be able to prioritize traffic.

.5 Image

- .1 The door station shall incorporate Automatic and Manual White Balance
- .2 The door station shall be equipped with an electronic shutter.
- .3 The door station shall incorporate automatic and manually defined exposure zones.
- .4 The door station shall support a configurable maximum shutter in the range from 1/192 s to 1/37 in 50Hz mode.
- .5 The door station shall support a configurable maximum shutter in the range from 1/192 s to 1/44 in 60Hz mode.
- .6 The door station shall be equipped with Wide Dynamic Range functionality – Dynamic Capture.

- .7 The door station shall provide backlight compensation.
- .8 The door station shall support manually defined values for:
  - .1 Color level
  - .2 Brightness
  - .3 Sharpness
  - .4 Contrast
- .9 The door station shall incorporate a function for optimization of low light behavior.
- .10 The door station shall incorporate a mode with preset exposure settings, in order to distinguish colors in dark scenes.
- .6 Audio
  - .1 The door station shall support two-way full duplex audio:
    - .1 Input sources
      - .1 Built-in microphone
    - .2 Output sources
      - .1 Built-in speaker
      - .2 External line device
  - .2 The door station shall be equipped with active echo cancellation and noise reduction.
  - .3 The door station shall support SIP for integration with VoIP, peer-to-peer or integrated into SIP/PBX.
  - .4 The door station shall support the following encoding algorithms:
    - .1 AAC LC at 8/16 kHz
    - .2 G.711 PCM at 8 kHz
    - .3 Wideband  $\mu$ -law at 16 kHz
    - .4 G.726 ADPCM at 8 kHz
  - .5 The door station shall provide configurable bit rate.
  - .6 The door station shall provide a sound pressure of at least 85dB.
- .7 User Interface
  - .1 Web server
    - .1 The door station shall contain a built-in web server making video and configuration available to multiple clients in a standard operating system and browser environment using HTTP, without the need for additional software.
    - .2 Optional components downloaded from the door station for specific tasks, e.g. Active X, shall be signed by an organization providing digital trust services, such as Verisign, Inc.
  - .2 IP addresses
    - .1 The door station shall support both fixed IP addresses and dynamically assigned IP addresses provided by a Dynamic Host Control Protocol (DHCP) server.
    - .2 The door shall allow for automatic detection of the camera based on UPnP and Bonjour when using a PC with an operating system supporting this feature.
    - .3 The camera shall provide support for both IPv4 and IPv6.

- .8 PTZ functionality
  - .1 The door station shall:
    - .1 Provide Digital PTZ functionality.
    - .2 Provide support for up-loadable PTZ drivers.
- .9 Event functionality
  - .1 The door station shall be equipped with an integrated event functionality, which can be triggered by:
    - .1 Video Motion Detection
    - .2 Audio Detection
    - .3 SIP Call state incl. incoming call
    - .4 SIP DTMF sequences
    - .5 Live Stream Accessed
    - .6 Door station tampering
    - .7 Manual Trigger/Virtual Inputs
    - .8 PTZ functionality
    - .9 External input
    - .10 Embedded third party applications
    - .11 Edge storage disruption detection
    - .12 Shock Detected
  - .2 Response to triggers shall include:
    - .1 Send notification, using HTTP, HTTPS, TCP or email
    - .2 Send images, using FTP, HTTP, HTTPS, network share or email
    - .3 Send video clip, using FTP, HTTP, HTTPS, network share or email
    - .4 Recording of video and audio to local storage and/or network attached storage
    - .5 Make call
    - .6 Activating external output
    - .7 Play audio clip
    - .8 PTZ control functionality
    - .9 WDR mode
  - .3 The door station shall provide memory for pre & post alarm recordings.
- .10 Edge storage
  - .1 The door station shall support continuous and event controlled recording to:
    - .1 Local memory added to the cameras SD-card slot
    - .2 Network attached storage, located on the local network
  - .2 The door station shall be able to detect and notify Edge storage disruptions.
- .11 Protocol
  - .1 The door station shall incorporate support for at least IPv4/v6, HTTP, HTTPS, SIP, SSL/TLS, QoS Layer 3 DiffServ, TCP, ICMP, SNMPv1/v2c/v3 (MIB-II), RTSP, RTP, UDP, IGMP, RTCP, SMTP, FTP, DHCP, UPnP, ARP, DNS, DynDNS, SOCKS, SSH, NTP, CIFS/SMB and Bonjour.
  - .2 The SMTP implementation shall include support for SMTP authentication.

.12 Text overlay

- .1 The door station shall:
  - .1 Provide embedded on-screen text with support for date & time, and a customer-specific text, door station name, of at least 45 ASCII characters.
  - .2 To ensure accuracy, the door station shall accept external time synchronization from an NTP (Network Time Protocol) server.
  - .3 Provide the ability to apply privacy masks to the image.
  - .4 Allow for the overlay of a graphical image, such as a logotype, into the image.

.13 Security

- .1 The door station shall support the use of HTTPS and SSL/TLS, providing the ability to upload signed certificates to encrypt and secure authentication and communication of both administration data and video streams.
- .2 The door station shall provide centralized certificate management, with both pre-installed CA certificates and the ability to upload additional CA certificates. The certificates shall be signed by an organization providing digital trust services.
- .3 The door station shall support IEEE 802.1X authentication.
- .4 The door station shall provide support for restricting access to pre-defined IP addresses only, so-called IP address filtering.
- .5 The door station shall restrict access to the built-in web server by usernames and passwords at three different levels.

.14 API support

- .1 The door station shall be fully supported by an open and published API (Application Programmers Interface), which shall provide necessary information for integration of functionality into third party applications.
- .2 The camera shall support relevant ONVIF profiles as defined by the ONVIF Organization.

.15 Embedded applications

- .1 The door station shall provide a platform allowing the upload of third party applications into the door station.

.16 Installation and maintenance

- .1 The door station shall be supplied with Windows-based management software which allows the assignment of IP addresses, upgrade of firmware and backup of the door stations' configuration.
- .2 The door station shall support the use of SNMP-based management tools according to SNMP v1, 2c & 3 / MIB-II.
- .3 The door station shall allow updates of the software (firmware) over the network, using FTP or HTTP.
- .4 The door station shall provide the ability to apply a rectangle of customer-defined number of pixels to the image, which can be used as a pixel counter identifying the size of objects in number of pixels.
- .5 The door station shall store all customer-specific settings in a non-volatile memory that shall not be lost during power cuts or soft reset.

.17 Access log

- .1 The door station shall provide a log file, containing information about the 250 latest connections and access attempts since the unit's latest restart. The file shall include information about the connecting IP addresses and the time of connecting.
- .2 Provide a connection list of all currently connected viewers. The file shall include information about connecting IP address, time of connecting and the type of stream accessed.

.18 Door station diagnostics

- .1 The door station shall be equipped with LEDs, capable of providing status information. LEDs shall indicate the Door station's operational status and provide information about power, communication with receiver, the network status and the Door station status.
- .2 The door station shall be monitored by a Watchdog functionality, which shall automatically re-initiate processes or restart the unit if a malfunction is detected.
- .3 The door station shall send a notification when the unit has re-booted and all services are initialized.

.19 Hardware interfaces

.1 Network interface

- .1 The door station shall be equipped with one 100BASE-TX Fast Ethernet-port, using a standard male RJ45 connector and shall support auto negotiation of network speed (100 MBit/s and 10 MBit/s) and transfer mode (full and half duplex).

.2 Inputs/Outputs

- .1 The door station shall, accessible via removable terminal block, be equipped with:
  - .1 Four configurable I/O ports. These inputs/outputs shall be configurable to respond to normally open (NO) or normally closed (NC) dry contacts.
  - .2 Two relay outputs (max 0.7A @ 30 V DC).

.3 Audio

- .1 The door station shall be equipped with a removable terminal block for line output.

.4 Power

- .1 The door station shall be equipped with a removable terminal block providing connectivity for external power.

.20 Enclosure

.1 The door station shall:

- .1 Be manufactured with an IP66, IP67 and NEMA250 4X rated aluminum enclosure.
- .2 Be fitted with a stainless steel front.
- .3 Be equipped with an illuminated Call button.

.21 Power

- .1 Power over Ethernet Plus IEEE 802.3at Type 2 Class 4
- .2 Power over Ethernet IEEE 802.3af/802.3at Type 1 Class 3 (Limited Output functionality)
- .3 10 - 28 V DC, 25 W (excluding devices connected to the I/O)

.22 Environmental

- .1 Operate in a temperature range of -25 °C to +50 °C (-13 °F to 122 °F).
- .2 Operate in a humidity range of 10–100% RH (condensing).

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- .1 The Contractors or subcontractors main resources within the project shall carry proper professional certification issued by the manufacturer and verified by a third party organization to confirm sufficient product and technology knowledge.
- .2 The Contractor shall carefully follow instructions in documentation provided by the manufacturer to ensure all steps have been taken to provide a reliable, easy-to-operate system.
- .3 All equipment shall be tested and configured in accordance with instructions provided by the manufacturer prior to installation.
- .4 All firmware found in products shall be the latest and most up-to-date provided by the manufacturer, or of a version as specified by the provider of the Video Management Application (VMA) or Network Video Recorder (NVR).
- .5 All equipment requiring users to log on using a password shall be configured with user/site-specific password/passwords. No system/product default passwords shall be allowed.
- .6 A proper installation shall meet NEC (National Electrical Code – US only) per the guidelines of that year's revision. When properly installed equipment meets Low Voltage, Class 2 classification of the NEC.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 SYSTEM DESCRIPTION**

- .1 General Requirements
  - .1 The specified unit shall be of manufacturer's official product line, designed for commercial and/or industrial 24/7/365 use.
  - .2 The specified unit shall be based upon standard components and proven technology using open and published protocols.
- .2 Sustainability
  - .1 The specified unit shall be manufactured in accordance with ISO 14001.
  - .2 The specified unit shall be compliant with the EU directives 2011/65/EU (RoHS) and 2012/19/EU (WEEE).
  - .3 The specified unit shall be compliant with the EU regulation 1907/2006 (REACH).
  - .4 The specified unit shall be PVC free.
  - .5 The manufacturer shall have signed and support the UN Global Compact initiative as defined by United Nations [www.unglobalcompact.org/](http://www.unglobalcompact.org/)

### **1.2 CERTIFICATIONS AND STANDARDS**

- .1 General abbreviations and acronyms
  - .1 API: Application Programming Interface
  - .2 Aspect ratio: A ratio of width to height in images
  - .3 Bit Rate: The number of bits/time unit sent over a network
  - .4 Bonjour: Enables automatic discovery of computers, devices, and services on IP networks.
  - .5 DHCP: Dynamic Host Configuration Protocol
  - .6 DNS: Domain Name System
  - .7 FPS: Frames per Second
  - .8 FTP: File Transfer Protocol
  - .9 H.264 (Video Compression Format)
  - .10 IEEE 802.1x: Authentication framework for network devices
  - .11 IP: Internet Protocol
  - .12 IR light: Infrared light
  - .13 ISO: International Standards Organization
  - .14 JPEG: Joint Photographic Experts Group (image format)
  - .15 LED: Light Emitting Diode
  - .16 Lux: A standard unit of illumination measurement
  - .17 MBR: Maximum Bit Rate
  - .18 MPEG: Moving Picture Experts Group
  - .19 Multicast: Communication between a single sender and multiple receivers on a network

- .20 NTP: Network Time Protocol
  - .21 ONVIF: Global standard for the interface of IP-based physical security products
  - .22 PoE: Power over Ethernet (IEEE 802.3af/at) standard for providing power over network cable
  - .23 Progressive scan: An image scanning technology which scans the entire picture
  - .24 PTZ: Pan/Tilt/Zoom
  - .25 QoS: Quality of Service
  - .26 SMPTE: Society of Motion Picture and Television Engineers
  - .27 SNMP: Simple Network Management Protocol
  - .28 SSL: Secure Sockets Layer
  - .29 TCP: Transmission Control Protocol
  - .30 TLS: Transport Layer Security
  - .31 Unicast: Communication between a single sender and single receiver on a network
  - .32 UPnP: Universal Plug and Play
  - .33 VBR: Variable Bit Rate
  - .34 WDR: Wide dynamic range
- .2 The specified unit shall carry the following EMC approvals:
- .1 EN 55032 Class A, EN 55024, EN 61000-6-1, EN 61000-6-2
  - .2 FCC Part 15 - Subpart B Class A
  - .3 VCCI Class A
  - .4 RCM AS/NZS CISPR 22 Class A
  - .5 ICES-003 Class A
- .3 The specified unit shall meet the following product safety standards:
- .1 IEC/EN/UL 60950-1
  - .2 IEC/EN 62471 (risk group 1)
- .4 The specified unit shall meet relevant parts of the following video standards:
- .1 SMPTE 296M (HDTV 720p)
  - .2 SMPTE 274M (HDTV 1080p)
- .5 The specified unit shall meet the following standards
- .1 MPEG-4:
    - .1 ISO/IEC 14496-10 Advanced Video Coding (H.264)
  - .2 Networking:
    - .1 IEEE 802.3af/802.3at (Power over Ethernet)
    - .2 IEEE 802.1X (Authentication)
    - .3 IPv4 (RFC 791)
    - .4 IPv6 (RFC 2460)
    - .5 QoS – DiffServ (RFC 2475)

- .3 Mechanical Environment:
  - .1 IEC/EN 60529 IP52
  - .2 IEC/EN 62262 IK08
  - .3 IEC 60068-2-1
  - .4 IEC 60068-2-2
  - .5 IEC 60068-2-6 (vibration)
  - .6 IEC 60068-2-14
  - .7 IEC 60068-2-27 (shock)
  - .8 IEC 60068-2-30
  - .9 IEC 60068-2-78
- .4 Railway environment:
  - .1 EN 50121-4
  - .2 IEC 62236-4

### 1.3 QUALITY ASSURANCE

- .1 The contractor or security sub-contractor shall be a licensed security Contractor with a minimum of five (5) years' experience installing and servicing systems of similar scope and complexity and evidence that is completed at least three (3) projects of similar design and is currently engaged in the installation and maintenance of systems herein described.
- .2 All installation, configuration, setup, program and related work shall be performed by electronic technicians thoroughly trained by the manufacturer in the installation and service of the equipment provided.
- .3 The contractor or designated sub-contractor shall submit credentials of completed manufacturer certification, verified by a third-party organization, as proof of the knowledge.
- .4 The contractor shall provide four (4) current references from clients with systems of similar scope and complexity that became operational in the past three (3) years. At least three (3) of the references shall be utilizing the same system components, in a similar configuration as the proposed system.
- .5 The specified unit shall be manufactured in accordance with ISO9001.

### 1.4 WARRANTY

- .1 All security system components and labor furnished by the contractor including wiring, software, hardware and custom parts shall be fully warranted for parts, materials, labor and travel expenses for a minimum of three (3) years from date of the final acceptance of the Video Surveillance System.
- .2 The manufacturer shall provide warranty and optional extended warranty for the camera for a total period of maximum five years. If enacted as part of the contract, the contractor will repair or replace parts and/or labor per the warranty for the length of this warranty at no cost to the client.

## **PART 2 - PRODUCTS**

### **2.1 GENERAL**

- .1 Cameras shall be IP-based and comply with established network and video standards.
- .2 Cameras shall be powered by the switch utilizing the network cable. Power injectors (midspans) shall be provided by the contractor when required for proper operation.
- .3 Cameras shall be fully supported by an open and published API (Application Programmers Interface), which shall provide necessary information for integration of functionality into third-party applications.

### **2.2 VIDEO SURVEILLANCE SCHEDULE**

- .1 Camera types listed below describing various resolutions, form-factor and features shall be supplied by a single camera manufacturer video surveillance system.
- .2 The camera manufacture and model numbers will be as follows:
  - .1 Interior 1080p fixed dome network camera shall be AXIS P3235-LV, or similar with no less technical or functional capabilities.

### **2.3 VIDEO SURVEILLANCE CAMERAS**

- .1 1080p fixed dome network camera
  - .1 The dome network camera shall meet or exceed the following design specifications:
    - .1 The camera shall operate on an open source; Linux-based platform, and including a built-in web server.
    - .2 The camera shall be equipped with an IR-sensitive progressive scan megapixel sensor.
    - .3 The camera shall provide a removable IR-cut filter, providing day/night functionality.
    - .4 The camera shall be equipped with built-in IR LEDs with automatic seamless adapting angle of illumination and intensity.
    - .5 The camera shall be equipped with a varifocal lens with P-iris, with
      - .1 Horizontal field of view: 90°-34°
      - .2 Vertical field of view: 50°-20°
    - .6 The camera shall provide local video storage utilizing a microSD/microSDHC/microSDXC memory card expansion.
    - .7 The camera shall be manufactured with an IP52-rated, IK08 impact-resistant, polycarbonate casing.
    - .8 The camera shall provide a manual 3-axis (pan/tilt/rotation) positioning to allow adjustment for optimum camera rotation and placement.
    - .9 The camera shall provide options for clear and smoked lower dome.

- .2 The dome network camera shall meet or exceed the following performance specifications:
  - .1 Illumination
    - .1 The camera shall meet or exceed the following illumination specifications:
      - .1 HDTV 1080p 25/30 fps with forensic WDR
        - .1 Color: 0.16 lux at 50 IRE, F1.4
        - .2 B/W: 0.03 lux at 50 IRE, F1.4
        - .3 0 lux with IR illumination on
      - .2 HDTV 1080p 50/60 fps without forensic WDR
        - .1 Color: 0.32 lux at 50 IRE, F1.4
        - .2 B/W: 0.06 lux at 50 IRE, F1.4
        - .3 0 lux with IR illumination on
  - .2 Resolution
    - .1 The camera shall be designed to provide video streams in (1920x1080) with WDR at up to 30 frames per second (60Hz mode) or 25 frames per second (50Hz mode) using H.264 or Motion JPEG.
    - .2 The camera shall be designed to provide video streams in (1920x1080) without WDR at up to 60 frames per second (60Hz mode) or 50 frames per second (50Hz mode) using H.264 or Motion JPEG.
    - .3 The camera shall provide up to 2 individually cropped out view areas.
    - .4 The camera shall support video resolutions including:
      - .1 1920x1080 (HDTV 1080p)
      - .2 1280x720 (HDTV 720p)
    - .5 The camera shall provide both landscape format (4:3 and 16:9 aspect ratio) as well as corridor format (3:4 and 9:16 aspect ratio).
  - .3 Encoding
    - .1 The camera shall support the following video encoding algorithms:
      - .1 Motion JPEG encoding in a selectable range from 1 up to 25/30 frames per second in all resolutions.
      - .2 Baseline Profile H.264 encoding with motion estimation in up to 25/30 frames per second.
      - .3 Main Profile H.264 encoding with motion estimation and context-adaptive binary arithmetic coding (CABAC) in up to 25/30 frames per second.
      - .4 Support High Profile H.264 encoding with motion estimation up to 25/30 frames per second.
      - .5 Support H.264 with automatic scene adaptive bitrate control in up to 25/30 frames per second.
    - .2 The camera shall provide independently configured simultaneous H.264 and Motion JPEG streams.
    - .3 The camera shall in H.264 support Variable Bit Rate (VBR) for video quality adapted to scene content. To protect the network from unexpected bit rate spikes the camera shall support Constant Bit Rate (CBR) or Maximum Bit Rate (MBR).
    - .4 The camera shall provide configurable compression levels.

- .5 Support standard baseline profile H.264 with motion estimation.
- .6 Support motion estimation in H.264/MPEG-4 Part 10/AVC.
- .7 The camera shall for its H.264 implementation support scene adaptive bitrate control with automatic dynamic ROI to reduce bitrate in unprioritized regions in order to lowering bandwidth and storage requirements.
- .4 Transmission
  - .1 The camera shall allow for video to be transported over:
    - .1 HTTP (Unicast)
    - .2 HTTPS (Unicast)
    - .3 RTP (Unicast & Multicast)
    - .4 RTP over RTSP (Unicast)
    - .5 RTP over RTSP over HTTP (Unicast)
  - .2 The camera shall support Quality of Service (QoS) to be able to prioritize traffic.
- .5 Image
  - .1 The camera shall incorporate automatic and manual white balance.
  - .2 The camera shall incorporate an electronic shutter operating in the range of 1/66500 s to 1 s.
  - .3 The camera shall incorporate forensic wide dynamic range functionality providing up to 120 dB dynamic range.
  - .4 The camera shall support manually defined values for:
    - .1 Color level
    - .2 Brightness
    - .3 Sharpness
    - .4 Contrast
  - .5 The camera shall incorporate a function for optimization of low light behavior.
  - .6 The camera shall allow for rotation of the image in steps of 90°.
- .6 Audio
  - .1 The camera shall support two-way full duplex audio:
    - .1 Input sources
      - .1 External microphone
      - .2 External line device
      - .3 Digital input with ring power
    - .2 Output sources
      - .1 External line device
  - .2 Encoding
    - .1 The camera shall support:
      - .1 AAC LC at 8/16/32/44.1/48 kHz
      - .2 24-bit LPCM 48 kHz
      - .3 G.711 PCM at 8 kHz
      - .4 G.726 ADPCM at 8 kHz
      - .5 Opus at 8/16/48kHz

- .7 IR Illumination
  - .1 The camera shall be equipped with built-in IR LEDs with automatic seamless adapting angle of illumination and intensity.
    - .1 The IR LEDs shall have a range of up to 30 m (100 ft)
    - .2 The IR LEDs shall emit light with a wavelength of 850 nm
- .8 User Interface
  - .1 Web server
    - .1 The camera shall contain a built-in web server making video and configuration available to multiple clients in a standard operating system and browser environment using HTTP, without the need for additional software.
    - .2 Optional components downloaded from the camera for specific tasks shall be signed by an organization providing digital trust services, such as Verisign, Inc.
  - .2 Language Specification
    - .1 The camera shall provide a function for altering the language of the user interface, and shall include support for at least 10 different languages.
  - .3 IP addresses
    - .1 The camera shall support both fixed IP addresses and dynamically assigned IP addresses provided by a Dynamic Host Control Protocol (DHCP) server.
    - .2 The camera shall allow for automatic detection of the camera based on UPnP and Bonjour when using a PC with an operating system supporting this feature.
    - .3 The camera shall provide support for both IPv4 and IPv6.
- .9 PTZ functionality
  - .1 The camera shall:
    - .1 Provide Digital PTZ functionality.
    - .2 Provide preset position functionality
- .10 Event functionality
  - .1 The camera shall be equipped with an integrated event functionality, which can be triggered by:
    - .1 Detectors functionality
      - .1 Video motion detection
      - .2 Audio detection
    - .2 Hardware functionality
    - .3 Input Signal functionality
      - .1 External input
      - .2 Manual trigger / virtual inputs via API
      - .3 Camera tampering
      - .4 Live Stream Accessed
    - .4 System functionality
      - .1 Embedded third-party applications
      - .2 Edge storage fail-over recording detection
  - .2 Response to triggers shall include:
    - .1 Send notification, using HTTP, HTTPS, TCP, SNMP trap or email
    - .2 Send images, using FTP, SFTP, HTTP, HTTPS, network share or email

- .3 Send video clip, using FTP, SFTP, HTTP, HTTPS, network share or email
  - .4 Activate external output
  - .5 Play audio clip
  - .6 Recording to local storage and/or network attached storage
- .3 The camera shall provide memory for pre & post alarm recordings.
- .11 Edge storage
  - .1 The camera shall support continuous and event controlled recording to:
    - .1 Local memory added to the cameras SD-card slot
    - .2 Network attached storage, located on the local network
  - .2 The camera shall be able to detect and notify Edge storage disruptions.
- .12 Protocol
  - .1 The camera shall incorporate support for at least IPv4/v6, HTTP, HTTPS, SSL/TLS, QoS Layer 3 DiffServ, FTP, SFTP, CIFS/SMB, SMTP, Bonjour, UPnP®, SNMP v1/v2c/v3 (MIB-II), DNS, DynDNS, NTP, RTSP, RTP, SRTP, TCP, UDP, IGMP, RTCP, ICMP, DHCP, ARP, SOCKS, SSH, LLDP
  - .2 The SMTP implementation shall include support for SMTP authentication.
- .13 Text overlay
  - .1 The camera shall:
    - .1 Provide embedded on-screen text with support for date & time, and a customer-specific text, camera name, of at least 45 ASCII characters.
    - .2 Provide the ability to apply privacy masks to the image.
    - .3 Allow for the overlay of a graphical image, such as a logotype, into the image.
- .14 Security
  - .1 The camera shall support the use of HTTPS and SSL/TLS, providing the ability to upload signed certificates to encrypt and secure authentication and communication of both administration data and video streams.
  - .2 The camera shall provide centralized certificate management, with both pre-installed CA certificates and the ability to upload additional CA certificates. The certificates shall be signed by an organization providing digital trust services.
  - .3 The camera shall support IEEE 802.1X authentication.
  - .4 The camera shall provide support for restricting access to pre-defined IP addresses only, so-called IP address filtering.
  - .5 The camera shall restrict access to the built-in web server by usernames and passwords at three different levels.
- .15 API support
  - .1 The camera shall be fully supported by an open and published API (Application Programmers Interface), which shall provide necessary information for integration of functionality into third-party applications.
  - .2 The camera shall conform to ONVIF profile G as defined by the ONVIF Organization.
  - .3 The camera shall conform to ONVIF profile S as defined by the ONVIF Organization.
  - .4 For ONVIF profile specifications, see [www.onvif.org/](http://www.onvif.org/)

.16 Embedded applications

- .1 The camera shall provide a platform allowing the upload of third-party applications into the camera.

.17 Installation and maintenance

- .1 The camera shall be supplied with Windows-based management software which allows the assignment of IP addresses, upgrade of firmware and backup of the cameras' configuration.
- .2 The camera shall support the use of SNMP-based management tools according to SNMP v1, 2c & 3 / MIB-II.
- .3 The camera shall allow updates of the software (firmware) over the network, using FTP or HTTP.
- .4 The camera shall provide the ability to apply a rectangle of customer-defined number of pixels to the image, which can be used as a pixel counter identifying the size of objects in number of pixels.
- .5 The camera shall accept external time synchronization from an NTP (Network Time Protocol) server.
- .6 The camera shall store all customer-specific settings in a non-volatile memory that shall not be lost during power cuts or soft reset.
- .7 The camera shall provide Remote zoom and Remote focus functionality.

.18 Access log

- .1 The camera shall provide a log file, containing information about the 250 latest connections and access attempts since the unit's latest restart. The file shall include information about the connecting IP addresses and the time of connecting.
- .2 Provide a connection list of all currently connected viewers. The file shall include information about connecting IP address, time of connecting and the type of stream accessed.

.19 Camera diagnostics

- .1 The camera shall be equipped with LEDs, capable of providing visible status information. LEDs shall indicate the camera's operational status and provide information about power, communication with receiver, the network status and the camera status.
- .2 The camera shall be monitored by a Watchdog functionality, which shall automatically re-initiate processes or restart the unit if a malfunction is detected.
- .3 The camera shall send a notification when the unit has re-booted and all services are initialized.

.20 Hardware interfaces

.1 Network interface

- .1 The camera shall be equipped with one 10BASE-T/100BASE-TX PoE Fast Ethernet-port, using a standard RJ45 connector and shall support auto negotiation of network speed (100 MBit/s and 10 MBit/s) and transfer mode (full and half duplex).

.2 Inputs/Outputs

- .1 The camera shall be equipped with four configurable I/O ports, accessible via a removable terminal block for 1 supervised alarm input and 1 output. The output shall be able to provide 12 V DC, 50 mA.

.3 Audio

- .1 The camera shall be equipped with four configurable audio I/O, accessible via a removable terminal block.

.21 Enclosure

.1 The camera shall:

- .1 Be manufactured with an IP52-rated, IK08 impact-resistant, polycarbonate casing.
- .2 Be fitted with a dehumidifying membrane.
- .3 Provide encapsulated electronics and captive screws.

.22 Power

.1 Power over Ethernet IEEE 802.3af/802.3at Type 1 Class 3

- .1 Max: 9.6 W
- .2 Typical: 5.6 W

.23 Environmental

.1 The camera shall:

- .1 Operate in a temperature range of 0 °C to 50 °C (32 °F to 122 °F).
- .2 Operate in a humidity range of 10–85% RH (non-condensing).

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- .1 The contractor's or subcontractor's main resources within the project shall carry proper professional certification issued by the manufacturer and verified by a third-party organization to confirm sufficient product and technology knowledge.
- .2 The contractor shall carefully follow instructions in documentation provided by the manufacturer to ensure all steps have been taken to provide a reliable, easy-to-operate system.
- .3 All equipment shall be tested and configured in accordance with instructions provided by the manufacturer prior to installation.
- .4 All firmware found in products shall be the latest and most up-to-date provided by the manufacturer, or of a version as specified by the provider of the Video Management Application (VMA) or Network Video Recorder (NVR).
- .5 All equipment requiring users to log on using a password shall be configured with user/site-specific password/passwords. No system/product default passwords shall be allowed.
- .6 A proper installation shall meet NEC (National Electrical Code – US only) per the guidelines of that year's revision. When properly installed equipment meets Low Voltage, Class 2 classification of the NEC.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 SYSTEM DESCRIPTION**

- .1 General Requirements
  - .1 The specified unit shall be of manufacturer's official product line, designed for commercial and/or industrial 24/7/365 use.
  - .2 The specified unit shall be based upon standard components and proven technology using open and published protocols.
- .2 Sustainability
  - .1 The specified unit shall be manufactured in accordance with ISO 14001.
  - .2 The specified unit shall be compliant with the EU directives 2011/65/EU (RoHS) and 2012/19/EU (WEEE).
  - .3 The specified unit shall be compliant with the EU regulation 1907/2006 (REACH).
  - .4 The specified unit shall be PVC-free in accordance with IEC 61249-2-21.
  - .5 The manufacturer shall have signed and support the UN Global Compact initiative as defined by United Nations <https://www.unglobalcompact.org/>

### **1.2 CERTIFICATIONS AND STANDARDS**

- .1 General abbreviations and acronyms
  - .1 AGC: Automatic gain control
  - .2 AES: Advanced Encryption Standard
  - .3 API: Application Programming Interface
  - .4 Aspect ratio: A ratio of width to height in images
  - .5 Bit Rate: The number of bits/time unit sent over a network
  - .6 Bonjour: Enables automatic discovery of computers, devices, and services on IP networks.
  - .7 DHCP: Dynamic Host Configuration Protocol
  - .8 DNS: Domain Name System
  - .9 EIS: Electronic Image Stabilization
  - .10 FPS: Frames per Second
  - .11 FTP: File Transfer Protocol
  - .12 H.264 (Video Compression Format)
  - .13 IEEE 802.1x: Authentication framework for network devices
  - .14 IP: Internet Protocol
  - .15 IR light: Infrared light
  - .16 ISO: International Standards Organization
  - .17 JPEG: Joint Photographic Experts Group (image format)
  - .18 LAN: Local Area Network
  - .19 LED: Light Emitting Diode
  - .20 LPR: License Plate Recognition
  - .21 Lux: A standard unit of illumination measurement

- .22 MBR: Maximum Bit Rate
  - .23 MPEG: Moving Picture Experts Group
  - .24 Multicast: Communication between a single sender and multiple receivers on a network
  - .25 NTP: Network Time Protocol
  - .26 NTSC: National Television System Committee – a color encoding system based on 60Hz
  - .27 ONVIF: Global standard for the interface of IP-based physical security products
  - .28 PACS: Physical Access Control System
  - .29 PAL: Phase Alternating Line – a color encoding system based on 50Hz
  - .30 PoE: Power over Ethernet (IEEE 802.3af/at) standard for providing power over network cable
  - .31 Progressive scan: An image scanning technology which scans the entire picture
  - .32 PTZ: Pan/Tilt/Zoom
  - .33 QoS: Quality of Service
  - .34 RAID: Redundant Array of Independent Disks
  - .35 SaaS: Software as a Service
  - .36 SIP: Session Initiation Protocol
  - .37 SMTP: Simple Mail Transfer Protocol
  - .38 SMPTE: Society of Motion Picture and Television Engineers
  - .39 SNMP: Simple Network Management Protocol
  - .40 SSL: Secure Sockets Layer
  - .41 TCP: Transmission Control Protocol
  - .42 TLS: Transport Layer Security
  - .43 Unicast: Communication between a single sender and single receiver on a network
  - .44 UPnP: Universal Plug and Play
  - .45 UPS: Uninterruptible Power Supply
  - .46 VBR: Variable Bit Rate
  - .47 VMS: Video Management System
  - .48 WDR: Wide dynamic range
- .2 The specified unit shall carry the following EMC approvals:
- .1 EN 55022 Class B, EN 55024, EN 61000-6-1, EN 61000-6-2
  - .2 FCC Part 15 - Subpart B Class A + B
  - .3 VCCI Class B
  - .4 RCM AS/NZS CISPR 22 Class B
  - .5 ICES-003 Class B
  - .6 KCC KN22 Class B, KN24
- .3 The specified unit shall meet the following product safety standards:
- .1 IEC/EN/UL 60950-1
  - .2 IEC/EN/UL 60950-22
  - .3 IEC/EN 62471 (risk group 1)

- .4 The specified unit shall meet relevant parts of the following video standards:
  - .1 SMPTE 296M (HDTV 720p)
  - .2 SMPTE 274M (HDTV 1080p)
- .5 The specified unit shall meet the following standards
  - .1 MPEG-4:
    - .1 ISO/IEC 14496-10 Advanced Video Coding (H.264)
  - .2 Networking:
    - .1 IEEE 802.3af/802.3at (Power over Ethernet)
    - .2 IEEE 802.1X (Authentication)
    - .3 IPv4 (RFC 791)
    - .4 IPv6 (RFC 2460)
    - .5 QoS – DiffServ (RFC 2475)
  - .3 Network video
    - .1 Relevant ONVIF profile as defined by the ONVIF Organization.
  - .4 Mechanical Environment:
    - .1 IEC/EN 60529 IP66
    - .2 NEMA 250 Type 4X
    - .3 IEC/EN 62262 IK10
    - .4 IEC 60068-2-1
    - .5 IEC 60068-2-2
    - .6 IEC 60068-2-14
    - .7 IEC 60068-2-6 (vibration)
    - .8 IEC 60068-2-27 (shock)
    - .9 IEC 60068-2-30
    - .10 IEC 60068-2-78
  - .5 Railway environment:
    - .1 EN 50121-4
    - .2 IEC 62236-4

### 1.3 QUALITY ASSURANCE

- .1 The Contractor or security sub-contractor shall be a licensed security Contractor with a minimum of five (5) years' experience installing and servicing systems of similar scope and complexity and evidence that is completed at least three (3) projects of similar design and is currently engaged in the installation and maintenance of systems herein described.
- .2 All installation, configuration, setup, program and related work shall be performed by electronic technicians thoroughly trained by the manufacturer in the installation and service of the equipment provided.
- .3 The contractor or designated sub-contractor shall submit credentials of completed manufacturer certification, verified by a third party organization, as proof of the knowledge.

- .4 The Contractor shall provide four (4) current references from clients with systems of similar scope and complexity that became operational in the past three (3) years. At least three (3) of the references shall be utilizing the same system components, in a similar configuration as the proposed system.
- .5 The specified unit shall be manufactured in accordance with ISO9001.

#### **1.4 WARRANTY**

- .1 All security system components and labor furnished by the contractor including wiring, software, hardware and custom parts shall be fully warranted for parts, materials, labor and travel expenses for a minimum of three (3) years from date of the final acceptance of the Video Surveillance System.
- .2 The manufacturer shall provide warranty and optional extended warranty for the camera for a total period of maximum five years. If enacted as part of the contract, the contractor will repair or replace parts and/or labor per the warranty for the length of this warranty at no cost to the client.

### **PART 2 - PRODUCTS**

#### **2.1 GENERAL**

- .1 Cameras shall be IP-based and comply with established network and video standards.
- .2 Cameras shall be powered by the switch utilizing the network cable. Power injectors (midspans) shall be provided by the contractor when required for proper operation.
- .3 Cameras shall be fully supported by an open and published API (Application Programmers Interface), which shall provide necessary information for integration of functionality into third party applications.
- .4 Cameras shall comply with relevant ONVIF profile as defined by the ONVIF Organization.

#### **2.2 VIDEO SURVEILLANCE SCHEDULE**

- .1 Camera types listed below describing various resolutions, form-factor and features shall be supplied by a single camera manufacturer video surveillance system.
- .2 The camera manufacture and model numbers will be as follows:
  - .1 Exterior fixed dome vandal-resistant 1080p network camera shall be AXIS P3225-LVE Mk II, or similar with no less technical or functional capabilities.

#### **2.3 VIDEO SURVEILLANCE CAMERAS**

- .1 Fixed dome 1080p network camera
  - .1 The fixed dome network camera shall meet or exceed the following design specifications:
    - .1 The camera shall operate on an open source; Linux-based platform, and including a built-in web server.
    - .2 The camera shall be equipped with an IR-sensitive progressive scan megapixel sensor.

- .3 The camera shall provide a removable IR-cut filter, providing day/night functionality.
- .4 The camera shall be equipped with a varifocal lens with P-iris.
- .5 The camera shall provide local video storage utilizing a microSD/microSDHC/microSDXC memory card expansion.
- .6 The camera shall be manufactured with an IP66- and NEMA 4X-rated, IK10 impact-resistant casing.
- .7 The camera shall provide a manual 3-axis (pan/tilt/rotation) positioning to allow adjustment for optimum camera rotation and placement.
- .8 The camera shall provide options for clear and smoked lower dome.
- .2 The fixed dome network camera shall meet or exceed the following performance specifications:
  - .1 Illumination
    - .1 The camera shall meet or exceed the following illumination specifications:
      - .1 HDTV 1080p 25/30 fps with WDR - forensic capture
        - .1 0.16 lux at 50 IRE, F1.4 (color)
        - .2 0.03 lux at 50 IRE, F1.4, 0 lux with IR illumination on (B/W)
      - .2 HDTV 1080p 50/60 fps without WDR - forensic capture
        - .1 0.32 lux at 50 IRE, F1.4 (color)
        - .2 0.06 lux at 50 IRE, F1.4, 0 lux with IR illumination on (B/W)
  - .2 Resolution
    - .1 The camera shall be designed to provide at least two video streams in HDTV 720p (1280x720) at up to 60 frames per second (60Hz mode) or 50 frames per second (50Hz mode) using H.264 or Motion JPEG (WDR inactive).
    - .2 The camera shall be designed to provide at least two video streams in HDTV 720p (1280x720) at up to 30 frames per second (60Hz mode) or 25 frames per second (50Hz mode) using H.264 or Motion JPEG (WDR active).
    - .3 The camera shall be designed to provide 2 individually cropped out view areas.
    - .4 The camera shall support video resolutions including:
      - .1 1920x1080 (HDTV 1080p)
      - .2 1280x960
      - .3 1280x720 (HDTV 720p)
      - .4 1024x768
      - .5 1024x640
    - .5 The camera shall provide both landscape format (4:3 and 16:9 aspect ratio) as well as corridor format (3:4 and 9:16 aspect ratio).
  - .3 Encoding
    - .1 The camera shall support the following video encoding algorithms:
      - .1 Motion JPEG encoding in a selectable range from 1 up to 25/30 frames per second.
      - .2 Motion JPEG encoding in a selectable range from 1 up to 50/60 frames per second.
      - .3 Baseline Profile H.264 encoding with motion estimation in up to 25/30 frames per second.
      - .4 Baseline Profile H.264 encoding with motion estimation in up to 50/60 frames per second.
      - .5 Main Profile H.264 encoding with motion estimation and context-adaptive binary arithmetic coding (CABAC) in up to 25/30 frames per second.

- .6 Main Profile H.264 encoding with motion estimation and context-adaptive binary arithmetic coding (CABAC) in up to 50/60 frames per second.
- .7 Support High Profile H.264 encoding with motion estimation up to 25/30 frames per second.
- .8 Support High Profile H.264 encoding with motion estimation up to 50/60 frames per second.
- .9 Support H.264 with automatic scene adaptive bitrate control.
- .2 The camera shall provide independently configured simultaneous H.264 and Motion JPEG streams.
- .3 The camera shall in H.264 support Variable Bit Rate (VBR) for video quality adapted to scene content. To protect the network from unexpected bit rate spikes the camera shall support Constant Bit Rate (CBR) or Maximum Bit Rate (MBR).
- .4 The camera shall provide configurable compression levels.
- .5 Support standard baseline profile H.264 with motion estimation.
- .6 Support motion estimation in H.264/MPEG-4 Part 10/AVC.
- .7 The camera shall for its H.264 implementation support scene adaptive bitrate control with automatic dynamic ROI to reduce bitrate in unprioritized regions in order to lowering bandwidth and storage requirements.
- .4 Transmission
  - .1 The camera shall allow for video to be transported over:
    - .1 HTTP (Unicast)
    - .2 HTTPS (Unicast)
    - .3 RTP (Unicast & Multicast)
    - .4 RTP over RTSP (Unicast)
    - .5 RTP over RTSP over HTTP (Unicast)
  - .2 The camera shall support Quality of Service (QoS) to be able to prioritize traffic.
- .5 Image
  - .1 The camera shall incorporate Automatic and Manual White Balance.
  - .2 The camera shall incorporate an electronic shutter operating in the range of 1/66500 s to 1 s.
  - .3 The camera shall incorporate capture mode with the following settings:
    - .1 25/30 fps (WDR-Forensic Capture) (50/60 Hz)
    - .2 50/60 fps (no WDR-Forensic Capture) (50/60 Hz)
  - .4 The camera shall incorporate Wide Dynamic Range - Forensic Capture functionality providing up to 120dB dynamic range.
  - .5 The camera shall support manually defined values for:
    - .1 Color level
    - .2 Brightness
    - .3 Sharpness
    - .4 Contrast
  - .6 The camera shall incorporate a function for optimization of low light behavior.
  - .7 The camera shall allow for rotation of the image in steps of 90°.

- .6 IR Illumination
  - .1 The camera shall be equipped with built-in IR LEDs with adjustable illumination intensity.
    - .1 The IR LEDs shall have a range of up to 30 m (100 ft).
    - .2 The IR LEDs shall emit light with a wavelength of 850 nm.
- .7 User Interface
  - .1 Web server
    - .1 The camera shall contain a built-in web server making video and configuration available to multiple clients in a standard operating system and browser environment using HTTP, without the need for additional software.
    - .2 Optional components downloaded from the camera for specific tasks, e.g. Active X, shall be signed by an organization providing digital trust services, such as Verisign, Inc.
  - .2 Language Specification
    - .1 The camera shall provide a function for altering the language of the user interface, and shall include support for at least 10 different languages.
  - .3 IP addresses
    - .1 The camera shall support both fixed IP addresses and dynamically assigned IP addresses provided by a Dynamic Host Control Protocol (DHCP) server.
    - .2 The camera shall allow for automatic detection of the camera based on UPnP and Bonjour when using a PC with an operating system supporting this feature.
    - .3 The camera shall provide support for both IPv4 and IPv6.
- .8 PTZ functionality
  - .1 The camera shall:
    - .1 Provide Digital PTZ functionality.
- .9 Event functionality
  - .1 The camera shall be equipped with an integrated event functionality, which can be triggered by:
    - .1 Video Motion Detection
    - .2 Live Stream Accessed
    - .3 Day/Night Mode
    - .4 Camera tampering
    - .5 Manual Trigger/Virtual Inputs
    - .6 PTZ functionality
    - .7 Embedded third party applications
    - .8 Edge storage disruption detection
  - .2 Response to triggers shall include:
    - .1 Send notification, using HTTP, HTTPS, TCP, SNMP trap or email
    - .2 Send images, using FTP, HTTP, HTTPS, network share or email
    - .3 Send video clip, using FTP, HTTP, HTTPS, network share or email
    - .4 Send SNMP trap message
    - .5 Activate/Deactivate IR Illumination
    - .6 Recording to local storage and/or network attached storage
    - .7 PTZ control functionality
    - .8 WDR mode
  - .3 The camera shall provide memory for pre & post alarm recordings.

.10 Edge storage

- .1 The camera shall support continuous and event controlled recording to:
  - .1 Local memory added to the cameras microSD-card slot
  - .2 Network attached storage, located on the local network
- .2 The camera shall be able to detect and notify Edge storage disruptions.

.11 Protocol

- .1 The camera shall incorporate support for at least IPv4/v6, HTTP, HTTPS, SSL/TLS, QoS Layer 3 DiffServ, TCP, ICMP, SNMPv1/v2c/v3 (MIB-II), RTSP, RTP, UDP, IGMP, RTCP, SMTP, FTP, DHCP, UPnP, ARP, DNS, DynDNS, SOCKS, SSH, NTP, CIFS/SMB, Bonjour.
- .2 The SMTP implementation shall include support for SMTP authentication.

.12 Text overlay

- .1 The camera shall:
  - .1 Provide embedded on-screen text with support for date & time, and a customer-specific text, camera name, of at least 45 ASCII characters.
  - .2 Provide the ability to apply privacy masks to the image.
  - .3 Allow for the overlay of a graphical image, such as a logotype, into the image.

.13 Security

- .1 The camera shall support the use of HTTPS and SSL/TLS, providing the ability to upload signed certificates to encrypt and secure authentication and communication of both administration data and video streams.
- .2 The camera shall provide centralized certificate management, with both pre-installed CA certificates and the ability to upload additional CA certificates. The certificates shall be signed by an organization providing digital trust services.
- .3 The camera shall support IEEE 802.1X authentication.
- .4 The camera shall provide support for restricting access to pre-defined IP addresses only, so-called IP address filtering.
- .5 The camera shall restrict access to the built-in web server by usernames and passwords at three different levels.

.14 API support

- .1 The camera shall be fully supported by an open and published API (Application Programmers Interface), which shall provide necessary information for integration of functionality into third party applications.
- .2 The camera shall support relevant ONVIF profiles as defined by the ONVIF Organization.

.15 Embedded applications

- .1 The camera shall provide a platform allowing the upload of third party applications into the camera.

.16 Installation and maintenance

- .1 The camera shall be supplied with Windows-based management software which allows the assignment of IP addresses, upgrade of firmware and backup of the cameras' configuration.
- .2 The camera shall support the use of SNMP-based management tools according to SNMP v1, 2c & 3 / MIB-II.
- .3 The camera shall allow updates of the software (firmware) over the network, using FTP or HTTP.

- .4 The camera shall provide the ability to apply a rectangle of customer-defined number of pixels to the image, which can be used as a pixel counter identifying the size of objects in number of pixels.
- .5 The camera shall accept external time synchronization from an NTP (Network Time Protocol) server.
- .6 The camera shall store all customer-specific settings in a non-volatile memory that shall not be lost during power cuts or soft reset.
- .7 The camera shall provide Remote zoom and Remote focus functionality.
- .8 Access log
- .9 The camera shall provide a log file, containing information about the 250 latest connections and access attempts since the unit's latest restart. The file shall include information about the connecting IP addresses and the time of connecting.
- .10 Provide a connection list of all currently connected viewers. The file shall include information about connecting IP address, time of connecting and the type of stream accessed.
- .17 Camera diagnostics
  - .1 The camera shall be equipped with LEDs, capable of providing visible status information. LEDs shall indicate the camera's operational status and provide information about power, communication with receiver, the network status and the camera status.
  - .2 The camera shall be monitored by a Watchdog functionality, which shall automatically re-initiate processes or restart the unit if a malfunction is detected.
  - .3 The camera shall send a notification when the unit has re-booted and all services are initialized.
- .18 Hardware interfaces
  - .1 Network interface
    - .1 The camera shall be equipped with one 10BASE-T/100BASE-TX PoE Fast Ethernet-port, using a standard connector and shall support auto negotiation of network speed (100 MBit/s and 10 MBit/s) and transfer mode (full and half duplex).
- .19 Enclosure
  - .1 The camera shall:
    - .1 Be manufactured with an IP66- and NEMA 4X-rated, IK10 impact-resistant casing.
    - .2 Be fitted with a dehumidifying membrane.
    - .3 Providing encapsulated electronics and captive screws.
- .20 Power
  - .1 Power over Ethernet IEEE 802.3af/802.3at Type 1 Class 3
    - .1 Max: 10.8 W
    - .2 Typical 7.3 W
- .21 Environmental
  - .1 Operate in a temperature range of -30 °C to +50 °C (-22 °F to 122 °F).
  - .2 Operate in a humidity range of 10–100% RH (condensing).

## **PART 3- EXECUTION**

### **3.1 INSTALLATION**

- .1 The Contractors or subcontractors main resources within the project shall carry proper professional certification issued by the manufacturer and verified by a third party organization to confirm sufficient product and technology knowledge.
  - .1 The Contractor shall carefully follow instructions in documentation provided by the manufacturer to ensure all steps have been taken to provide a reliable, easy-to-operate system.
  - .2 All equipment shall be tested and configured in accordance with instructions provided by the manufacturer prior to installation.
  - .3 All firmware found in products shall be the latest and most up-to-date provided by the manufacturer, or of a version as specified by the provider of the Video Management Application (VMA) or Network Video Recorder (NVR).
  - .4 All equipment requiring users to log on using a password shall be configured with user/site-specific password/passwords. No system/product default passwords shall be allowed.
  - .5 A proper installation shall meet NEC (National Electrical Code – US only) per the guidelines of that year's revision. When properly installed equipment meets Low Voltage, Class 2 classification of the NEC.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 SYSTEM DESCRIPTION**

- .1 General Requirements
  - .1 The specified unit shall be of manufacturer's official product line, designed for commercial and/or industrial 24/7/365 use.
  - .2 The specified unit shall be based upon standard components and proven technology using open and published protocols.
- .2 Sustainability
  - .1 The specified unit shall be manufactured in accordance with ISO 14001.
  - .2 The specified unit shall be compliant with the EU directives 2011/65/EU (RoHS) and 2012/19/EU (WEEE).
  - .3 The specified unit shall be compliant with the EU regulation 1907/2006 (REACH).
  - .4 The product, including all its components, shall not contain any added PVC.
  - .5 The manufacturer shall have signed and support the UN Global Compact initiative as defined by United Nations

### **1.2 CERTIFICATIONS AND STANDARDS**

- .1 General abbreviations and acronyms
  - .1 AGC: Automatic gain control
  - .2 AES: Advanced Encryption Standard
  - .3 API: Application Programming Interface
  - .4 Aspect ratio: A ratio of width to height in images
  - .5 Bit Rate: The number of bits/time unit sent over a network
  - .6 Bonjour: Enables automatic discovery of computers, devices, and services on IP networks.
  - .7 DHCP: Dynamic Host Configuration Protocol
  - .8 DNS: Domain Name System
  - .9 EIS: Electronic Image Stabilization
  - .10 FPS: Frames per Second
  - .11 FTP: File Transfer Protocol
  - .12 SFTP: Secure File Transfer Protocol
  - .13 H.264 (Video Compression Format)
  - .14 IEEE 802.1x: Authentication framework for network devices
  - .15 IP: Internet Protocol
  - .16 IR light: Infrared light
  - .17 ISO: International Standards Organization
  - .18 JPEG: Joint Photographic Experts Group (image format)
  - .19 LAN: Local Area Network
  - .20 LED: Light Emitting Diode
  - .21 LPR: License Plate Recognition

- .22 Lux: A standard unit of illumination measurement
  - .23 MBR: Maximum Bit Rate
  - .24 MPEG: Moving Picture Experts Group
  - .25 Multicast: Communication between a single sender and multiple receivers on a network
  - .26 NTP: Network Time Protocol
  - .27 NTSC: National Television System Committee – a color encoding system based on 60Hz
  - .28 ONVIF: Global standard for the interface of IP-based physical security products
  - .29 PACS: Physical Access Control System
  - .30 PAL: Phase Alternating Line – a color encoding system based on 50Hz
  - .31 PoE: Power over Ethernet (IEEE 802.3af/at) standard for providing power over network cable
  - .32 Progressive scan: An image scanning technology which scans the entire picture
  - .33 PTZ: Pan/Tilt/Zoom
  - .34 QoS: Quality of Service
  - .35 RAID: Redundant Array of Independent Disks
  - .36 SaaS: Software as a Service
  - .37 SIP: Session Initiation Protocol
  - .38 SMTP: Simple Mail Transfer Protocol
  - .39 SMPTE: Society of Motion Picture and Television Engineers
  - .40 SNMP: Simple Network Management Protocol
  - .41 SSL: Secure Sockets Layer
  - .42 TCP: Transmission Control Protocol
  - .43 TLS: Transport Layer Security
  - .44 Unicast: Communication between a single sender and single receiver on a network
  - .45 UPnP: Universal Plug and Play
  - .46 UPS: Uninterruptible Power Supply
  - .47 VBR: Variable Bit Rate
  - .48 VMS: Video Management System
  - .49 WDR: Wide dynamic range
- .2 The specified unit shall carry the following EMC approvals:
- .1 EN 55032 Class A
  - .2 EN 55024
  - .3 FCC Part 15 - Subpart B Class A
  - .4 VCCI Class A
  - .5 RCM AS/NZS CISPR 32 Class A
  - .6 ICES-003 Class A
  - .7 KC KN32 Class A
  - .8 KC KN35

- .3 The specified unit shall meet the following product safety standards:
  - .1 IEC/EN/UL 60950-22
  - .2 IEC/EN/UL 62368-1
  - .3 IEC/EN 62471
- .4 The specified unit shall meet relevant parts of the following video standards:
  - .1 SMPTE 296M (HDTV 720p)
  - .2 SMPTE 274M (HDTV 1080p)
- .5 The specified unit shall meet the following standards
  - .1 MPEG-4:
    - .1 ISO/IEC 14496-10 Advanced Video Coding (H.264)
  - .2 Networking:
    - .1 IEEE 802.3af/802.3at (Power over Ethernet)
    - .2 IEEE 802.1X (Authentication)
    - .3 IPv4 (RFC 791)
    - .4 IPv6 (RFC 2460)
    - .5 QoS – DiffServ (RFC 2475)
    - .6 NIST SP500-267
  - .3 Mechanical Environment:
    - .1 IEC/EN 60529 IP66
    - .2 NEMA 250 Type 4X
    - .3 IEC/EN 62262 IK10
    - .4 IEC 60068-2-1
    - .5 IEC 60068-2-2
    - .6 IEC 60068-2-6
    - .7 IEC 60068-2-14
    - .8 IEC 60068-2-27
    - .9 IEC 60721-3-5 Class 5M3 (vibration and shock)
  - .4 Railway environment:
    - .1 EN 50121-4
    - .2 IEC 62236-4

### 1.3 QUALITY ASSURANCE

- .1 The Contractor or security sub-contractor shall be a licensed security Contractor with a minimum of five (5) years' experience installing and servicing systems of similar scope and complexity and evidence that is completed at least three (3) projects of similar design and is currently engaged in the installation and maintenance of systems herein described.
- .2 All installation, configuration, setup, program and related work shall be performed by electronic technicians thoroughly trained by the manufacturer in the installation and service of the equipment provided.

- .3 The contractor or designated sub-contractor shall submit credentials of completed manufacturer certification, verified by a third-party organization, as proof of the knowledge.
- .4 The Contractor shall provide four (4) current references from clients with systems of similar scope and complexity that became operational in the past three (3) years. At least three (3) of the references shall be utilizing the same system components, in a similar configuration as the proposed system
- .5 The specified unit shall be manufactured in accordance with ISO9001.

#### **1.4 WARRANTY**

- .1 All security system components and labor furnished by the contractor including wiring, software, hardware and custom parts shall be fully warranted for parts, materials, labor and travel expenses for a minimum of three (3) years from date of the final acceptance of the Video Surveillance System.
- .2 The manufacturer shall provide warranty and optional extended warranty for the camera for a total period of maximum five years. If enacted as part of the contract, the contractor will repair or replace parts and/or labor per the warranty for the length of this warranty at no cost to the client.

### **PART 2 - PRODUCTS**

#### **2.1 GENERAL**

- .1 Cameras shall be IP-based and comply with established network and video standards.
- .2 Cameras shall be powered by the switch utilizing the network cable. Power injectors (midspans) shall be provided by the contractor when required for proper operation.
- .3 Cameras shall be fully supported by an open and published API (Application Programmers Interface), which shall provide necessary information for integration of functionality into third party applications.

#### **2.2 VIDEO SURVEILLANCE SCHEDULE**

- .1 Camera types listed below describing various resolutions, form-factor and features shall be supplied by a single camera manufacturer video surveillance system.
- .2 The camera manufacture and model numbers will be as follows:
- .3 6 MP outdoor-ready dome network camera shall be AXIS M3057-PLVE, or similar with no less technical or functional capabilities.

## 2.3 VIDEO SURVEILLANCE CAMERAS

- .1 6 MP outdoor-ready dome network camera
  - .1 The network camera shall meet or exceed the following design specifications:
    - .1 The camera shall operate on an open source and Linux-based platform, and include a built-in web server.
    - .2 The camera shall be equipped with a progressive scan megapixel sensor.
    - .3 The camera shall provide a removable IR-cut filter, providing day/night functionality.
    - .4 The camera shall be factory-focused, which removes the need for manual focusing.
    - .5 The camera shall be manufactured with a repaintable casing.
    - .6 The camera shall provide local video storage utilizing a microSD/microSDHC/microSDXC memory card expansion.
    - .7 The camera shall be manufactured with an IP66-, NEMA 250 4X-rated and IK-10 impact-resistant casing with polycarbonate and aluminum hard-coated dome.
  - .2 The network camera shall meet or exceed the following performance specifications:
    - .1 Illumination
      - .1 The camera shall meet or exceed the following illumination specifications:
        - .1 Color: 0.16 lux at 50 IRE F2.0
        - .2 B/W: 0.03 lux at 50 IRE F2.0
        - .3 0 lux with IR illumination on
- .2 Resolution
  - .1 The camera shall be designed to provide at multiple, individually configurable streams in H.264 and Motion JPEG.
  - .2 The camera shall support 360° overview, de-warped panorama, double panorama, corridor and quad views. Up to four individually cropped out and de-warped view areas. The 360° overview can be streamed simultaneously with four view areas or one other de-warped view.
  - .3 The camera shall support video resolutions including:
    - .1 Overview: 2048x2048 to 160x160
    - .2 Panorama: 2560x960 to 192x72
    - .3 Double Panorama: 2560x1920 to 256x144
    - .4 Quad view: 2560x1920 to 256x144
    - .5 View area 1-4, 16:9: 2048x1152 to 256x144, 4:3: 1920x1440 to 320x240
    - .6 Panorama corner left or right: 2368x1184 to 192x72
    - .7 Double panorama corner: 2048x2048 to 320x240
    - .8 Corridor: 2560x1920 to 256x144
  - .4 The camera shall provide both landscape format (4:3 and 16:9 aspect ratio) as well as corridor format (3:4 and 9:16 aspect ratio).
- .3 Encoding
  - .1 The camera shall support the following video encoding algorithms:
    - .1 Motion JPEG encoding with WDR in a selectable range from 1 up to 25/30 frames per second in 360° overview and de-warped views.
    - .2 Motion JPEG encoding without WDR in a selectable range from 1 up to 50/60 frames per second in 360° overview.
    - .3 Baseline Profile H.264 encoding with motion estimation.

- .4 Main Profile H.264 encoding with motion estimation and context-adaptive binary arithmetic coding (CABAC).
    - .5 High Profile H.264 encoding with motion estimation.
  - .2 The camera shall provide independently configured simultaneous H.264 and Motion JPEG streams.
  - .3 The camera shall in H.264 support Variable Bit Rate (VBR) for video quality adapted to scene content. To protect the network from unexpected bit rate speaks the camera shall support Maximum Bit Rate (MBR).
  - .4 The camera shall provide configurable compression levels.
  - .5 The camera shall support standard baseline profile H.264 with motion estimation.
  - .6 The camera shall support motion estimation in H.264/MPEG-4 Part 10/AVC.
  - .7 The camera shall for its H.264 implementation support scene adaptive bitrate control with automatic dynamic ROI to reduce bitrate in unprioritized regions in order to lowering bandwidth and storage requirements.
- .4 Transmission
  - .1 The camera shall allow for video to be transported over:
    - .1 HTTP (Unicast)
    - .2 HTTPS (Unicast)
    - .3 RTP (Unicast & Multicast)
    - .4 RTP over RTSP (Unicast)
    - .5 RTP over RTSP over HTTP (Unicast)
    - .6 SRTP (Unicast & Multicast)
  - .2 The camera shall support Quality of Service (QoS) to be able to prioritize traffic.
- .5 Image
  - .1 The camera shall incorporate automatic and manual white balance.
  - .2 The camera shall incorporate an electronic shutter operating in the range of 1/100000 s to 2 s.
  - .3 The camera shall incorporate forensic wide dynamic range functionality, providing up to 120 dB dynamic range.
  - .4 The camera shall support manually defined values for:
    - .1 Color level
    - .2 Brightness
    - .3 Sharpness
    - .4 Contrast
  - .5 The camera shall allow for rotation of the image.
- .6 IR Illumination
  - .1 The camera shall be equipped with built-in IR LEDs.
  - .2 The IR LEDs shall have a range of up to 20 m (66 ft)
  - .3 The IR LEDs shall emit light with a wavelength of 850 nm.

- .7 User Interface
  - .1 Web server
    - .1 The camera shall contain a built-in web server making video and configuration available to multiple clients in a standard operating system and browser environment using HTTP, without the need for additional software.
    - .2 Optional components downloaded from the camera for specific tasks, e.g. Active X, shall be signed by an organization providing digital trust services, such as Verisign, Inc.
  - .2 Language Specification
    - .1 The camera shall provide a function for altering the language of the user interface, and shall include support for at least 10 different languages.
  - .3 IP addresses
    - .1 The camera shall support both fixed IP addresses and dynamically assigned IP addresses provided by a Dynamic Host Control Protocol (DHCP) server.
    - .2 The camera shall allow for automatic detection of the camera based on UPnP and Bonjour when using a computer with an operating system supporting this feature.
    - .3 The camera shall provide support for both IPv4 and IPv6.
- .8 PTZ functionality
  - .1 The camera shall:
    - .1 Provide digital PTZ functionality of view areas.
    - .2 Provide preset positions functionality.
    - .3 Provide digital pan (except panorama at wall mount) and tilt of panorama, corner, corridor and quad views.
    - .4 Provide a guard tour functionality which allows the dome to automatically move between selected presets using an individual speed and viewing time for each preset.
- .9 Event functionality
  - .1 The camera shall be equipped with an integrated event functionality, which can be triggered by:
    - .1 Video Motion Detection
    - .2 Camera tampering
    - .3 Manual Trigger/Virtual Inputs
    - .4 PTZ functionality
    - .5 Embedded third party applications
    - .6 Edge storage fail-over recording detection
  - .2 Response to triggers shall include event actions:
    - .1 Send notification, using HTTP, HTTPS, TCP, SNMP trap or email
    - .2 Send images, using FTP, SFTP, HTTP, HTTPS, network share or email
    - .3 Send video clip, using FTP, SFTP, HTTP, HTTPS, network share or email
    - .4 Send SNMP trap message
    - .5 Recording to local storage and/or network attached storage
    - .6 Activate external output
    - .7 PTZ control functionality
    - .8 WDR mode
    - .9 Day and night mode
  - .3 The camera shall provide memory for pre & post alarm recordings.

- .10 Edge storage
  - .1 The camera shall support continuous and event controlled recording to:
    - .1 Local memory added to the cameras microSD-card slot
    - .2 Network attached storage, located on the local network
  - .2 The camera shall incorporate encryption functionality for the SD card.
  - .3 The camera shall be able to detect and notify edge storage disruptions.
- .11 Protocol
  - .1 The camera shall incorporate support for at least IPv4/v6, HTTP, HTTPS, SSL/TLS, QoS Layer 3 DiffServ, FTP, SFTP, CIFS/SMB, SMTP, Bonjour, UPnP, SNMP v1/v2c/v3 (MIB-II), DNS, DynDNS, NTP, RTSP, RTP, SRTP, TCP, UDP, IGMP, RTCP, ICMP, DHCP, ARP, SOCKS, SSH, LLDP, HDMI 1.4.
  - .2 The SMTP implementation shall include support for SMTP authentication.
- .12 Text overlay
  - .1 The camera shall:
    - .1 Provide embedded on-screen text with support for date & time, and a customer-specific text, camera name, of at least 45 ASCII characters.
    - .2 Provide the possibility to choose different font sizes for embedded on-screen text, and to use white or black text on at least four different backgrounds.
    - .3 Provide the ability to manually set up and configure privacy masks to the image.
    - .4 Allow for the overlay of a graphical image, such as a logotype, into the image.
- .13 Security
  - .1 The camera shall support the use of HTTPS and SSL/TLS, providing the ability to upload signed certificates to encrypt and secure authentication and communication of both administration data and video streams.
  - .2 The camera shall provide centralized certificate management, with both pre-installed CA certificates and the ability to upload additional CA certificates. The certificates shall be signed by an organization providing digital trust services.
  - .3 The camera shall support IEEE 802.1X authentication.
  - .4 The camera shall provide support for restricting access to pre-defined IP addresses only, so-called IP address filtering.
  - .5 The camera shall restrict access to the built-in web server by usernames and passwords at three different levels.
- .14 API support
  - .1 The camera shall be fully supported by an open and published API (Application Programmers Interface), which shall provide necessary information for integration of functionality into third party applications.
  - .2 The camera shall conform to ONVIF profile G as defined by the ONVIF Organization.
  - .3 The camera shall conform to ONVIF profile S as defined by the ONVIF Organization.
    - .1 For ONVIF profile specifications, see [www.onvif.org/](http://www.onvif.org/)
- .15 Embedded applications
  - .1 The camera shall provide a platform allowing the upload of third party applications into the camera.

- .16 Installation and maintenance
  - .1 The camera shall be supplied with Windows-based management software which allows the assignment of IP addresses, upgrade of firmware and backup of the cameras' configuration.
  - .2 The camera shall support the use of SNMP-based management tools according to SNMP v1, 2c & 3 / MIB-II.
  - .3 The camera shall allow updates of the software (firmware) over the network, using FTP or HTTP.
  - .4 The camera shall provide the ability to apply a rectangle of customer-defined number of pixels to the image, which can be used as a pixel counter identifying the size of objects in number of pixels.
  - .5 The camera shall accept external time synchronization from an NTP (Network Time Protocol) server.
  - .6 The camera shall store all customer-specific settings in a non-volatile memory that shall not be lost during power cuts or soft reset.
- .17 Access log
  - .1 The camera shall provide a log file, containing information about the 250 latest connections and access attempts since the unit's latest restart. The file shall include information about the connecting IP addresses and the time of connecting.
  - .2 The camera shall provide a connection list of all currently connected viewers. The file shall include information about connecting IP address, time of connecting and the type of stream accessed.
- .18 Camera diagnostics
  - .1 The camera shall be equipped with LEDs, capable of providing visible status information. LEDs shall indicate the camera's operational status and provide information about power, communication with receiver, the network status and the camera status.
  - .2 The camera shall be monitored by a Watchdog functionality, which shall automatically re-initiate processes or restart the unit if a malfunction is detected.
  - .3 The camera shall send a notification when the unit has re-booted and all services are initialized.
- .19 Hardware interfaces
  - .1 Network interface
    - .1 The camera shall be equipped with one 10BASE-T/100BASE-TX Fast Ethernet-port using a RJ45 connector, and shall support auto negotiation of network speed (100 MBit/s and 10 MBit/s) and transfer mode (full and half duplex).
  - .2 Inputs/Outputs
    - .1 The camera shall be equipped with one supervised (alarm) input and one digital output, accessible via a removable terminal block. This input shall be configurable to respond to normally open (NO) or normally closed (NC) dry contacts. The output shall be able to provide 12 V DC, 25 mA.
- .20 Enclosure
  - .1 The camera shall:
    - .1 Be manufactured with an IP66, NEMA 4X and IK10 impact-resistant casing in polycarbonate and aluminum.
    - .2 Be fitted with a dehumidifying membrane.

- .21 Power
  - .1 The camera shall provide power over Ethernet IEEE 802.3af/802.3at Type 1 Class 3
    - .1 Max: 12.95 W
    - .2 Typical: 7.7 W
- .22 Environmental
  - .1 The camera shall:
    - .1 Operate in a temperature range of -40 °C to 50 °C (-40 °F to 122 °F)
    - .2 Operate in a maximum temperature (intermittent) of 55 °C (131 °F)
    - .3 Operate in a humidity range of 10–100% RH (condensing).

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- .1 The Contractors or subcontractors main resources within the project shall carry proper professional certification issued by the manufacturer and verified by a third party organization to confirm sufficient product and technology knowledge.
- .2 The Contractor shall carefully follow instructions in documentation provided by the manufacturer to ensure all steps have been taken to provide a reliable, easy-to-operate system.
- .3 All equipment shall be tested and configured in accordance with instructions provided by the manufacturer prior to installation.
- .4 All firmware found in products shall be the latest and most up-to-date provided by the manufacturer, or of a version as specified by the provider of the Video Management Application (VMA) or Network Video Recorder (NVR).
- .5 All equipment requiring users to log on using a password shall be configured with user/site-specific password/passwords. No system/product default passwords shall be allowed.
- .6 A proper installation shall meet NEC (National Electrical Code – US only) per the guidelines of that year's revision. When properly installed equipment meets Low Voltage, Class 2 classification of the NEC.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 SYSTEM DESCRIPTION**

- .1 General Requirements
  - .1 The specified unit shall be of manufacturer's official product line, designed for commercial and/or industrial 24/7/365 use.
  - .2 The specified unit shall be based upon standard components and proven technology using open and published protocols.
- .2 Sustainability
  - .1 The specified unit shall be manufactured in accordance with ISO 14001.
  - .2 The specified unit shall be compliant with the EU directives 2011/65/EU (RoHS) and 2012/19/EU (WEEE).
  - .3 The specified unit shall be compliant with the EU regulation 1907/2006 (REACH).
  - .4 The product, including all its components, shall not contain any added PVC.
  - .5 The manufacturer shall have signed and support the UN Global Compact initiative as defined by United Nations [www.unglobalcompact.org/](http://www.unglobalcompact.org/)

### **1.2 CERTIFICATIONS AND STANDARDS**

- .1 General abbreviations and acronyms
  - .1 API: Application Programming Interface
  - .2 Bit Rate: The number of bits/time unit sent over a network
  - .3 Bonjour: Enables automatic discovery of computers, devices, and services on IP networks.
  - .4 DHCP: Dynamic Host Configuration Protocol
  - .5 DNS: Domain Name System
  - .6 FPS: Frames per Second
  - .7 FTP: File Transfer Protocol
  - .8 H.264 (Video Compression Format)
  - .9 IEEE 802.1x: Authentication framework for network devices
  - .10 IP: Internet Protocol
  - .11 IR light: Infrared light
  - .12 JPEG: Joint Photographic Experts Group (image format)
  - .13 LAN: Local Area Network
  - .14 LED: Light Emitting Diode
  - .15 Lux: A standard unit of illumination measurement
  - .16 MBR: Maximum Bit Rate
  - .17 MPEG: Moving Picture Experts Group
  - .18 Multicast: Communication between a single sender and multiple receivers on a network

- .19 NTP: Network Time Protocol
  - .20 ONVIF: Global standard for the interface of IP-based physical security products
  - .21 PoE: Power over Ethernet (IEEE 802.3af/at) standard for providing power over network cable
  - .22 Progressive scan: An image scanning technology which scans the entire picture
  - .23 PTZ: Pan/Tilt/Zoom
  - .24 QoS: Quality of Service
  - .25 SMPTE: Society of Motion Picture and Television Engineers
  - .26 SNMP: Simple Network Management Protocol
  - .27 SSL: Secure Sockets Layer
  - .28 TCP: Transmission Control Protocol
  - .29 TLS: Transport Layer Security
  - .30 Unicast: Communication between a single sender and single receiver on a network
  - .31 UPnP: Universal Plug and Play
  - .32 VBR: Variable Bit Rate
- .2 The specified unit shall carry the following EMC approvals:
- .1 EN55032 Class A, EN55024, EN61000-6-1, EN61000-6-2
  - .2 FCC Part 15 - Subpart B Class A
  - .3 VCCI Class A
  - .4 RCM AS/NZS CISPR 32 Class A
  - .5 ICES-003 Class A
  - .6 KCC KN32 Class A
  - .7 KN35
- .3 The specified unit shall meet the following product safety standards:
- .1 IEC/EN/UL 60950-22
  - .2 IEC/EN/UL 62368-1
- .4 The specified unit shall meet relevant parts of the following video standards:
- .1 SMPTE 296M (HDTV 720p)
  - .2 SMPTE 274M (HDTV 1080p)
- .5 The specified unit shall meet the following standards
- .1 MPEG-4:
    - .1 ISO/IEC 14496-10 Advanced Video Coding (H.264)
  - .2 Networking:
    - .1 IEEE 802.3at (Power over Ethernet Plus)
    - .2 IEEE 802.1X (Authentication)
    - .3 IPv6 (RFC 2460)

- .4 QoS – DiffServ (RFC 2475)
- .3 Mechanical Environment:
  - .1 IEC/EN 60529 IP66/IP67 (Ingress protection)
  - .2 NEMA 250 Type 4X
  - .3 IEC/EN 62262 IK10
  - .4 IEC 60068-2-1
  - .5 IEC 60068-2-2
  - .6 IEC 60068-2-6
  - .7 IEC 60068-2-14
  - .8 IEC 60068-2-27
  - .9 IEC 60068-2-78
- .4 Railway environment:
  - .1 EN 50121-4
  - .2 IEC 62236-4

### 1.3 QUALITY ASSURANCE

- .1 The contractor or security sub-contractor shall be a licensed security Contractor with a minimum of five (5) years' experience installing and servicing systems of similar scope and complexity and evidence that is completed at least three (3) projects of similar design and is currently engaged in the installation and maintenance of systems herein described.
- .2 All installation, configuration, setup, program and related work shall be performed by electronic technicians thoroughly trained by the manufacturer in the installation and service of the equipment provided.
- .3 The contractor or designated sub-contractor shall submit credentials of completed manufacturer certification, verified by a third-party organization, as proof of the knowledge.
- .4 The contractor shall provide four (4) current references from clients with systems of similar scope and complexity that became operational in the past three (3) years. At least three (3) of the references shall be utilizing the same system components, in a similar configuration as the proposed system.
- .5 The specified unit shall be manufactured in accordance with ISO9001.

### 1.4 WARRANTY

- .1 All security system components and labor furnished by the contractor including wiring, software, hardware and custom parts shall be fully warranted for parts, materials, labor and travel expenses for a minimum of three (3) years from date of the final acceptance of the Video Surveillance System.
- .2 The manufacturer shall provide warranty and optional extended warranty for the camera for a total period of maximum five years. If enacted as part of the contract, the contractor will repair or replace parts and/or labor per the warranty for the length of this warranty at no cost to the client.

## **PART 2 - PRODUCTS**

### **2.1 GENERAL**

- .1 Cameras shall be IP-based and comply with established network and video standards.
- .2 Cameras shall be powered by the switch utilizing the network cable. Power injectors (midspans) shall be provided by the contractor when required for proper operation.
- .3 Cameras shall be fully supported by an open and published API (Application Programmers Interface), which shall provide necessary information for integration of functionality into third-party applications.

### **2.2 VIDEO SURVEILLANCE SCHEDULE**

- .1 Camera types listed below describing various resolutions, form-factor and features shall be supplied by a single camera manufacturer video surveillance system.
- .2 The camera manufacture and model numbers will be as follows:
  - .1 Fixed dome multi-sensor panoramic network camera shall be AXIS P3807-PVE, or similar with no less technical or functional capabilities.

### **2.3 VIDEO SURVEILLANCE CAMERAS**

- .1 Fixed dome multi-sensor panoramic network camera
  - .1 The fixed dome multi-sensor network camera shall meet or exceed the following design specifications:
    - .1 The camera shall operate on an open source; Linux-based platform, and including a built-in web server.
    - .2 The camera shall be equipped with an IR-sensitive progressive scan megapixel sensor.
    - .3 The camera shall provide an automatically removable IR-cut filter, providing day/night functionality.
    - .4 The camera shall be manufactured with an IP66/IP67 and NEMA 4X-rated, IK10 impact-resistant aluminum casing fitted with an repaintable weather shield.
    - .5 The camera shall be equipped with 3,2 mm fixed lenses providing a
    - .6 Horizontal field of view: 180°
    - .7 Vertical field of view: 90°
    - .8 The camera shall provide a manual 3-axis (pan/tilt/rotation) positioning to allow adjustment for optimum camera rotation and placement.
    - .9 The camera shall provide a 180° panoramic overview provided by four sensors.
  - .2 The fixed dome multi-sensor network camera shall meet or exceed the following performance specifications:
    - .1 Illumination
      - .1 The camera shall meet or exceed the following illumination specifications:

- .1 0.17 lux in color
  - .2 0.05 lux B/W
- .2 Resolution
  - .1 Be designed to provide video streams in:
    - .1 8.3 MP: up to 25/30 fps with power line frequency 50/60 Hz
    - .2 7.5 MP (dewarped): up to 12.5/15 fps with power line frequency 50/60 Hz
  - .2 The individual cameras shall support video resolutions including:
    - .1 1920x1080 (HDTV 1080p)
    - .2 1280x720 (HDTV 720p)
- .3 Encoding
  - .1 The camera shall support the following video encoding algorithms:
    - .1 Motion JPEG encoding in a selectable range from 1 up to 25/30 frames per second in all resolutions.
    - .2 Baseline Profile H.264 encoding with motion estimation in up to 25/30 frames per second.
    - .3 Main Profile H.264 encoding with motion estimation and context-adaptive binary arithmetic coding (CABAC) in up to 25/30 frames per second.
    - .4 Support High Profile H.264 encoding with motion estimation up to 50/60 frames per second.
  - .2 The camera shall provide two independently configured simultaneous H.264 and Motion JPEG streams.
  - .3 The camera shall in H.264 support Variable Bit Rate (VBR) for video quality adapted to scene content. To protect the network from unexpected bit rate spikes the camera shall support Constant Bit Rate (CBR) or Maximum Bit Rate (MBR).
  - .4 The camera shall provide configurable compression levels.
  - .5 The camera shall support motion estimation in H.264/MPEG-4 Part 10/AVC.
- .4 Transmission
  - .1 The camera shall allow for video to be transported over:
    - .1 HTTP (Unicast)
    - .2 HTTPS (Unicast)
    - .3 RTP (Unicast & Multicast)
    - .4 RTP over RTSP (Unicast)
    - .5 RTP over RTSP over HTTP (Unicast)
  - .2 The camera shall support Quality of Service (QoS) to be able to prioritize traffic.
- .5 Image
  - .1 The camera shall incorporate automatic and manual white balance.
  - .2 The camera shall incorporate an electronic shutter operating in the range of 1/33500s to 1/10s.
  - .3 The camera shall incorporate forensic wide dynamic range functionality, providing up to 120 dB dynamic range.

- .4 The camera shall support manually defined values for:
  - .1 Saturation
  - .2 Contrast
  - .3 Sharpness
  - .4 Brightness
- .5 The camera shall incorporate a function for optimization of low light behavior.
- .6 User Interface
  - .1 Web server
    - .1 The camera shall contain a built-in web server making video and configuration available to multiple clients in a standard operating system and browser environment using HTTP, without the need for additional software.
    - .2 Optional components downloaded from the camera for specific tasks shall be signed by an organization providing digital trust services, such as Verisign, Inc.
  - .2 Language Specification
    - .1 The camera shall provide a function for altering the language of the user interface, and shall include support for at least 10 different languages.
  - .3 IP addresses
    - .1 The camera shall support both fixed IP addresses and dynamically assigned IP addresses provided by a Dynamic Host Control Protocol (DHCP) server.
    - .2 The camera shall allow for automatic detection of the camera based on UPnP and Bonjour when using a PC with an operating system supporting this feature.
    - .3 The camera shall provide support for IPv6.
- .7 Event functionality
  - .1 The camera shall be equipped with an integrated event functionality:
    - .1 Detectors functionality
      - .1 Video motion detection
  - .2 Shock detection
    - .1 Hardware functionality
    - .2 Input Signal functionality
      - .1 External input
      - .2 Manual trigger / virtual Inputs
      - .3 Camera tampering
  - .3 Storage functionality
  - .4 System functionality
    - .1 Embedded third-party applications
    - .2 Edge storage fail-over recording detection
- .3 Response to triggers shall include:
  - .1 Send notification, using HTTP, HTTPS, TCP or email

- .2 Send images, using FTP, SFTP, HTTP, HTTPS, network share or email
- .3 Send video clip, using FTP, SFTP, HTTP, HTTPS, network share or email
- .4 Send SNMP trap message
- .5 Recording to local storage and/or network attached storage
- .6 Day/Night Vision Mode
- .7 Overlay Text
- .4 The camera shall provide memory for pre & post alarm recordings.
- .8 Edge storage
  - .1 The camera shall support continuous and event controlled recording to:
    - .1 Local memory added to the cameras microSD-card slot
    - .2 Network attached storage, located on the local network.
  - .2 The camera shall incorporate encryption functionality for the SD card.
  - .3 The camera shall be able to detect and notify edge storage disruptions.
- .9 Protocol
  - .1 The camera shall incorporate support for at least IPv6, HTTP, HTTPS, SSL/TLS, QoS Layer 3 DiffServ, FTP, SFTP, CIFS/SMB, SMTP, Bonjour, UPnP, SNMP v1/v2c/v3 (MIB-II), DNS, DynDNS, NTP, RTSP, RTP, TCP, UDP, IGMP, RTCP, ICMP, DHCP, ARP, SOCKS, SSH, LLDP
  - .2 The SMTP implementation shall include support for SMTP authentication.
- .10 Text overlay
  - .1 The camera shall:
    - .1 Provide embedded on-screen text with support for date & time, and a customer-specific text, camera name, of at least 45 ASCII characters.
    - .2 Provide the possibility to choose different font sizes for embedded on-screen text, and to use white or black text on at least four different backgrounds.
    - .3 Provide the ability to manually set up and configure privacy masks to the image.
    - .4 Allow for the overlay of a graphical image, such as a logotype, into the image.
- .11 Security
  - .1 The camera shall support the use of HTTPS and SSL/TLS, providing the ability to upload signed certificates to encrypt and secure authentication and communication of both administration data and video streams.
  - .2 The camera shall provide centralized certificate management, with both pre-installed CA certificates and the ability to upload additional CA certificates. The certificates shall be signed by an organization providing digital trust services.
  - .3 The camera shall support IEEE 802.1X authentication.
  - .4 The camera shall provide support for restricting access to pre-defined IP addresses only, so-called IP address filtering.
  - .5 The camera shall restrict access to the built-in web server by usernames and passwords at three different levels.
- .12 API support
  - .1 The camera shall be fully supported by an open and published API (Application

Programmers Interface), which shall provide necessary information for integration of functionality into third party applications.

- .2 The camera shall conform to ONVIF profile G as defined by the ONVIF Organization.
  - .3 The camera shall conform to ONVIF profile S as defined by the ONVIF Organization.
- .13 Embedded applications
- .1 The camera shall provide a platform allowing the upload of third-party applications into the camera.
- .14 Installation and maintenance
- .1 The camera shall be supplied with Windows-based management software which allows the assignment of IP addresses, upgrade of firmware and backup of the cameras' configuration.
  - .2 The camera shall support the use of SNMP-based management tools according to SNMP v1, 2c & 3 / MIB-II.
  - .3 The camera shall allow updates of the software (firmware) over the network, using FTP or HTTP.
  - .4 The camera shall provide the ability to apply a rectangle of customer-defined number of pixels to the image, which can be used as a pixel counter identifying the size of objects in number of pixels.
  - .5 The camera shall accept external time synchronization from an NTP (Network Time Protocol) server.
  - .6 The camera shall store all customer-specific settings in a non-volatile memory that shall not be lost during power cuts or soft reset.
- .15 Access log
- .1 The camera shall provide a log file, containing information about the 250 latest connections and access attempts since the unit's latest restart. The file shall include information about the connecting IP addresses and the time of connecting.
  - .2 Provide a connection list of all currently connected viewers. The file shall include information about connecting IP address, time of connecting and the type of stream accessed.
- .16 Camera diagnostics
- .1 The camera shall be equipped with LEDs, capable of providing visible status information. LEDs shall indicate the camera's operational status and provide information about power, communication with receiver, the network status and the camera status.
  - .2 The camera shall be monitored by a Watchdog functionality, which shall automatically re-initiate processes or restart the unit if a malfunction is detected.
  - .3 The camera shall send a notification when the unit has re-booted and all services are initialized.
- .17 Hardware interfaces
- .1 Network interface
    - .1 The camera shall be equipped with one 10BASE-T/100BASE-TX/1000BASE-T Ethernet-port using a RJ45 connector, and shall support auto negotiation of network speed and transfer mode (full and half duplex).
- .18 Enclosure
- .1 The camera shall:

- .1 Be manufactured with an IP66-/IP67- and NEMA 4X-rated, IK10-rated impact-resistant casing with polycarbonate hard coated clear dome.
- .2 Be fitted with a dehumidifying membrane.

.19 Power

- .1 Power over Ethernet Plus (PoE+) IEEE 802.3at Type 1 Class 3
  - .1 Max: 12.9 W
  - .2 Typical: 7 W

.20 Environmental

- .1 Operate in a temperature range of -30 °C to 50 °C (-22 °F to 122 °F).
- .2 Operate in a maximum temperature (intermittent) of 60 °C (140 °F)
- .3 Operate in a humidity range of 10 -100% RH (condensing).

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- .1 The contractor's or subcontractor's main resources within the project shall carry proper professional certification issued by the manufacturer and verified by a third-party organization to confirm sufficient product and technology knowledge.
- .2 The contractor shall carefully follow instructions in documentation provided by the manufacturer to ensure all steps have been taken to provide a reliable, easy-to-operate system.
- .3 All equipment shall be tested and configured in accordance with instructions provided by the manufacturer prior to installation.
- .4 All firmware found in products shall be the latest and most up-to-date provided by the manufacturer, or of a version as specified by the provider of the Video Management Application (VMA) or Network Video Recorder (NVR).
- .5 All equipment requiring users to log on using a password shall be configured with user/site-specific password/passwords. No system/product default passwords shall be allowed.
- .6 A proper installation shall meet NEC (National Electrical Code – US only) per the guidelines of that year's revision. When properly installed equipment meets Low Voltage, Class 2 classification of the NEC.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 SUMMARY**

- .1 Section Includes:
  - .1 Materials and installation for fire alarm systems.
  - .2 Control panel to carry out fire alarm and protection functions, including receiving alarm signals, initiating general alarm, supervising system continuously, actuating zone annunciators, and initiating trouble signals.
  - .3 Trouble signal devices.
  - .4 Power supply facilities.
  - .5 Manual alarm stations.
  - .6 Automatic alarm initiating devices.
  - .7 Audible signal devices.
  - .8 End-of-line devices.
  - .9 Annunciators.
  - .10 Visual alarm signal devices.
  - .11 Ancillary devices.

### **1.2 REFERENCES**

- .1 Government of Canada:
  - .1 TB OSH Chapter 3-03, 1997-01-28, Treasury Board of Canada, Occupational Safety and Health, Chapter 3-03, Standard for Fire Protection Electronic Data Processing Equipment.
  - .2 TB OSH Chapter 3-04, 1994-12-22, Treasury Board of Canada, Occupational Safety and Health, Chapter 3-04, Standard for Fire Alarm Systems.
- .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS):
  - .1 Material Safety Data Sheets (MSDS).
- .3 Underwriter's Laboratories of Canada (ULC):
  - .1 CAN/ULC-S524-2001, Standard for the Installation of Fire Alarm Systems.
  - .2 CAN/ULC-S525-1999, Audible Signal Device for Fire Alarm Systems.
  - .3 CAN/ULC-S526-2002, Visual Signal Devices for Fire Alarm Systems.
  - .4 CAN/ULC-S527-1999, Control Units.
  - .5 CAN/ULC-S528-1991, Manual Pull Stations for Fire Alarm Systems.
  - .6 CAN/ULC-S529-2002, Smoke Detectors for Fire Alarm Systems.
  - .7 CAN/ULC-S530-M1991, Heat Actuated Fire Detectors for Fire Alarm Systems.
  - .8 CAN/ULC-S531-2002, Standard for Smoke Alarms.
  - .9 CAN/ULC-S536-S537-2004, Burglar and Fire Alarm Systems and Components.
- .4 National Fire Protection Agency:
  - .1 NFPA 72-2002, National Fire Alarm Code.
  - .2 NFPA 90A-2002, Installation of Air- Conditioning and Ventilating Systems.

### 1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 – Submittal Procedures.
  - .2 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Shop Drawings:
  - .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
    - .1 Shop drawings: stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
  - .2 Include:
    - .1 Layout of equipment.
    - .2 Zoning.
    - .3 Complete wiring diagram, including schematics of modules.
- .3 Quality Assurance Submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
  - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
  - .2 Instructions: Submit manufacturer's installation instructions.
  - .3 Manufacturer's Field Reports: Manufacturer's field reports specified.
- .4 Closeout Submittals:
  - .1 Submit maintenance and engineering data for incorporation into manual specified in Section 01 78 00 – Closeout Submittals in accordance with ANSI/NFPA 20.
  - .2 Authority of Jurisdiction will delegate authority for review and approval of submittals required by this Section.
  - .3 Submit to Authority of Jurisdiction 2 sets of approved submittals and drawings immediately after approval but no later than 15 working days to prior to final inspection.
  - .4 Submit the following:
    - .1 Manufacturer's data for:
      - .1 Control panel modules.
      - .2 Manual pull stations.
      - .3 Heat detectors.
      - .4 Open-area smoke detectors.
      - .5 Duct smoke detectors.
      - .6 Alarm bells.
      - .7 Visible appliances.
      - .8 Electro-magnetic door holder-releases.
      - .9 Valve tamper switches.
      - .10 Wiring.
      - .11 Conduit.
      - .12 Outlet boxes.
      - .13 Fittings for conduit and outlet boxes.
      - .14 Trouble bell.
      - .15 Surge suppression devices.

- .16 Mark data that describes more than one type of item to indicate which type will be provided.
- .17 Submit 1 original for each item and clear, legible, first-generation photocopies for remainder of specified copies.
- .2 System Wiring Diagrams:
  - .1 Submit complete wiring diagrams of system showing points of connection and terminals used for electrical connections in the system.
  - .2 Show modules, relays, switches and lamps in control panel.
- .3 Design Data: Power Calculations:
  - .1 Submit design calculations for existing system and new work specified to substantiate that battery capacity exceeds supervisory and alarm power requirements.
  - .2 Show comparison of detector power requirements per zone versus control panel smoke detector power output per zone in both standby and alarm modes.
  - .3 Show comparison of notification appliance circuit alarm power requirements with rated circuit power output.
- .4 Schedules:
  - .1 Conductor wire marker schedule.
- .5 Test Reports:
  - .1 Open-area, 4-wire smoke detectors.
  - .2 Preliminary testing:
    - .1 Final acceptance testing.
    - .2 Submit for inspections and tests specified under Field Quality Control.

#### 1.4 QUALITY ASSURANCE

- .1 Qualifications:
  - .1 Installer: company or person specializing in fire alarm system installations with 5 years' documented experience approved by manufacturer.
- .2 Provide services of representative or technician from manufacturer of system, experienced in installation and operation of type of system being provided, to supervise installation, adjustment, preliminary testing, and final testing of system and to provide instruction to project personnel.
- .3 System:
  - .1 To TB OSH Chapter 3-04.
  - .2 Subject to Fire Commissioner of Canada (FC) approval.
  - .3 Subject to FC inspection for final acceptance.
  - .4 Manufacturer: Notifier to suit University-wide fire alarm system.
- .4 Extra Materials:
  - .1 Provide maintenance materials in accordance with Section 01 78 00 – Closeout Submittals.
  - .2 Include:
    - .1 Spare glass rods for manual pull box stations if applicable.
- .5 Maintenance Service:
  - .1 Provide one year's free maintenance with two inspections by manufacturer during warranty period. Inspection tests to conform to CAN/ULC-S536. Submit inspection report to Consultant.

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS**

- .1 Equipment and Devices: ULC listed and labelled and supplied by single manufacturer.
- .2 Power Supply: to CAN/ULC-S524.
- .3 Audible Signal Devices: to CAN/ULC-S525.
- .4 Visual Signal Devices: to CAN/ULC-S526.
- .5 Control Unit: to CAN/ULC-S527.
- .6 Manual Pull Stations: to CAN/ULC-S528.
- .7 Thermal Detectors: to CAN/ULC-S530.
- .8 Smoke Detectors: to CAN/ULC-S529.

### **2.2 SYSTEM OPERATION**

- .1 Provide complete, electrically supervised, code 3 temporal common coded, manual and automatic, zoned, annunciated, fire alarm system using existing fire alarm panel.
- .2 Provide separate circuits from control panel to each zone of initiating devices. Transmission of signals from more than one zone over common circuit to control panel is prohibited.
- .3 Single-stage operation. Operation to actuation following:
  - .1 Manual station.
  - .2 Heat detector.
  - .3 Smoke detector.
  - .4 Automatic fire sprinkler system.
  - .5 Fire extinguishing system.
- .4 Actuation of single operation device to initiate following:
  - .1 Building evacuation alarm devices to operate continuously.
  - .2 Transmit signal to fire department via monitoring station.
  - .3 Zone of alarm device to be indicated on control panel and remote annunciator.
  - .4 Air-conditioning and ventilating fans to shut down or to function so as to provide required control of smoke movement.
  - .5 Fire doors and smoke control doors if normally held open, to close automatically.
  - .6 Electromagnetic door holders to de-energize.
  - .7 Operations to remain in alarm mode (except alarm notification appliances if manually silenced) until system is manually restored to normal.
  - .8 Fire alarm system to operate in conjunction with adjacent buildings in the OVC facility as currently designed in existing system.

- .5 Capability to program smoke detector status change confirmation on any or zones in accordance with CAN/ULC-S527, Appendix C.

## **2.3 CONTROL PANEL**

- .1 Reuse existing fire alarm control panel located in the electrical room of OVC Building 046.
- .2 Upgrade panel to include additional 12 zone LED indicator panel to incorporate additional zones.

## **2.4 POWER SUPPLY**

- .1 120 Vac, 60 Hz input, 24 Vdc output from rectifier to operate alarm and signal circuits, with standby power of gel cell batteries minimum expected life of 4 years, sized in accordance with NBC.

## **2.5 MANUAL ALARM STATIONS**

- .1 Provide non-coded single action type with mechanical reset features.
  - .1 Non-coded single pole normally open contact for single stage.
  - .2 General alarm key switch for two-stage system.
- .2 Stations: surface mounted and interior type as indicated.
  - .1 For surface mounting provide station manufacturer's approved back box.
  - .2 Back box finish to match station finish.
- .3 Equip each station with terminal strip with contacts of proper number and type to perform functions required.
- .4 Stations: type not subject to operation by jarring or vibration.
  - .1 Break-glass front stations are not permitted; pull-lever break-rod type is acceptable provided presence of rod is not required to reset station.
- .5 Station Colour: Red.
- .6 Provide station with visible indication of operation.
- .7 Restoration to require use of key.
  - .1 Keys: identical throughout system for stations and control panel(s).
- .8 Mount stations with operating lever not more than 1.2 m above finished floor.
- .9 Where weatherproof stations are required, provide stations with cast metal, weatherproof housings with hinged access doors.
  - .1 Finish housings with red enamel paint and provide permanently affixed raised-letter plastic bilingual signage indicating "FIRE ALARM" with white letters of 19 mm high.

## 2.6 AUTOMATIC ALARM INITIATING DEVICES

- .1 Heat Detectors: provide heat detectors designed for detection of fire by combination fixed temperature rate-of-rise principle.
- .2 Combination Fixed Temperature Rate-of-Rise Detectors (Spot Type): designed for surface outlet box mounting and supported independently of conduit, tubing or wiring connections.
  - .1 Contacts: self-resetting after response to rate-of-rise actuation
  - .2 Operation under fixed temperature actuation to result in external indication.
  - .3 Detector units located in boiler rooms, showers, or other areas subject to abnormal temperature changes to operate on fixed temperature principle only.
- .3 Open-Area Smoke Detectors: provide detectors designed for detection of abnormal smoke densities by photoelectric principle.
  - .1 Detectors: 4-wire type.
  - .2 Provide necessary control and power modules required for operation integral with control panel.
  - .3 Detectors and associated modules: compatible with control panel and suitable for use in supervised circuit.
  - .4 Malfunction of electrical circuits to detector or its control or power units to result in operation of system trouble signals.
  - .5 Equip each detector with visible indicator lamp that will flash when detector is in normal standby mode and glow continuously when detector is activated.
  - .6 Provide remote indicator lamps for each detector that is concealed from view.
  - .7 Each detector: Plug-in type with tab-lock or twist-lock, quick disconnect head and separate base in which detector base contains screw terminals for making wiring connections.
  - .8 Detector head: removable from its base without disconnecting wires. Removal of detector head from its base to cause activation of system trouble signals.
  - .9 Screen each detector to prevent entrance of insects into detection chamber(s).
- .4 4-Wire Smoke Detectors: detector circuits 4-wire type capable of transmitting detector operating power over conductors separate from initiating circuit.
  - .1 Provide separate, power circuit for each smoke detection initiating circuit (zone).
  - .2 Failure of power circuit to be indicated as trouble condition on corresponding initiating circuit.
- .5 Ionization Detectors: Multiple-chamber type responsive to both invisible and visible particles of combustion.
  - .1 Detectors: Not susceptible to operation by changes in relative humidity.
- .6 Photoelectric Detectors: Operate on light scattering principle using LED light source.
  - .1 Detector: Respond to both flaming and smoldering fires.
- .7 Locate detectors in accordance with their listing by ULC and the requirements of NFPA 72, except provide at least 2 detectors in rooms of 54 square metres or larger in area.
- .8 Mount detectors at underside of ceiling or deck above unless otherwise indicated.
  - .1 For mounting heights greater than 3 m above floor level, reduce actual detector linear spacing from listed spacing as required by NFPA 72.
  - .2 For heights greater than 9 m space detectors no farther apart than 34% of their listed spacing.
- .9 Temperature Rating of Detectors: in accordance with NFPA 72.

- .10 Locate detectors minimum 300 mm to lighting fixtures and not closer than 600 mm to air supply or return diffuser.
- .11 Ensure detectors, located in areas subject to moisture or exterior atmospheric conditions or hazardous locations as defined by NFPA 70, are approved for such locations.
- .12 Provide detectors with terminal screw-type connections.
- .13 Removal of detector head from its base to cause activation of system trouble signals if detectors are provided with separable heads and bases.

## **2.7 ALARM INITIATING DEVICE SPACING AND LOCATION**

- .1 Detector Spacing and Location: in accordance with manufacturer's recommendations and requirements of NFPA 72.
- .2 Spacing: Not to exceed 9 m by 9 m per detector, and 9 linear m per detector along corridors.
- .3 Locate detectors minimum 0.9 m from air discharge or return grille, and not closer than 300 mm to lighting fixtures.
- .4 In areas without finished ceilings, mount detectors at underside of deck above unless otherwise indicated.
- .5 Mount detectors installed beneath raised floors with base within 50 mm of underside of raised floor, with detector facing downward.
  - .1 Where space under raised floor is less than 300 mm in height, mount detectors with their bases either horizontal or vertical, with detection chamber(s) located in upper half of underfloor space.
  - .2 Do not mount detectors facing upward.
  - .3 Space detectors beneath raised floors maximum 4.5 m by 4.5 m, 6 m by 6 m per detector.

## **2.8 DUCT SMOKE DETECTORS**

- .1 Provide detectors installed in ducts of ionization type and listed by ULC duct installation.
- .2 Provide integral control and power modules required for operation with main control panel.
- .3 Ensure detectors and associated modules are compatible with main control panel and suitable for use in supervised circuit.
- .4 Detector circuits: 4-wire type where detector operating power is transmitted over conductors separate from initiating circuit. Malfunction of electrical circuits to detector or its control or power modules to cause operation of system trouble signals.
- .5 Provide a separate, fused power circuit for each smoke detection initiating circuit.
- .6 Failure of power circuit: Indicated as a trouble condition on corresponding initiating circuit.
- .7 Provide duct detectors in accordance with NFPA 90A.
- .8 Provide duct detectors with approved duct housing, mounted exterior to duct, with perforated sampling tubes extending across width of duct.

- .9 Activation of duct detectors to cause shutdown of associated air- handling unit annunciation at control panel, tripping of master box and sounding of building evacuation alarms.
- .10 Provide detectors with visible indicator lamp that flashes when detector is in normal standby mode and glows continuously when detector is activated.
- .11 Provide remote indicator lamp for each detector.
- .12 Permanently label remote indicator with description and number of associated air-handling unit(s).
- .13 Provide each detector with remote test switch. Mount switch not more than 1.8 m above finished floor.
- .14 Permanently label test switch with description number of associated air-handling unit(s).

## **2.9 AUDIBLE SIGNAL DEVICES**

- .1 Provide remote system trouble 100 mm bell arranged to operate in conjunction with panel's integral trouble signal.
- .2 Locate remote trouble bell as indicated.
  - .1 Provide 100 mm trouble bell at control panel arranged to operate in conjunction with panel's integral trouble signal.
  - .2 Provide trouble bell with rigid plastic white on red engraved identification sign which reads "FIRE ALARM SYSTEM TROUBLE".
  - .3 Lettering on identification sign: minimum 25 mm high.
- .3 Audible Device(s):
  - .1 Bells: motorized type, gongs of special alloy steel, 24 Vdc, 150 mm, 92 dB.
- .4 Do not exceed 80 percent of listed rating in amperes of notification appliance circuit. Provide additional circuits above those shown if required to meet this requirement.
- .5 Provide appliances specifically listed for outdoor use in locations exposed to weather.
- .6 Finish appliances in red enamel.
- .7 For surface mounting, provide appliance manufacturer's approved back box. Back box finish to match appliance finish.

## **2.10 REMOTE ANNUNCIATOR PANELS**

- .1 Existing remote annunciator panel to remain. Update panel to include updated programming of devices.

## **2.11 GRAPHIC ANNUNCIATOR PANEL**

- .1 Expand existing annunciator with module to suit new fire alarm system.
- .2 Panel Graphic: Update to show locations of annunciator panel and control panel, and have "YOU ARE HERE" arrow showing its location. Orient building floor plan on graphic to location of person viewing graphic, i.e., direction viewer is facing is toward top of graphic display. Provide North arrow.
- .3 Update existing primary OVC annunciator graphic located in the breezeway between building 039 and building 040 to reflect changes to building 046.
- .4 Label principal rooms and areas shown with room numbers.
- .5 Provide detectors mounted on ceilings and different types of initiating devices with different symbols for identification. Lamps to illuminate upon activation of corresponding device and remain illuminated until system is reset.
  - .1 Provide panel with lamp test switch.

## **2.12 VISUAL ALARM SIGNAL DEVICES**

- .1 Surface-mounted assembly of stroboscopic type suitable for use in electrically supervised circuit and powered from notification appliance circuits.
- .2 Appliances: minimum of 30 candela measured as approved by ULC, but not less than effective intensity required by National Building Code of Canada for appliance spacing and location.
- .3 Protect lamps with thermoplastic lens and labelled "FIRE" in letters at least 12 mm high.
- .4 Provide visible appliances within 300 mm of each audible appliance.
- .5 Visible appliances may be part of audio-visual assembly, where more than two appliances are located in same room or corridor.

## **2.13 FREEZE PROTECTION THERMOSTATIC SWITCH**

- .1 Provide switch with concealed set point, cover, and Allen head screws.
- .2 Omit temperature indicator or conceal indicator within cover. Switch: not to be adjustable below 4 degrees C. Switch contacts to transfer when fire protection equipment room air temperature drops below 4 degrees C, causing supervisory signal on fire alarm system. Removal of switch from circuit to cause trouble signal on its respective zone.
- .3 Mount switch with centerline 1.5 m above finished floor.
- .4 Provide with insulating sub-base when mounting on exterior wall.

## **2.14 ELECTRO-MAGNETIC DOOR HOLDER-RELEASES**

- .1 Provide as indicated.
- .2 Mount armature portion on door. Armature, complete with adjusting screw for setting angle of contact plate.

- .3 Mount electromagnetic release on wall or in wall recess behind door.
- .4 Activation of smoke detector designated for door release service to release doors on circuit to close.
- .5 Total projection of door holder release not to exceed 100 mm.
- .6 Door Holders: do not require battery backup power.

## **2.15 VALVE TAMPER SWITCHES**

- .1 Provide switches to monitor open position of valves controlling water supply to sprinkler systems.
- .2 Switch contacts to transfer from normal position to off-normal position during first two revolutions of hand wheel or when stem of valve has moved not more than one-fifth of distance from its normal position.
- .3 Provide switch with tamper resistant cover.
- .4 Removal of the cover to cause switch to operate into off-normal position.

## **2.16 OFF-PREMISES FIRE ALARM**

- .1 Provide auxiliary connection to base fire alarm system in accordance with NFPA 72, except as specified.

## **2.17 CONDUIT**

- .1 Rigid Steel Conduit:
  - .1 Zinc coated.
- .2 Intermediate Metal Conduit (IMC):
  - .1 Zinc-coated steel only.
- .3 Electrical Metallic Tubing (EMT).
- .4 Surface Metal Raceway and Fittings:
  - .1 Two-piece painted steel.
  - .2 Totally enclosed snap-cover type.

## **2.18 WIRING**

- .1 Wire for 120 V circuits: No. 12 AWG minimum solid copper conductor.
- .2 Wire for low voltage dc circuits: No. 14 AWG minimum solid copper conductor
- .3 Wire to remote annunciators: No. 18 AWG minimum solid copper conductor.
- .4 Wire for connection to base telegraphic alarm loop: No. 10 AWG minimum solid copper conductor.

- .5 Insulation 75 degrees C minimum with nylon jacket.
- .6 Colour code wiring.

## **2.19 SURGE SUPPRESSION**

- .1 Provide line voltage and low voltage surge suppression devices to suppress voltage transients that might damage control panel components.
- .2 Mount suppressors in separate enclosure(s) adjacent to control panel unless suppressors are specifically UL approved for mounting inside control panel provided and approved for such use by control panel manufacturers.

## **2.20 LINE VOLTAGE SURGE SUPPRESSOR**

- .1 Suppressor: ULC approved with maximum 330 V clamping level and maximum response time of 5 nanoseconds.
- .2 Suppressor: multi-stage construction that includes inductors and silicon avalanche Zener diodes.
- .3 Equip suppressor with light emitting diode that extinguishes upon failure of protection components.
- .4 Fuses: externally accessible.
- .5 Wire in series with incoming power source to protected equipment using screw terminations

## **2.21 LOW VOLTAGE SURGE SUPPRESSOR**

- .1 Provide surge suppression for circuits that leave building shell.
- .2 When circuits interconnect 2 or more buildings, provide arrestor at circuit entrance to each building.
- .3 Suppressor: UL 497B listed with maximum 30 V clamping level and maximum response time of 5 nanoseconds.
- .4 Suppressor: multi-stage construction and both differential and common mode protection.

## **2.22 AS-BUILT RISER DIAGRAM**

- .1 Update and replace existing Fire Alarm System Riser Diagram: in glazed frame on black lamacoid sheet with bevelled edges, white lettering and designations, minimum size 600 x 600 mm. Also, update riser diagram at the main annunciator in the breezeway between building 39 and 40.

## **PART 3 - EXECUTION**

### **3.1 MANUFACTURER'S INSTRUCTIONS**

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and data sheet.

### **3.2 INSTALLATION**

- .1 Install systems in accordance with CAN/ULC-S524 and TB OSH Chapter 3-04.
- .2 Reuse existing main control panel and connect to ac power supply, ac standby power.
- .3 Demolition:
  - .1 Retain all existing connections including wiring and conduit from existing fire alarm control panel to fire alarm devices servicing Wing A.
  - .2 Remove all existing connections including conduit from existing fire alarm control panel to existing bells servicing Wing B and Wing C and replace / modify to include new bells.
  - .3 Retain existing connection including wiring and conduit between fire alarm control panel and fire alarm annunciator.
  - .4 Remove all other fire alarm device connections to the main fire alarm control panel.
  - .5 Upgrade LED indicator panel on existing fire alarm panel and remote fire alarm panel at Building 39 - 40.
- .4 Locate and install manual alarm stations and connect to alarm circuit wiring.
- .5 Locate and install detectors and connect to alarm circuit wiring. Do not mount detectors within 1 m of air outlets. Maintain at least 600 mm radius clear space on ceiling, below and around detectors. Locate duct-type detectors in straight portions of ducts.
- .6 Connect alarm circuits to main control panel.
- .7 Locate and install bells and visual signal devices and connect to signalling circuits.
- .8 Connect signalling circuits to main control panel.
- .9 Install end-of-line devices at end of alarm and signalling circuits.
- .10 Install remote annunciator panels and connect to annunciator circuit wiring.
- .11 Locate and install door releasing devices.
- .12 Locate and install remote relay units to control fan shutdown.
- .13 Sprinkler system: wire alarm and supervisory switches and connect to control panel.

### 3.3 FIELD QUALITY CONTROL

- .1 Site Tests:
  - .1 Perform tests in accordance with Section 26 05 00 – Common Work Results for Electrical, and CAN/ULC-S537.
  - .2 Fire Alarm System:
    - .1 Test each device and alarm circuit to ensure manual stations, thermal and smoke detectors sprinkler system transmit alarm to control panel and actuate general alarm.
    - .2 Check annunciator panels to ensure zones are shown correctly.
    - .3 Simulate grounds/breaks on alarm and signalling circuits to ensure proper system operation.
    - .4 Class A Circuits.
      - .1 Test each conductor on circuits for capability of providing alarm signal on each side of single open-circuit fault condition imposed near midmost point of circuit. Reset control unit after each alarm function and correct imposed fault after completion of each test.
      - .2 Test each conductor on circuits for capability of providing alarm signal during ground-fault condition imposed near midmost point of circuit. Reset control unit after each alarm function and correct imposed fault after completion of each test.
    - .5 Class B Circuits.
      - .1 Test each conductor on circuits for capability of providing alarm signal on line side of single open-circuit fault condition imposed at electrically most remote device on circuit. Reset control unit after each alarm function; correct imposed fault after each test.
      - .2 Test each conductor on circuits for capability of providing alarm signal during ground-fault condition imposed at electrically most remote device on circuit. Reset control unit after each alarm function and correct imposed fault after completion of each test.
- .2 Manufacturer's Field Services:
  - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 – SUBMITTALS.
  - .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, as directed in PART 1 – QUALITY ASSURANCE.

### 3.4 PROTECTION

- .1 Protect existing equipment to remain and new installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by fire alarm system installation.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 MULTIFUNCTIONAL LOW-PROFILE LED STATUS INDICATOR**

- .1 The LED Status indicator is to be UL 1638 listed, as a visual signaling appliance.
- .2 Compatible with 12-24VAC/DC or 120-240VAC
- .3 PLC compatible with PNP or NPN connections
- .4 Multicolor LED producing Amber, Green and Red
- .5 Field configurable to steady or flashing mode for each color
- .6 50,000-hour LED lamp life
- .7 Type 4X, IP66 enclosure
- .8 Operating Temperature shall be -30°C to 50°C, (22°F to 122°F)

## **PART 2 - PRODUCTS**

- .1 Not used.

## **PART 3 - EXECUTION**

- .1 Not used.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 RELATED SECTIONS**

- .1 Section 01 35 43 – Environmental Protection
- .2 Section 01 35 29 – Health and Safety Requirements
- .3 Section 01 74 11 – Cleaning

### **1.2 REFERENCES**

- .1 City of Guelph Linear Infrastructure Standards (2018) (CoGLIS)
  - .1 Section 1 Standard Specifications
    - .1 SS-1 – Specifications for Clearing and Grubbing
  - .2 Section 2 Special Provisions
- .2 Specifications below are to be used except as modified by CoGLIS
- .3 American Society for Testing and Materials International (ASTM)
  - .1 ASTM D 698-07e1, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (600kN-m/m<sup>3</sup>).
- .4 Canadian Standards Association (CSA International)
  - .1 CSA-A23.1/A23.2-09, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
- .5 Ontario Provincial Standard Specifications (OPSS)
  - .1 OPSS 1010, Material Specification for Aggregates – Base, Sub-base, Select Subgrade, and Backfill Material.

### **1.3 QUALITY ASSURANCE**

- .1 Shore and brace excavations, protect slopes and banks and perform work in accordance with Geotechnical Report.
- .2 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 29– Health and Safety Requirements and manufacturer's instructions.

### **1.4 EXISTING CONDITIONS**

- .1 Buried services:
  - .1 Before commencing work verify location of buried services on and adjacent to site. Notify JLR of findings. Known underground and surface utility lines are indicated on drawings.
    - .1 The Contractor will be responsible for hiring and arranging for the location of any underground services and utilities in the areas of work.
    - .2 The Contractor will be responsible for any costs as a result of damage caused by the Contractor to any underground services or utilities.
- .2 Before commencing work, conduct, with the Contract Administrator, a pre-condition survey of existing structures, trees and other plants, lawns, fencing, service poles, wires, paving, survey bench marks, and monuments which may be affected by work

## **1.5 ADMINISTRATIVE REQUIREMENTS**

- .1 Prior to construction, examine site and note all characteristics and features affecting the work.
- .2 Co-ordination: arrange with authority having jurisdiction for relocation of buried services that interfere with execution of work.
  - .1 Pay costs of relocating services

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS**

- .1 Granular A, Granular B and Select Subgrade to OPSS 1010.
- .2 Unshrinkable fill: proportioned and mixed to provide:
  - .1 Maximum compressive strength of 0.4 MPa at 28 days.
  - .2 Maximum Portland cement content of 25 kg/m<sup>3</sup>.
  - .3 Minimum strength of 0.07MPa at 24 hours.
  - .4 Concrete aggregates: to CSA A23.1/A23.2 .
  - .5 Cement: to CSA A3000, Type GU.
  - .6 Slump: 160 to 200 mm.

## **PART 3 - EXECUTION**

### **3.1 TEMPORARY EROSION AND SEDIMENTATION CONTROL**

- .1 Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to requirements of authorities having jurisdiction.
- .2 Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.
- .3 Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

### **3.2 PREPARATION/PROTECTION**

- .1 Protect excavations from freezing.
- .2 Keep excavations clean, free of standing water, and loose soil.
- .3 Protect natural and man-made features required to remain undisturbed. Unless otherwise indicated or located in an area to be occupied by new construction, protect existing trees from damage.
- .4 Protect buried services that are required to remain undisturbed.

### 3.3 CLEARING AND GRUBBING

- .1 Remove trees, stumps, logs, brush, shrubs, bushes, vines, undergrowth, rotten wood, dead plant material, exposed boulders. and debris within areas designated on drawings.
- .2 Remove stumps and tree roots below footings, slabs, and paving, and to 600mm below finished grade elsewhere.
- .3 Dispose of cleared and grubbed material off site daily to disposal areas acceptable to authority having jurisdiction.

### 3.4 DEWATERING

- .1 Keep excavations free of water while Work is in progress.
- .2 Avoid excavation below groundwater table if quick condition or heave is likely to occur.
  - .1 Prevent piping or bottom heave of excavations by groundwater lowering, sheet pile cut-offs, or other means.
- .3 Protect open excavations against flooding and damage due to surface run-off.
- .4 Dispose of water in accordance with Section 01 35 43 - Environmental Procedures in a manner not detrimental to public and private property, or portion of Work completed or under construction.
  - .1 Provide and maintain temporary drainage ditches and other diversions outside of excavation limits.
- .5 Remove suspended solids or other materials before discharging to storm sewers, watercourses, or drainage areas.

### 3.5 EXCAVATION

- .1 Strip topsoil over areas to be covered by new construction, over areas where grade changes are required, and so that excavated material may be stockpiled without covering topsoil.
  - .1 Stockpile topsoil on site for later use.
- .2 Excavate as required to carry out work as follows:
  - .1 Do not disturb soil or rock below bearing surfaces.
  - .2 Notify Contract Administrator when excavations are complete.
  - .3 If bearings are unsatisfactory, additional excavation will be authorized in writing and paid for as additional work.
- .3 Protect from freezing excavated surfaces against which concrete or fill is to be placed.
- .4 Do not leave excavated bearing surfaces exposed to weather for more than 24 hours. Program operations to ensure that concrete mud slabs will be poured over same within this time period but do not conceal bearing surfaces before they have been inspected and approved by the Contract Administrator.
- .5 Excavate trenches to provide uniform continuous bearing and support for 150mm thickness of pipe bedding material on solid and undisturbed ground.
  - .1 Trench widths below point 150mm above pipe not to exceed diameter of pipe plus 600mm.

- .6 Excavate for paving to subgrade levels.
  - .1 In addition, remove all topsoil, organic matter, debris, and other loose and harmful matter encountered at subgrade level.
- .7 Notify Contract Administrator if any pockets of material are found to contain free product (e.g. flowing or gas), staining, or any hydrocarbon odour is detected and segregate material from the excavated material.

### 3.6 STOCKPILING

- .1 Stockpile all excavated materials on-site, separated by material type (topsoil, earth fill, concrete, rock, asphalt, etc.)
- .2 Rock, once surplus soils have been separated, can be disposed of without further work or testing
- .3 Asphalt and concrete are to be processed for recycling, based on the requirements of the receiving site(s). Documentation regarding tonnages and destination sites to be retained.
- .4 Native soils that will not be reused on site shall be stockpiled onsite and sampled by the Contractor according to the following table:
  - .1 <50m3 minimum of 1 sample
  - .2 <150m3 minimum of 3 samples
  - .3 <500m3 minimum of 5 samples
  - .4 <1500m3 minimum of 10 samples
  - .5 >1500m3 minimum of 15 samples
- .5 Once sampled, surplus soil stockpiles cannot be moved, added to, or altered in any way until the test results have been reviewed and approved by Contract Administrator.
- .6 Soil analytical testing parameters to be according to the MOECC Table 3 criteria in addition to any other criteria required by the receiving site(s). All testing to be by the Contractor.

### 3.7 BACKFILLING

- .1 Inspection: do not commence backfilling until fill material and spaces to be filled have been inspected and approved by Contract Administrator.
- .2 Remove snow, ice, construction debris, organic soil, and standing water from spaces to be filled.
- .3 Lateral support: maintain even levels of backfill around structures as work progresses, to equalize earth pressures.
- .4 Compaction of subgrade: compact existing subgrade under walks, paving, and slabs on grade, to same compaction as specified for fill.
  - .1 Fill excavated areas with selected subgrade material compacted as specified for fill.
- .5 Placing:
  - .1 Place backfill, fill, and base course material in 150mm lifts: add water as required to achieve specified density.
- .6 Compaction: compact each layer of material to the following densities for material to ASTM D 698:
  - .1 To underside of base courses: 100%.
  - .2 Base courses: 100%.

- .3 Elsewhere: 95%.
- .4 Under slabs and paving:
- .5 Use select fill up to bottom of granular base courses.
- .6 Under seeded and sodded areas: use site excavated material to bottom of topsoil except in trenches and within 600 mm of foundations.
- .7 Against foundations (except as applicable to trenches and under slabs and paving): excavated material or imported material with no stones larger than 200 mm diameter within 600 mm of structures.

### **3.8 GRADING**

- .1 Grade so that water will drain away from buildings, walls and paved areas, to catch basins and other disposal areas.
- .1 Grade to be gradual between finished spot elevations shown on drawings.

### **3.9 FIELD QUALITY CONTROL**

- .1 Testing of materials and compaction of backfill and fill and unshrinkable fill will be carried out by testing laboratory designated by Contract Administrator.
- .2 Do not begin backfilling or filling operations until material has been approved for use by Contract Administrator.
- .3 Not later than 48 hours before backfilling or filling with approved material, notify Contract Administrator so that compaction tests can be carried out by designated testing agency.

### **3.10 SHORTAGE AND SURPLUS**

- .1 Supply all necessary fill to meet backfilling and grading requirements and with minimum and maximum rough grade variance.
- .2 Soil, other than Granular Fill shall only be imported to the site if it has been sampled and analyzed in accordance with the requirements of Schedule E of O.Reg. 153/04, as amended, under the supervision of a Qualified Person. As specified by the Regulation, samples shall be collected and analyzed at a frequency of one sample per 160 cubic metres of soil for the first 5,000 cubic metres to be brought to the site, and one sample for each additional 300 cubic metres of soils. Documentation of soil sampling and analyses shall be provided to the Contract Administrator at least 10 Working Days prior to importing the soil. The documentation shall be in the form of a written report signed and sealed by the Qualified Person who supervised the work. The Contract Administrator may, at its sole discretion, reject the proposed soil imports. Imported Soil must meet the current "Table 1" MOECC background standards, which were most recently published April 15, 2011, as the "Soil, Ground Water and Sediment Standards for Use Under Part XV.1 of the Environmental Protection Act".
- .3 Export all surplus soils from the site to meet grading requirements.

### **3.11 SOIL EXPORT**

- .1 Stockpiled and tested soils may be exported from the site after approval by Contract Administrator
- .2 The Contractor is responsible for all costs related to the export of surplus fill, not limited to excavation, stockpiling, testing, hauling, and disposal fees.

- .3 The Contractor shall provide the Contract Administrator with notice in writing of their proposed excess soil receiving site(s) no less than 15 Working Days in advance of the transport of soils off the project site. The Contractor shall provide the analytical results for the stockpile(s) to be exported.
- .4 Under no circumstances are surplus native soils to be exported off site without prior approval by Contract Administrator.
- .5 For surplus soils exceeding MOECC Table 3 criteria:
  - .1 The Contractor shall dispose of these soils at an MOECC licensed non-hazardous waste disposal facility. The Contractor shall provide the name of the MOECC licensed disposal facility and the number of its Environmental Compliance Approval or Certificate of Approval to the Contract Administrator in a Notice in Writing prior to removing contaminated soils from the site.
  - .2 The MOECC licensed disposal facility will define which additional parameters (if any) are required to be analyzed in order to comply with their Environmental Compliance Approval or Certification of Approval to accept waste. Should additional analyses be required, the Contractor will conduct sampling and Analytical results will be provided to the Contract Administrator within 10 Working Days of sampling.
  - .3 The Contractor shall transport contaminated soils using trucks and drivers that are duly licensed by the MOECC as a waste hauler. Contaminated soil must be transported directly from the project site to the MOECC licensed waste disposal site and must not be temporarily stored at any other location, or otherwise altered, prior to delivery to the receiving site.
  - .4 The Contractor shall track all quantities of contaminated soils that are removed from site for disposal at an MOECC licensed facility. The Contractor shall obtain waybills from the MOECC licensed facility for all contaminated soil disposed of at the facility and provide these records to the Contract Administrator within 5 Working Days of disposal of these soils.
- .6 For surplus soils meeting MOECC Table 3 criteria:
  - .1 The Contractor may remove surplus soils for reuse at one or more off-site receiving sites. The Contractor may also decide to utilize an MOECC licensed facility, if no other off-site receiving sites are available. If an MOECC site is used, then requirements for its transport are described in 3.11.4 above.
  - .2 The Contractor shall provide the Contract Administrator with a copy of the proposed receiving site(s) Fill Management Plan and a letter signed by the Contract Administrator of the receiving site no less than 15 Working Days in advance of the transport of soils off the site to the proposed receiving site. This letter shall be in a form approved by the Contract Administrator.
  - .3 The Contract Administrator may, at their sole discretion, reject any proposed receiving site(s) at any time and request that one or more alternatives be identified.
  - .4 Excess soil must be transported directly from the project site to the receiving site and must not be temporarily stored at any other location, or otherwise altered, prior to delivery to the receiving site.
  - .5 The Contractor shall obtain or produce a final summary that reports the total volume of soil accepted by the receiving site(s) and the source of these soils, as identified by the excavation number. This summary shall be provided to the Contract Administrator within 10 Working Days of completion of off-site movement of the soils to the receiving site.

### 3.12 CLEANING

- .1 Proceed in accordance with Section 01 74 11 - Cleaning.
- .2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools, and equipment.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 REFERENCES**

- .1 City of Guelph Linear Infrastructure Standards (2018) (CoGLIS)
  - .1 SS-1 – Specifications for Clearing and Grubbing
- .2 Specifications below are to be used except as modified by CoGLIS
- .3 Ontario Provincial Standard Specifications (OPSS)
  - .1 OPSS 801, Construction Specification for the Protection of Trees.

### **1.2 DEFINITIONS**

- .1 Clearing consists of cutting off trees and brush vegetative growth to not more than specified height above ground and disposing of felled trees, previously uprooted trees and stumps, and surface debris.
- .2 Underbrush clearing consists of removal from treed areas of undergrowth, deadwood, and trees smaller than 50 mm trunk diameter and disposing of fallen timber and surface debris.
- .3 Grubbing consists of excavation and disposal of stumps and roots to not less than specified depth below existing ground surface.

### **1.3 STORAGE AND PROTECTION**

- .1 Prevent damage to fencing, trees, landscaping, natural features, bench marks, existing buildings, existing pavement, utility lines, site appurtenances, water courses, root systems of trees which are to remain.
  - .1 Repair damaged items to approval of Contract Administrator.
  - .2 Replace trees designated to remain, if damaged, as directed by Contract Administrator.

### **1.4 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate waste materials for reuse and recycling. All debris resulting from clearing and grubbing and clean-up operations, except that which may be burned on site, shall be disposed of off site at locations arranged for by and at the sole expense of the Contractor.

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS**

- .1 Soil Material for Fill:
  - .1 Excavated soil material: free of debris, roots, wood, scrap material, vegetable matter, refuse, soft unsound particles, deleterious, or objectionable materials.
  - .2 Remove and store soil material for reuse.

## **PART 3 - PRODUCTS**

### **3.1 TEMPORARY EROSION AND SEDIMENTATION CONTROL**

- .1 Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.
- .2 Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

### **3.2 PREPARATION**

- .1 Inspect site and verify with Contract Administrator, items designated to remain, as well as trees and vegetation to be cleared and grubbed.
- .2 Locate and protect utility lines: preserve in operating condition active utilities traversing site.
  - .1 Notify Contract Administrator immediately of damage to or when unknown existing utility line(s) are encountered.
  - .2 When utility lines which are to be removed are encountered within area of operations, notify Contract Administrator in ample time to minimize interruption of service.
- .3 Notify utility authorities before starting clearing and grubbing.
- .4 Keep roads and walks free of dirt and debris.

### **3.3 CLEARING**

- .1 Clearing shall consist of cutting of trees, brush and other vegetation within the areas to be cleared, and the disposal of timber, brush, windfalls and other surface litter.
- .2 All trees, shrubs and other vegetation as designated by the Engineer to be saved shall be carefully protected from danger of injury, during all construction operations. The Contractor may be required to cut only certain selected trees on certain areas, leaving the rest of the trees in the indicated areas unharmed.
- .3 Where possible, trees shall be felled towards the centre of the area to be cleared. Where trees cannot be felled without danger to traffic or injury to other trees, structures or property, they shall be cut in sections from the top down.
- .4 Burning of inflammable debris may be carried out provided all provincial and municipal statutes, by-laws and regulations are conformed to and all necessary permits and approvals are obtained.
- .5 In areas where burning is permitted, windfalls and other surface litter and all brush and timber which is not to be salvaged shall be piled in the centre of the cleared area and burned in such a manner as not to injure live trees. Where burning is performed alongside travelled roads it shall be performed in a manner which is safe and which will result in minimum discomfort to the travelling public.
- .6 The Contractor shall continually maintain sufficient force and equipment to prevent fires from spreading.
- .7 Any damage caused by the Contractor's operations to surrounding property shall be paid for by the Contractor.

- .8 In areas where burning is not permitted inflammable debris shall be disposed of off-site.
- .9 All timber cut under this Contract shall become the property of the Contractor and shall be hauled clear of the right-of-way before the final acceptance of the work by the Engineer.
- .10 Protect trees and plants on site as per Ontario Provincial Standard Specification 801 "Construction Specification for the Protection of trees".
- .11 Clear underbrush from areas as indicated at ground level.

### **3.4 GRUBBING**

- .1 Grubbing shall consist of the removal and disposal of all stumps, roots, embedded logs and all debris from the areas designated to be grubbed, and shall be performed by the Contractor on the sites of excavations and embankments, and for any other highway requirements, as directed by the Engineer.
- .2 The grubbed area shall, after removal of all debris, be levelled sufficiently to permit machine mowing. In no case shall any part or portion of the resultant debris from the grubbing operations be placed in or under any embankment.
- .3 The Contractor may be required to grub single or individual stumps, and to protect from danger of injury during this and all other construction operations the vegetation designated to be saved.
- .4 Grub out stumps and roots to not less than 450 mm below ground surface.
- .5 Grub out visible rock fragments and boulders, greater than 300 mm in greatest dimension, but less than 0.25 m<sup>3</sup>.
- .6 Fill depressions made by grubbing with suitable material and to make new surface conform with existing adjacent surface of ground.

### **3.5 REMOVAL AND DISPOSAL**

- .1 Remove cleared and grubbed materials off site. t

### **3.6 FINISHED SURFACE**

- .1 Leave ground surface in condition suitable for stripping of topsoil.

### **3.7 CLEANING**

- .1 The Contractor shall remove and dispose of all piled or surface boulders, regardless of size, old fences and other litter and debris, from the entire area of the right-of-way within the limits of the Contract, or as directed by the Engineer.
- .2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 RELATED SECTIONS**

- .1 Section 31 23 33.01 – Excavation, Trenching and Backfilling.
- .2 Section 32 01 90.33 – Tree and Shrub Preservation.
- .3 Section 31 00 00.01 – Earthwork.

### **1.2 REFERENCES**

- .1 City of Guelph Linear Infrastructure Standards (2018) (CoGLIS)
  - .1 Section 1 – Standard Specifications
  - .2 Section 2 – Special Provisions
- .2 ASTM International:
  - .1 ASTM D 698-07e1, Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (600 kN-m/m<sup>3</sup>).

### **1.3 EXISTING CONDITIONS**

- .1 Known underground and surface utility lines and buried objects indicated on site plan are for general information. Contractor responsible for locating all underground utilities.
- .2 Prevent damage to fencing, trees, landscaping, natural features, benchmarks, existing buildings, existing pavement, surface or underground utility lines that are to remain. Make good any damage.

### **1.4 PROTECTION**

- .1 Protect and/or transplant existing trees that are to remain as directed by Consultant. If damaged, restore to original or better condition unless directed otherwise.
- .2 Maintain access roads to prevent accumulation of construction related debris on roads.

### **1.5 MATERIALS**

- .1 Fill Material: in accordance with of Section 31 23 33.01 - Excavating, Trenching and Backfilling.
- .2 Excavated or graded material existing on site suitable to use as fill for grading work to be approved by Contract Administrator.

## **PART 2 - EXECUTION**

### **2.1 GRADING**

- .1 Rough grade to levels, profiles, and contours allowing for surface treatment as indicated.
- .2 Slope rough grade away from building 1:50 minimum.
- .3 Prior to placing fill over existing ground, scarify surface to depth of 150 mm minimum before placing fill over existing ground. Maintain fill and existing surface at approximately same moisture content to facilitate bonding.
- .4 Compact filled and disturbed areas to maximum dry density to ASTM D 698, as follows: Compact filled and disturbed areas to Standard Proctor maximum dry density to ASTM D 698, as follows:
  - .1 95% under landscaped areas.
  - .2 100% under paved and walk areas.
- .5 Minimize disturbance to soil within branch spread of trees or shrubs to remain.

### **2.2 SURPLUS MATERIAL**

- .1 Remove surplus material and material unsuitable for fill, grading, or landscaping, off site as per Section 31 00 00.01 – Earthwork. Surplus material must be sorted into types (concrete, asphalt, rock, soil, etc.) prior to stockpiling and disposal

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 RELATED SECTIONS**

- .1 Section 01 74 21 – Construction/Demolition Waste Management and Disposal.
- .2 Section 31 00 00 – Earthwork.
- .3 Section 32 01 90.33 – Tree and Shrub Preservation.
- .4 Section 33 11 16 – Water Distribution Piping.

### **1.2 REFERENCES**

- .1 City of Guelph Linear Infrastructure Standards (2018) (CoGLIS)
  - .1 Section 1 – Standard Specifications.
  - .2 Section 2 – Special Provisions.
- .2 Specifications below are to be used except as modified by CoGLIS
- .3 Canadian Standards Association (CSA International)
  - .1 CSA-A23.1-09/A23.2-09, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
- .4 Ontario Provincial Standard Specifications (OPSS)
  - .1 OPSS 805, Construction Specification for Temporary Erosion and Sediment Control Measures.

### **1.3 DEFINITIONS**

- .1 Excavation classes: two classes of excavation will be recognized; common excavation and rock excavation.
  - .1 Rock: solid material in excess of 1.00m<sup>3</sup> and which cannot be removed by means of heavy duty mechanical excavating equipment. Frozen material not classified as rock.
  - .2 Common excavation: excavation of materials of whatever nature, which are not included under definitions of rock excavation.
- .2 Unclassified excavation: excavation of deposits of whatever character encountered in Work.
- .3 Topsoil:
  - .1 Material capable of supporting good vegetative growth and suitable for use in top dressing, landscaping, and seeding.
  - .2 Material reasonably free from subsoil, clay lumps, brush, objectionable weeds, and other litter, and free from cobbles, stumps, roots, and other objectionable material larger than 25 millimeters in any dimension.
- .4 Waste material: excavated material unsuitable for use in Work or surplus to requirements.
- .5 Borrow material: material obtained from locations outside area to be graded, and required for construction of fill areas or for other portions of Work.

- .6 Recycled fill material: material, considered inert, obtained from alternate sources and engineered to meet requirements of fill areas.
- .7 Unsuitable materials:
  - .1 Weak, chemically unstable, and compressible materials.
- .8 Unshrinkable fill: very weak mixture of cement, concrete aggregates, and water that resists settlement when placed in utility trenches, and capable of being readily excavated.

#### **1.4 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate waste materials for recycling in accordance with Section 01 74 21.

#### **1.5 EXISTING CONDITIONS**

- .1 Buried services:
  - .1 Before commencing work verify location of buried services on and adjacent to site.
  - .2 Arrange with appropriate authority for relocation of buried services that interfere with execution of work.
  - .3 Remove obsolete buried services within 2m of foundations: cap cut-offs.
  - .4 Size, depth, and location of existing utilities and structures as indicated are for guidance only. Completeness and accuracy are not guaranteed.
  - .5 Prior to beginning excavation Work, notify applicable University of Guelph Representative and establish location and state of use of buried utilities and structures through utility company or other responsible party. University of Guelph Representative and responsible parties to clearly mark such locations to prevent disturbance during Work. University of Guelph does not provide locates on non-site controlled utilities.
  - .6 Confirm locations of buried utilities by careful test excavations.
  - .7 Maintain and protect from damage, water, sewer, gas, electric, telephone, and other utilities and structures encountered as indicated.
  - .8 Where utility lines or structures exist in area of excavation, obtain direction of University of Guelph Representative.
  - .9 Record location of maintained, re-routed, and abandoned underground lines.
  - .10 Confirm locations of recent excavations adjacent to area of excavation.
- .2 Existing buildings and surface features:
  - .1 Conduct, with University of Guelph Representative & Contract Administrator, condition survey of existing buildings, trees and other plants, lawns, fencing, service poles, wires, rail tracks, pavement, survey bench marks, and monuments which may be affected by Work.
  - .2 Protect existing buildings and surface features from damage while Work is in progress. In event of damage, immediately make repair as directed by the University of Guelph.

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS**

- .1 Granular 'A' and 'B' to OPSS 1010.
- .2 Type 3 fill: selected material from excavation or other sources, approved by University of Guelph Representative for use intended, unfrozen and free from rocks larger than 75mm, cinders, ashes, sods, refuse, or other deleterious materials.
- .3 Unshrinkable fill: proportioned and mixed to provide:
  - .1 Maximum compressive strength of 0.4 MPa at 28 days.
  - .2 Minimum strength of 0.07 MPa at 24 h.
  - .3 Concrete aggregates: to CSA-A23.1/A23.2.
  - .4 Cement: Type GU.
  - .5 Slump: 160 to 200 mm.
- .4 Materials for sedimentation control as per OPSS 805.

## **PART 3 - EXECUTION**

### **3.1 TEMPORARY EROSION AND SEDIMENTATION CONTROL**

- .1 Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.
- .2 Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

### **3.2 SITE PREPARATION**

- .1 Remove obstructions, ice, and snow from surfaces to be excavated within limits indicated.
- .2 Cut pavement or sidewalk neatly along limits of proposed excavation in order that surface may break evenly and cleanly.

### **3.3 PREPARATION/PROTECTION**

- .1 Protect existing features in accordance with applicable local regulations.
- .2 Keep excavations clean, free of standing water, and loose soil.
- .3 Where soil is subject to significant volume change due to change in moisture content, cover and protect to Contract Administrator's approval.
- .4 Protect natural and man-made features required to remain undisturbed. Unless otherwise indicated or located in an area to be occupied by new construction, protect existing trees from damage.
- .5 Protect buried services that are required to remain undisturbed.

### **3.4 STRIPPING OF TOPSOIL**

- .1 Begin topsoil stripping of areas as directed by Contract Administrator after area has been cleared of brush, weeds, and grasses and removed from site.
- .2 Strip topsoil to depths as directed by Contract Administrator.
  - .1 Do not mix topsoil with subsoil.
- .3 Stockpile in locations as directed by Contract Administrator.
  - .1 Stockpile height not to exceed 2m and should be protected from erosion.
- .4 Dispose of unused topsoil off site, as per Section 31 00 00.01 Earthwork. Topsoil must be separated from rock, concrete, and asphalt for disposal.

### **3.5 STOCKPILING**

- .1 Stockpile fill materials in areas designated by Contract Administrator.
  - .1 Stockpile granular materials in manner to prevent segregation.
- .2 Protect fill materials from contamination.
- .3 Implement sufficient erosion and sediment control measures to prevent sediment release off construction boundaries and into water bodies.

### **3.6 DEWATERING AND HEAVE PREVENTION**

- .1 Keep excavations free of water while Work is in progress.
- .2 Provide for Contract Administrator's approval details of proposed dewatering or heave prevention methods, including dikes, well points, and sheet pile cut-offs.
- .3 Avoid excavation below groundwater table if quick condition or heave is likely to occur.
  - .1 Prevent piping or bottom heave of excavations by groundwater lowering, sheet pile cut-offs, or other means.
- .4 Protect open excavations against flooding and damage due to surface run-off.
- .5 Dispose of water to approved runoff areas and in manner not detrimental to public and private property, or portion of Work completed or under construction.
  - .1 Provide and maintain temporary drainage ditches and other diversions outside of excavation limits.
- .6 Provide flocculation tanks, settling basins, or other treatment facilities to remove suspended solids or other materials before discharging to storm sewers, watercourses, or drainage areas.

### **3.7 EXCAVATION**

- .1 Advise Contract Administrator at least 7 days in advance of excavation operations for initial cross sections to be taken.
- .2 Excavate to lines, grades, elevations, and dimensions as directed by Contract Administrator.

- .3 Remove all fill material to expose native soils or native bedrock below the footprint of the new structure. Proof roll native soil material with heavy construction equipment. A qualified geotechnical engineer registered in the Province of Ontario is to inspect the native soil surface to ensure exposed subgrade has no local anomalies or soft areas prior to placement of engineered fill or footings.
- .4 Remove paving and other obstructions encountered during excavation with care.
- .5 Excavation must not interfere with bearing capacity of adjacent foundations.
- .6 Minimize disturbance of soil within branch spread of trees or shrubs that are to remain.
  - .1 When excavating through roots, excavate by hand and cut roots with sharp axe or saw.
- .7 For trench excavation, unless otherwise authorized by Contract Administrator in writing, do not excavate more than 30m of trench in advance of installation operations and do not leave open more than 15m at end of day's operation.
- .8 Keep excavated and stockpiled materials a safe distance away from edge of trench as directed by Contract Administrator.
- .9 Restrict vehicle operations directly adjacent to open trenches.
- .10 Dispose of surplus stripped topsoil, sod, and soil materials off site, as directed by Contract Administrator. Soil must be separated from rock, concrete, and asphalt for disposal.
- .11 Dispose of concrete and rock excavation off site, as per Section 31 00 00 Earthwork. Surplus material must be sorted into types (concrete, asphalt, rock, soil, etc.) prior to disposal.
- .12 All disposal of materials to be coordinated through the Contract Administrator.
- .13 Do not obstruct flow of surface drainage or natural watercourses.
- .14 Earth bottoms of excavations to be undisturbed soil, level, free from loose, soft or organic matter.
- .15 Notify Contract Administrator when bottom of excavation is reached.
- .16 Obtain Contract Administrator's approval of completed excavation.
- .17 Remove unsuitable material from trench bottom including those that extend below required elevations to extent and depth as directed by Contract Administrator.
- .18 Correct unauthorized over-excavation as follows:
  - .1 Fill under bearing surfaces and footings with Granular 'B' (Type II) fill compacted to not less than 100% Standard Proctor maximum dry density.
  - .2 Fill under other areas with Granular 'B' fill compacted to not less than 95% Standard Proctor maximum dry density.
- .19 Hand trim, make firm and remove loose material and debris from excavations.
  - .1 Where material at bottom of excavation is disturbed, compact foundation soil to density at least equal to undisturbed soil.

### **3.8 FILL TYPES AND COMPACTION**

- .1 Under concrete slabs: provide 200mm Granular 'A' material to underside of slab compacted to 100% SPMDD.
- .2 Under grass areas: provide Type 3 fill to 100mm below finished grade compacted to 95% SPMDD.

### **3.9 BEDDING AND SURROUND OF UNDERGROUND SERVICES**

- .1 Place and compact granular material for bedding and surround of underground services as specified in Section 33 11 16, Section 33 31 13, and Section 33 41 00.
- .2 Place bedding and surround material in unfrozen condition.

### **3.10 BACKFILLING**

- .1 Do not proceed with backfilling operations until completion of following:
  - .1 Contract Administrator has inspected and approved installations.
  - .2 Contract Administrator has inspected and approved of construction below finish grade.
  - .3 Inspection, testing, approval, and recording location of underground utilities.
  - .4 Removal of concrete formwork.
  - .5 Removal of shoring and bracing; backfilling of voids with satisfactory soil material.
- .2 Areas to be backfilled to be free from debris, snow, ice, water, and frozen ground.
- .3 Do not use backfill material that is frozen or contains ice, snow, or debris.
- .4 Place backfill material in uniform layers not exceeding 150mm compacted thickness up to grades indicated. Compact each layer before placing succeeding layer.
- .5 Backfilling around installations:
  - .1 Place bedding and surround material as specified elsewhere.
  - .2 Do not backfill around or over cast-in-place concrete within 24 hours after placing of concrete.
  - .3 Place layers simultaneously on both sides of installed Work to equalize loading. Difference not to exceed 0.5m.

### **3.11 RESTORATION**

- .1 Upon completion of Work, remove waste materials and debris in accordance to Section 01 74 11, trim slopes, and correct defects as directed by Contract Administrator.
- .2 Replace topsoil as directed by Contract Administrator.
- .3 Reinstall lawns to elevation that existed before excavation.
- .4 Reinstall pavements disturbed by excavation to thickness, structure, and elevation that existed before excavation.
- .5 Clean and reinstall areas affected by Work as directed by University of Guelph.
- .6 Use temporary plating to support traffic loads over unshrinkable fill for initial 24 hours.
- .7 Protect newly graded areas from traffic and erosion and maintain free of trash or debris.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 SUMMARY**

- .1 Section includes:
  - .1 Materials and installation for fertilizing and preserving root systems of plants affected by changing grades or excavation

### **1.2 RELATED SECTIONS**

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 32 92 23 – Sodding.

### **1.3 REFERENCES**

- .1 City of Guelph Linear Infrastructure Standards (2018) (CoGLIS).
  - .1 Section 1 – Standard Specifications.
  - .2 Section 2 – Special Provisions.
- .2 Specifications below are to be used except as modified by CoGLIS.
- .3 Department of Justice Canada (Jus).
  - .1 Fertilizers Act (R.S. 1985, c. F-10).
  - .2 Fertilizers Regulations (C.R.C., c. 666).
- .4 Health Canada - Pest Management Regulatory Agency (PMRA).
  - .1 National Standard for Pesticide Education, Training and Certification in Canada (1995).
- .5 Canadian Standards Association (CSA).
- .6 CSA G30.5, Welded Steel Wire Fabric.

### **1.4 DEFINITION**

- .1 Mycorrhiza: association between fungus and roots of plants. This symbiosis enhances plant establishment in newly landscaped and imported soils.

### **1.5 SCHEDULING**

- .1 Obtain approval from Contract Administrator of schedule indicating beginning of Work.

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS**

- .1 Fill:
  - .1 Type (A): clean, natural river sand and gravel material, free from silt, clay, loam, friable or soluble materials and organic matter.

- .2 Type (B): excavated soil, free from roots, rocks larger than 75 mm, building debris, and toxic ingredients (salt, oil, etc.). Excavated material shall be approved by Contract Administrator before use as fill.
- .2 Coarse washed stones: 35-75 mm diameter.
- .3 Sand: clean, natural river sand material, free from silt, clay, loam, friable, or soluble materials and organic matters.
- .4 Peatmoss:
  - .1 Derived from partially decomposed species of Sphagnum Mosses.
  - .2 Elastic and homogeneous.
  - .3 Free of wood and deleterious material which could prohibit growth.
  - .4 Shredded minimum particle size: 5 mm.
- .5 Fertilizer:
  - .1 To Canada Fertilizer Act and Fertilizers Regulations.
  - .2 Complete, commercial, slow release with 35 % of nitrogen content in water-insoluble form.
- .6 Anti-desiccant: commercial, wax-like emulsion.
- .7 Filter Cloth:
  - .1 Type 1: 100 % non-woven needle punched polyester, 2.75 mm thick, 240 g/m<sup>2</sup> mass.
  - .2 Type 2: biodegradable burlap.
- .8 Wood posts: 38 x 89 x 2400 mm length, untreated wood.
- .9 Welded wire fabric (WWF): 100 x 100 mm, to CSA G30.5.

### **PART 3 - EXECUTION**

#### **3.1 IDENTIFICATION AND PROTECTION**

- .1 Identify plants and limits of root systems to be preserved as approved by Contract Administrator.
- .2 Protect plant and root systems from damage, compaction and contamination resulting from construction as approved by Contract Administrator.
- .3 Ensure no pruning is done inside drip line. If pruning inside drip line is required consult an arborist or Canadian Certified Horticultural Technician (CCHT) as approved by Contract Administrator.

#### **3.2 ROOT CURTAIN SYSTEM**

- .1 Identify limits for required construction excavation as approved by Contract Administrator. Under no circumstances shall excavation within the drip line occur prior to discussions and approval regarding tree root protection with Contract Administrator. Minimizing disturbance to existing tree roots is imperative and agreement by Contract Administrator and University of Guelph Representative must be sought prior to disturbance of tree roots.
- .2 Prior to construction excavation, hand dig trench minimum 500 mm wide x 1500 mm deep, along perimeter of excavation limits.

- .3 Prune exposed roots cleanly at side of trench nearest plants to be preserved. Pruned ends to point obliquely downwards.
- .4 Install wooden posts and welded wire fabric against construction edge of trench.
- .5 Securely attach Type 2 filter fabric on plant side of wire mesh.
- .6 Prepare homogeneous mixture of fertilizer, parent material and organic matter.
  - .1 Add organic matter to mixture to achieve 7-9% organic matter content by weight.
  - .2 Incorporate with mixture grade 2:12:8 ratio fertilizer (dry) at rate of 1.5 kg/m<sup>3</sup>.
- .7 Backfill with homogeneous mixture between curtain wall and plants to be preserved in layers not exceeding 150 mm in depth. Compact each layer to 85% Standard Proctor Density.
- .8 Protect root curtain from damage during construction operations.
- .9 Water plants and root curtain sufficiently during construction to maintain optimum soil moisture condition until backfill operations are complete.
- .10 Protect root curtain before backfill operations. Ensure root curtain is cut down to 300 mm below finished grade and remove cut material.

### **3.3 LOWERING GRADE AROUND EXISTING TREE**

- .1 Begin Work in accordance with schedule approved by Contract Administrator.
- .2 Cut slope not less than 500 mm from tree trunk to new grade level.
- .3 Excavate to depths as indicated. Protect from damage root zone which is to remain
- .4 When severing roots at excavation level, cut roots with sharp tools.
- .5 Cultivate excavated surface manually to 15 mm depth.
- .6 Prepare homogeneous soil mixture consisting by volume of:
  - .1 60 % excavated soil cleaned of roots, plant matter, stones, debris.
  - .2 25 % coarse, clean sterile sand.
  - .3 15 % organic matter.
  - .4 Grade 2:12:8 fertilizer at rate of 1.5 kg/m<sup>3</sup>.
- .7 Place soil mixture over area of excavation to finished grade level. Compact to 85% Standard Proctor modified dry density.
- .8 Water entire root zone to optimum soil moisture level.
- .9 Install surface cover of sodding in accordance with Section 32 92 23 – Sodding.

### **3.4 ANTI-DESICCANT**

- .1 Apply anti-desiccant to foliage where applicable and as directed by Contract Administrator.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 REFERENCES**

- .1 City of Guelph Linear Infrastructure Standards (2018) (CoGLIS)
  - .1 Section 1 – Standard Specifications
  - .2 Section 2 – Special Provisions
- .2 Specifications below are to be used except as modified by CoGLIS
- .3 ASTM International
  - .1 ASTM D 698-07e1, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400ft-lbf/ft<sup>2</sup>) (600kN-m/m<sup>2</sup>).
- .4 Ontario Provincial Standard Specifications (OPSS)
  - .1 OPSS.MUNI 1010-November 2013, Material Specification for Aggregates – Base, Subbase, Select Subgrade, and Backfill Material.

### **1.2 ACTION AND INFORMATION SUBMITTALS**

- .1 Submit samples in accordance with Section 01 33 00 - Submittal Procedures and CoBSGC Section 2.17

### **1.3 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store, and handle materials in accordance with Section 01 61 00 - Common Product Requirements and Sections 1.09 and 1.19 of CoBSGC.

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS**

- .1 Granular 'A' base and Granular 'B', and sub-base to OPSS 1010 except as modified by CoBSGC Section 2.17.

## **PART 3 - EXECUTION**

### **3.1 PLACEMENT AND INSTALLATION**

- .1 Place granular base after subgrade is inspected and approved in writing by Contract Administrator.
- .2 Placing:
  - .1 Construct granular base to depth and grade in areas indicated.
  - .2 Ensure no frozen material is placed.
  - .3 Place material only on clean unfrozen surface, free from snow and ice.

- .4 For spreading and shaping material, use spreader boxes having adjustable templates or screeds which will place material in uniform layers of required thickness.
- .5 Place material to full width in uniform layers not exceeding 150 mm compacted thickness.
- .6 Shape each layer to smooth contour and compact to specified density before succeeding layer is placed.
- .7 Remove and replace that portion of layer in which material becomes segregated during spreading.
- .3 Compaction Equipment:
  - .1 Ensure compaction equipment is capable of obtaining required material densities.
- .4 Compacting:
  - .1 Compact to density not less than 100% in accordance with ASTM D 698.
  - .2 Shape and roll alternately to obtain smooth, even and uniformly compacted base.
  - .3 Apply water as necessary during compacting to obtain specified density.
  - .4 In areas not accessible to rolling equipment, compact to specified density with mechanical tampers approved in writing by Contract Administrator.
  - .5 Correct surface irregularities by loosening and adding or removing material until surface is within specified tolerance.
- .5 Proof rolling:
  - .1 For proof rolling use standard roller of 45400 kg gross mass with four pneumatic tires each carrying 11350 kg and inflated to 620 kPa. Four tires arranged abreast with centre to centre spacing of 730 mm.
  - .2 Obtain written approval from Contract Administrator to use non standard proof rolling equipment.
  - .3 Proof roll at level in granular base as indicated.
    - .1 If use of non standard proof rolling equipment is approved Contract Administrator to determine level of proof rolling.
  - .4 Make sufficient passes with proof roller to subject every point on surface to three separate passes of loaded tire.
  - .5 Where proof rolling reveals areas of defective granular and/or subgrade:
    - .1 Remove granular and/or subgrade material to depth and extent as directed by Contract Administrator.
    - .2 Replace granular and/or subgrade material and compact in accordance with this section at no extra cost.

### 3.2 SITE TOLERANCES

- .1 Finished base surface to be within plus or minus 10 mm of established grade and cross section but not uniformly high or low.

### 3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 – Cleaning.
  - .1 Leave Work area clean at end of each day.

- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 – Cleaning.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

### **3.4 PROTECTION**

- .1 Maintain finished base in condition conforming to this Section until succeeding material is applied or until acceptance by Contract Administrator.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 REFERENCES**

- .1 City of Guelph Linear Infrastructure Standards (2018) (CoGLIS)
  - .1 Section 1 – Standard Specifications
  - .2 Section 2 – Special Provisions
- .2 Specifications below are to be used except as modified by CoGLIS.
- .3 American Society for Testing and Materials International, (ASTM)
  - .1 ASTM D 698-[00a], Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft<sup>3</sup> (600 kN-m/m<sup>3</sup>)).
- .4 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-1.5-M91, Low Flash Petroleum Spirits Thinner (Reaffirmation of December 1991).
  - .2 CAN/CGSB-1.74-2001, Alkyd Traffic Paint
- .5 Ontario Provincial Standard Specifications (OPSS)
  - .1 OPSS.MUNI 302-November 2016, Construction Specification for Priming Granular Base.
  - .2 OPSS.PROV 308-April 2012, Construction specification for Tack Coating and Joint Painting
  - .3 OPSS 310-November 2012, Construction Specification for Hot Mix Asphalt
  - .4 OPSS.MUNI 314-November 2016, Construction Specification for Untreated Subbase, Base, Surface, Shoulder, Subgrade and Stockpiling.
  - .5 OPSS 710-November 2010, Construction Specification for Pavement Marking
  - .6 OPSS.MUNI 1010-November 2013, Material Specification for Aggregates-Base, Subbase, Select Subgrade, and Backfill Material
  - .7 OPSS.MUNI 1103-November 2016, Material Specification for Emulsified Asphalt.
  - .8 OPSS 1150-November 2010, Material Specification for Hot Mix Asphalt.
  - .9 OPSS 1716- February 1991, Material Specification for Water-Borne Traffic Paint.

### **1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit asphalt mix design in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Submit samples in accordance with Section 01 33 00 – Submittal Procedures.

### **1.3 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate and recycle waste materials in accordance with Section 01 74 21 — Construction/Demolition Waste Management and Disposal.
- .2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.
- .3 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.

- .4 Place materials defined as hazardous or toxic in designated containers.
- .5 Divert unused aggregate materials from landfill to facility for reuse as approved by Contract Administrator.
- .6 Dispose of unused paint and paint thinner materials at official hazardous material collections site as approved by Contract Administrator.
- .7 Fold up metal banding, flatten and place in designated area for recycling.
- .8 Do not dispose of unused paint and paint thinner material into sewer system, into streams, lakes, onto ground or in other location where it will pose health environmental hazard.
- .9 Divert unused asphalt from landfill to facility capable of recycling materials.

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS**

- .1 Aggregates to: OPS 1010:
  - .1 Granular A
  - .2 Granular B
- .2 Prime coat: SS-1 to OPSS 1103.
- .3 Tack coat: SS-1 to OPSS 1103.
- .4 Asphalt concrete: to OPSS 1150.
- .5 Traffic paint: yellow and white OPSS 1716
- .6 Paint thinner: to CAN/CGSB-1.5.

## **PART 3 - EXECUTION**

### **3.1 PAVEMENT THICKNESS**

- .1 Asphalt pavement structure for loading areas, driveways, and fire routes:
  - .1 40 mm HL3 Surface Asphalt
  - .2 60 mm HL8 Base Asphalt
  - .3 150 mm Granular 'A'
  - .4 400 mm Granular 'B' Type 1
- .2 Asphalt pavement structure for car parking:
  - .1 40 mm HL3 Surface Asphalt
  - .2 40 mm HL8 Base Asphalt
  - .3 150 mm Granular 'A'
  - .4 300 mm Granular 'B' Type I

### **3.2 PAVEMENT CONSTRUCTION**

- .1 Application of prime coat: OPSS 302.
- .2 Construction of asphalt concrete: OPSS 310.
- .3 Surface preparation: CCDG.

### **3.3 TRAFFIC MARKINGS**

- .1 Paint parking space divisions and other pavement markings in accordance with manufacturers' recommendations and as indicated.
- .2 Use paint thinner in accordance with manufacturer's requirements.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 SUMMARY INCLUDES**

- .1 Materials and installation for concrete walks, curbs and gutters.
- .2 Materials and installation for tactile walking surface indicator plates. Design and submission requirements.

### **1.2 REFERENCES**

- .1 City of Guelph Linear Infrastructure Standards (2018) (CoGLIS)
  - .1 Section 1 – Standard Specifications
  - .2 Section 2 – Special Provisions
- .2 Specifications below are to be used except as modified by CoGLIS
- .3 American Society for Testing and Materials International (ASTM)
  - .1 ASTM C 117-04, Standard Test Method for Materials Finer than 0.075 mm (No. 200) Sieve in Mineral Aggregates by Washing.
  - .2 ASTM C 136-05, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
  - .3 ASTM D 260-86(2001), Standard Specification for Boiled Linseed Oil.
  - .4 ASTM D 698-00a<sup>1</sup>, Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400ft-lbf/ft<sup>2</sup>) (600 kN-m/m<sup>2</sup>).
  - .5 ASTM A48 / A48M – 03, Gray Iron Castings.
  - .6 ASTM C 1028-07, Static Coefficient of Friction of Ceramic Tile and Other Like Surfaces by the Horizontal Dynamometer Pull-Meter Method
- .4 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-3.3-99(March 2004), Kerosene, Amend. No. 1, National Standard of Canada.
  - .2 CAN/CGSB-8.1-88, Sieves, Testing, Woven Wire, Inch Series.
- .5 Canadian Standards Association (CSA International)
  - .1 CSA-A23.1-04/A23.2-04, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
- .6 Ontario Provincial Standard Specifications (OPSS)
  - .1 OPSS 351-November 2015, Construction Specification for Concrete Sidewalk
  - .2 OPSS.MUNI 353-November 2016, Construction Specification for Concrete Curb and Gutter Systems
  - .3 OPSS.MUNI 1350-November 2014, Material Specification for Concrete – Materials and Production
- .7 Ontario Provincial Standard Drawings (OPSD)
  - .1 OPSD 310.039, Concrete Sidewalk Ramps Tactile Walking Surface Indicators Component.
  - .2 OPSD 310.010, Concrete Sidewalk
  - .3 OPSD 310.033, Concrete Sidewalk Ramps at Unsignalized Intersections

### 1.3 DESIGN AND SUBMISSION REQUIREMENTS

- .8 Before the installation of the tactile walking surface indicator plates, one (1) copy of the Working Drawing and manufacturer's installation instructions must be submitted to the Contract Administrator.
- .9 The manufacturer must also provide a certificate when requested, indicating that the product has been manufactured, meeting all test requirements, in accordance to the Contract Documents.
- .10 The requested certificate shall include test results from an independent testing laboratory recently accredited by the Standards Council of Canada.

### 1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Concrete mix design to be submitted in accordance with Section 01 33 00 - Submittal Procedures.
- .2 If materials have been tested by accredited testing laboratory approved by Contract Administrator within previous two (2) months and have passed tests equal to requirements of this specification, submit test certificates from testing laboratory showing suitability of materials for this project.

### 1.5 DELIVERY, STORAGE AND HANDLING

- .1 Waste Management and Disposal:
  - .1 Separate waste materials for reuse and recycling in accordance with Section 01 47 21 - Construction/Demolition Waste Management and Disposal.

## **PART 2 - PRODUCTS**

### 2.1 MATERIALS

- .1 Concrete mixes and materials: in accordance with Section 03 30 00 - Cast-in-Place Concrete and OPSS.MUNI 1350.
- .2 Curing Compound: in accordance with Section 03 30 00 - Cast-in-Place Concrete.
- .3 Granular base: Granular 'A' Material as per Section 32 11 23 – Aggregate Base Course.
- .4 Non-staining mineral type form release agent: chemically active release agents containing compounds that react with free lime to provide water-soluble soap.
- .5 Fill material: to Section 31 23 33.01 following requirements:
- .6 The material used for the tactile walking surface indicator plate shall be gray cast iron, specified in the Contract Documents.
  - .1 The castings shall be in accordance to ASTM A 48M, Class 35B.
  - .2 It shall have a high tonal contrast with the adjacent surface.
  - .3 It shall not be coated with paint or any other coatings or constituents; it shall be left bare.
  - .4 The castings shall be in good condition. It shall not have blowholes, cracks, pouring faults and other deficiencies.

- .7 According to ASTM C 1028, the surface of each new cast iron plate on both the tops of the truncated domes and the field between the truncated domes shall have a minimum wet and dry static coefficient of friction of 0.8.
- .8 The trademark or initial of the manufacturer, year of manufacture, and country of manufacture shall be clearly identified and legible in raised letters on the top side of each plate.

### **PART 3 - EXECUTION**

#### **3.1 GRADE PREPARATION**

- .1 Do grade preparation work in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.
- .2 Place fill in maximum 150 mm layers and compact to at least 95% of maximum dry density to ASTM D 698.

#### **3.2 GRANULAR BASE**

- .1 Obtain Contract Administrator's approval of subgrade before placing granular base.
- .2 Place granular base material to lines, widths, and depths as indicated.
- .3 Compact granular base in maximum 150 mm layers to at least 95% of maximum density to ASTM D 698.

#### **3.3 CONCRETE**

- .1 Obtain Contract Administrator approval of granular base prior to placing concrete.
- .2 Do concrete work in accordance with Section 03 30 00 - Cast-in-Place Concrete, OPSS 351, OPSS.MUNI 353. CoBSGC Section 2.02 and Section 2.19.
- .3 Immediately after floating, give sidewalk surface uniform broom finish to produce regular corrugations not exceeding 2 mm deep, by drawing broom in direction normal to centre line.
- .4 Provide edging as indicated with 10 mm radius edging tool.
- .5 Slip-form pavers equipped with string line system for line and grade control may be used if quality of work acceptable to Contract Administrator can be demonstrated. Hand finish surfaces when directed by Contract Administrator.
- .6 Place formwork for front and rear faces of curb and gutter to correct line and elevation. Firmly brace formwork in order to prevent any movement while concrete is being placed.
- .7 Supply and place concrete as specified within this Section true to required line and elevation. Concrete is to be thoroughly tamped by means of steel tamping bars.

- .8 Reinforce with three 10M dowels or as indicated. Expansion joints of a 6.5 mm thick piece of bituminous fibreboard cut to the vertical dimensions of curb cross-section. Steel reinforcing shall be continuous through the joint and no splicing within 300 mm of a joint will be permitted.
- .9 Form drop curbs at the ends of curbs over a length of 1200 mm or as otherwise directed by Contract Administrator.
- .10 At street intersections form curb and gutter to a true radius as directed by Contract Administrator.
- .11 Finish outer and upper edge of all curbs with a radius of 40 mm. Finish upper face with a wood float and complete outer face with a perfectly smooth finish. All of the above work shall conform to the drawings.

### 3.4 INSTALLATION

- .12 The cast iron tactile walking surface indicator plates shall be placed and pressed into wet prepared concrete at the location of the ramp, as specified in the Contract Documents and according to the plate manufacturer's installation instructions.
- .13 The plates shall be cleaned after installation.

### 3.5 TOLERANCES

- .1 Finish surfaces to within 3 mm in 3 m as measured with 3 m straightedge placed on surface.
- .2 Tolerances for the tactile walking surface indicator plates shall be stated in the Contract Documents, in the situation where the tactile walking surface indicator plates are not within the identified tolerances, the plates shall be refused.
- .3 The rejected plates shall be removed and changed as directed by the Contract Administrator.

### 3.6 EXPANSION AND CONTRACTION JOINTS

- .1 Install tooled transverse contraction joints after floating, when concrete is stiff, but still plastic, at intervals of 2 m.
- .2 Install expansion joints as per OPSD 310.010.
- .3 When sidewalk is adjacent to curb, make joints of curb, gutters and sidewalk coincide.

### 3.7 ISOLATION JOINTS

- .1 Install isolation joints around manholes and catch basins and along length adjacent to concrete curbs, catch basins, buildings, or permanent structure.
- .2 Seal isolation joints with sealant approved by Contract Administrator.

### 3.8 CURING

- .1 Cure concrete by adding moisture continuously in accordance with CSA-A23.1/A23.2 to exposed finished surfaces for at least 1 day after placing, or sealing moisture in by curing compound as directed by Contract Administrator.
- .2 Where burlap is used for moist curing, place two prewetted layers on concrete surface and keep continuously wet during curing period.
- .3 Apply curing compound evenly to form continuous film, in accordance with manufacturer's requirements.
- .4 Have all equipment and materials needed for curing and protection of concrete on hand before actual placing of concrete commences.
- .5 After concrete has set sufficiently, keep exposed surfaces continuously moist for at least 7 consecutive days after placing.
- .6 Use one of the following means of keeping surface of concrete wet:
  - .1 Continuous application of a fine spray of water;
  - .2 Covering with burlap soaked with water intermittently so that at all times it will be wet to touch, of which Contract Administrator will be sole judge.
- .7 As surfaces are exposed due to removal of forms, similarly treat.
- .8 Use of a proprietary membrane type of curing is permitted with provision that, to prevent leaching of water of hydration to subgrade, a layer of waterproof material strong enough to withstand tearing by weight of concrete is applied to subgrade before placement of concrete. Decision of the Contract Administrator is final as to suitability of the material. Provide means for shading concrete from direct sunlight.

### 3.9 BACKFILL

- .1 Allow concrete to cure for 7 days prior to backfilling.
- .2 Backfill to designated elevations with material as directed by Contract Administrator.
  - .1 Compact and shape to required contours as directed by Contract Administrator.

### 3.10 CLEANING

- .1 Proceed in accordance with Section 01 74 11 – Cleaning.
- .2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 WORK INCLUDED**

- .1 Supply and installation of benches and bicycle rings.
- .2 Maintenance and Warranty

### **1.2 REFERENCES**

- .1 ASTM Testing Standards:
  - .1 ASTM B 108 – Standard Specification for Aluminum-Alloy Permanent Mold Castings
  - .2 ASTM B 117 – Standard Practice for Operating Salt Spray (Fog) Apparatus
  - .3 ASTM B 221 – Standard Specification for Aluminum-Alloy and Aluminum-Alloy Extruded Bars, Rod, Wire, Profiles and Tubes
  - .4 ASTM D 522 – Standard Test Methods for Mandrel Bend Test of Attached Organic Coatings
  - .5 ASTM D 523 – Standard Test Method for Specular Gloss
  - .6 ASTM D 2247 – Standard Practice for Testing Water Resistance of Coatings in 100% Relative Humidity
  - .7 ASTM D 2794 – Standard Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)
  - .8 ASTM D 3359 – Standard Test Methods for Measuring Adhesion by Tape Test
  - .9 ASTM D 3363 – Standard Test Method for Film Hardness by Pencil Test
  - .10 ASTM G 155 – Standard Practice for Operating Xenon Arc Light Apparatus for Exposure of Non-Metallic Materials
- .2 ISO Testing Standards:
  - .1 ISO 1520 – Paints and Varnishes – Cupping Test
  - .2 ISO 2815 – Paints and Varnishes – Buchholz Indentation Test
- .3 ANSI/BIFMA Testing Standards:
  - .1 ANSI/BIFMA X5.5-2008– Standard Test for Desk / Tables.

### **1.3 QUALITY ASSURANCE**

- .1 Manufacturer's Qualifications: Manufacturer regularly engaged in manufacture of site furnishings.
- .2 Product Support: Products are supported with complete engineering drawings and design patents.
- .3 Production: Orders are filled within a 40-day schedule.
- .4 Facility Operator: Welders and machine operators are certified.

## 1.4 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 in accordance with manufacturer's instructions. Keep materials in manufacturer's original, unopened containers and packaging until installation.
- .3 Handling: Protect materials and finish during handling and installation to prevent damage.

## 1.5 WARRANTY

- .1 Warranty Information:
  - .1 Products will be free from defects in material and/or workmanship for period of three (3) years from the date of invoice.
  - .2 The warranty does not apply to damage resulting from accident, alteration, misuse, tampering, negligence, or abuse.
  - .3 The Manufacturer shall, at its option, repair, replace, or refund the purchase price of any items found defective upon inspection by an authorized Manufacturer's service representative.

## **PART 2 - PRODUCTS**

### 2.1 BENCHES

- .1 Maglin Bench (or approved equivalent):
  - .1 Maglin Site Furniture Inc., 27 Bysham Park Drive, Woodstock, Ontario N4T 1P1 Canada. Toll Free: (800) 716.5506. Phone: (519) 539.6776. Fax: (877) 260.9393. Website: [www.maglin.com](http://www.maglin.com). E-mail: [sales@maglin.com](mailto:sales@maglin.com).
- .2 Benches and Planters
  - .1 Model: Maglin Pixel
- .3 Dimensions and Quantities:
  - .1 24" x 24" x 6-3/4" Planter – Quantity: 1
  - .2 24" x 24" x 24" Raised Planter – Quantity 1
  - .3 24" x 25-13/16" x 34-7/16" Style 1 Standard Back Seat with Wood Top, Square Profile, With Cladding 1 Side – Quantity: 3
  - .4 24" x 24" x 18" - Style 1 Standard Platform with Wood Top, Square profile – Quantity 2
- .4 Options:
  - .1 Finish: Gloss Silver 14
  - .2 Wood: IPE
- .5 Mounting:
  - .1 Surface Mount

- .6 Quality Assurance
  - .1 Manufacturing of site furnishings since 1983.
  - .2 Manufactured in North America.
  - .3 Products are supported with CAD drawings.
  - .4 Warranty documentation is provided.
- .7 Components
  - .1 Materials
    - .1 Bench frame made from steel.
    - .2 Tops are lpe wood.
  - .2 All steel components are protected with Maglin's automotive-grade electrocoating for superior corrosion protection.
  - .3 Maglin UV Resistant Powdercoat System provides a durable finish on all metal surfaces.
  - .4 Maglin standard paint colour: Gloss Silver 14.
  - .5 Recycled Content
    - .1 Pre-consumer material: 27%
    - .2 Post-consumer material: 28%
    - .3 Contributes to MR Credit 4.1 and 4.2

## 2.2 BIKE RACKS

- .1 Maglin Bike Rack (or approved equivalent)
  - .1 Maglin Site Furniture Inc., 27 Bysham Park Drive, Woodstock, Ontario N4T 1P1 Canada. Toll Free: (800) 716.5506. Phone: (519) 539.6776. Fax: (877) 260.9393. Website: [www.maglin.com](http://www.maglin.com). Email: [sales@maglin.com](mailto:sales@maglin.com).
  - .2 Bike Rack
    - .1 Model: MBR200-S Bike Rack
  - .3 Dimensions:
    - .1 Height: 35.94" (91.3 cm)
    - .2 Diameter: 16.63" (42.2 cm)
    - .3 Weight: 18.45lbs (8.37kg)
- .2 Options:
  - .1 Powdercoat Colour: Gloss Silver 14
  - .2 Base Type: Surface Mount (MBR200-S)
  - .3 Centre Arm
- .3 Quality Assurance
  - .1 Manufacturing of site furnishings since 1983.
  - .2 Manufactured in North America.
  - .3 Products are supported with CAD drawings.
  - .4 Warranty documentation is provided.
- .4 Components
  - .1 Materials: Bike racks constructed using H.S. steel tube.
  - .2 All steel components are protected with Maglin's automotive-grade electrocoating for superior corrosion protection.
  - .3 Maglin UV Resistant Powdercoat System provides a durable finish on all metal surfaces.
  - .4 Maglin standard paint colour Black.

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### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- .1 Notify Consultant of source of material at least 7 days in advance of commencement of work to approve materials and layout of site furnishings. No work is to proceed without Consultant's approval.
- .2 Install furnishings square and plumb as shown on the drawing.
- .3 Bike Rack Anchoring: surface mounted onto concrete pad, fasteners and method as specified by manufacturer.
- .4 Bench Anchoring: surface mounted onto concrete pad, fasteners and method as specified by manufacturer.
- .5 Use vandal proof fasteners.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 RELATED SECTIONS**

- .1 Section 01 11 00 – Summary of Work.
- .2 Section 01 74 21 – Construction/Demolition Waste Management and Disposal.
- .3 Section 31 22 13 – Rough Grading.

### **1.2 REFERENCES**

- .1 City of Guelph Linear Infrastructure Standards (2018) (CoGLIS)
  - .1 Section 1 – Standard Specifications
  - .2 Section 2 – Special Provisions
- .2 Specifications below are to be used except as modified by CoGLIS
- .3 Agriculture and Agri-Food Canada
  - .1 The Canadian System of Soil Classification, Third Edition, 1998.
- .4 Canadian Council of Ministers of the Environment
  - .1 PN1340-2005, Guidelines for Compost Quality.
- .5 Ontario Provincial Standard Specifications (OPSS)
  - .1 OPSS 805, Construction Specification for Temporary Erosion and Sediment Control Measures.

### **1.3 DEFINITIONS**

- .1 Compost:
  - .1 Mixture of soil and decomposing organic matter used as fertilizer, mulch or soil conditioner.
  - .2 Compost is processed organic matter containing 40% or more organic matter as determined by Walkley-Black or Loss On Ignition (LOI) test.
  - .3 Product must be sufficiently decomposed (i.e. stable) so that any further decomposition does not adversely affect plant growth (C:N ratio below 25) and contain no toxic or growth inhibiting contaminants.
  - .4 Composed bio-solids to: CCME Guidelines for Compost Quality, Category (A)(B).

### **1.4 SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 11 00 – Summary of Work.
- .2 Quality Control Submittals
  - .1 Soil Testing: submit certified test showing compliance with specified performance characteristics and physical properties as described in Part 2 – Source Quality Control.
  - .2 Certificates: submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

## **1.5 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate waste materials for reuse in accordance with Section 01 74 21.
- .2 Divert unused soil amendments from landfill to official hazardous material collections site approved by Contract Administrator.
- .3 Do not dispose of unused soil amendments into sewer systems, into lakes, streams, onto ground or in locations where it will pose health or environmental hazard.

## **PART 2 - PRODUCTS**

### **2.1 TOPSOIL**

- .1 Topsoil for seeded, sodded and planting beds: mixture of particulates, micro organisms and organic matter which provides suitable medium for supporting intended plant growth.
  - .1 Soil texture based on The Canadian System of Soil Classification, to consist of 45% sand, minimum 20% clay, 35% silt, and contain 4% organic matter by weight.
  - .2 Contain no toxic elements or growth inhibiting materials.
  - .3 Finished surface free from:
    - .1 Debris and stones over 20 mm diameter.
    - .2 Course vegetative material, 10 mm diameter and 100 mm length, occupying more than 2% of soil volume.
  - .4 Consistence: friable when moist.

### **2.2 SOIL AMENDMENTS**

- .1 Fertilizer:
  - .1 Fertility: major soil nutrients present in following amounts:
  - .2 Nitrogen (N): 10%.
  - .3 Phosphorus (P): 6%.
  - .4 Potassium (K): 4%.
  - .5 Calcium, magnesium, sulfur and micro-nutrients present in balanced ratios to support germination and/or establishment of intended vegetation.
  - .6 Ph value: 6.5 to 8.0.
- .2 Peatmoss:
  - .1 Derived from partially decomposed species of Sphagnum Mosses.
  - .2 Elastic and homogeneous, brown in colour.
  - .3 Free of wood and deleterious material which could prohibit growth.
  - .4 Shredded particle minimum size: 5 mm.
- .3 Sand: washed coarse silica sand, medium to course textured.
- .4 Organic matter: compost Category A, in accordance with CCME PN1340, unprocessed organic matter, such as rotted manure, hay, straw, bark residue or sawdust, meeting the organic matter, stability and contaminant requirements.

- .5 Limestone:
  - .1 Ground agricultural limestone.
  - .2 Gradation requirements: percentage passing by weight, 90% passing 1.0 mm sieve, 50% passing 0.125 mm sieve.
- .6 Fertilizer: industry accepted standard medium containing nitrogen, phosphorous, potassium and other micro-nutrients suitable to specific plant species or application or defined by soil test.

### **PART 3 - EXECUTION**

#### **3.1 TEMPORARY EROSION AND SEDIMENTATION CONTROL**

- .1 Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, in accordance with OPSS 805.
- .2 Inspect, repair and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.
- .3 Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

#### **3.2 PREPARATION OF EXISTING GRADE**

- .1 Verify that grades are correct.
  - .1 If discrepancies occur, notify Contract Administrator and do not commence work until instructed by Contract Administrator.
- .2 Grade soil, eliminating uneven areas and low spots, ensuring positive drainage.
- .3 Remove debris, roots, branches, stones in excess of 20 mm diameter and other deleterious materials.
  - .1 Remove soil contaminated with calcium chloride, toxic materials and petroleum products.
  - .2 Remove debris that protrudes more than 20 mm above surface.
  - .3 Dispose of removed material off site.
- .4 Cultivate entire area which is to receive topsoil to minimum depth of 100 mm.
  - .1 Cross cultivate those areas where equipment used for hauling and spreading has compacted soil.

#### **3.3 PLACING AND SPREADING OF TOPSOIL/ PLANTING SOIL**

- .1 Place topsoil after Contract Administrator has accepted subgrade.
- .2 Spread topsoil in uniform layers not exceeding 150 mm.
- .3 For sodded areas keep topsoil 15 mm below finished grade.

- .4 Spread topsoil to following minimum depths after settlement.
  - .1 150 mm for seeded areas.
  - .2 .2135 mm for sodded areas.
  - .3 .3500 mm for shrub beds and reforestation beds.
- .5 Manually spread topsoil/planting soil around trees, shrubs and obstacles.

### **3.4 SOIL AMENDMENTS**

- .1 For planting beds turf: apply and thoroughly mix soil amendments into full specified depth of topsoil at rates determined by soil analysis.

### **3.5 FINISH GRADING**

- .1 Grade to eliminate rough spots and low areas and ensure positive drainage.
  - .1 Prepare loose friable bed by means of cultivation and subsequent raking.
- .2 Consolidate topsoil to required bulk density using equipment approved by Contract Administrator.
  - .1 Leave surfaces smooth, uniform and firm against deep footprinting.

### **3.6 ACCEPTANCE**

- .1 Contract Administrator will inspect and test topsoil in place and determine acceptance of material, depth of topsoil and finish grading.

### **3.7 SURPLUS MATERIAL**

- .1 Dispose of materials except topsoil not required off site.

### **3.8 CLEANING**

- .1 Upon completion of installation, remove surplus materials, rubbish, tools, and equipment barriers.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 RELATED SECTIONS**

- .1 Section 32 91 19.13 - Topsoil Placement and Grading.

### **1.2 REFERENCES**

- .1 City of Guelph Linear Infrastructure Standards (2018) (CoGLIS)
  - .1 Section 1 – Standard Specifications
  - .2 Section 2 – Special Provisions
- .2 Specifications below are to be used except as modified by CoGLIS
  - .1 Ontario Provincial Standard Specifications (OPSS)
  - .2 OPSS 803, Construction Specification for Sodding.

### **1.3 SCHEDULING**

- .1 Schedule sod laying to coincide with preparation of soil surface.
- .2 Schedule sod installation when frost is not present in ground.

### **1.4 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate and recycle waste materials in accordance with Section 01 74 21.
- .2 Divert unused fertilizer from landfill to official hazardous material collections site approved by Contract Administrator.
- .3 Do not dispose of unused fertilizer into sewer systems, into lakes, streams, onto ground or in locations where it will pose health or environmental hazard.

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS**

- .1 Commercial Grade Turfgrass Nursery Sod: Commercial turfgrass nursery sod is grass that has been seeded and cultivated in nursery sod fields as a turfgrass sod. At the time of sale, Commercial Grade Turfgrass Nursery Sod is to be in a healthy condition.
  - .1 Sod may contain up to 5 broadleaf weeds per 40 square metres and up to 20% native grasses.
  - .2 Sod should be of sufficient shoot density that no surface soil will be visible from a standing position when mowed to a height of 4 centimetres.
  - .3 The mowing height range should be 3 to 7 centimetres.
  - .4 The thickness of the soil portion of the sod should not exceed 1.5 centimetres.
  - .5 Required Seed mixture:
    - .1 60-70% Kentucky bluegrass cultivars
    - .2 30-40% creeping red, chewings, or hard fescue cultivars.

### **PART 3 - EXECUTION**

#### **3.1 PREPARATION**

- .1 Verify that grades are correct and prepared in accordance with Section 32 91 19.13 - Topsoil Placement and Grading. If discrepancies occur, notify Contract Administrator and do not commence work until instructed by Contract Administrator.
- .2 Do not perform work under adverse field conditions such as frozen soil, excessively wet soil or soil covered with snow, ice, or standing water.
- .3 Fine grade surface free of humps and hollows to smooth, even grade, to elevations indicated, to tolerance of plus or minus 8 mm, for Turf Grass Nursery Sod, surface to drain naturally.
- .4 Remove and dispose of weeds; debris; stones 20 mm in diameter and larger; soil contaminated by oil, gasoline and other deleterious materials; off site.

#### **3.2 SOD PLACEMENT**

- .1 Lay sod within 24 hours of being lifted if air temperature exceeds 20 degrees C.
- .2 Lay sod sections in rows, joints staggered. Butt sections closely without overlapping or leaving gaps between sections. Cut out irregular or thin sections with sharp implements.
- .3 Roll sod as directed by Contract Administrator. Provide close contact between sod and soil by light rolling. Use of heavy roller to correct irregularities in grade is not permitted.

#### **3.3 ACCEPTANCE**

- .1 Turf Grass Nursery Sod areas will be accepted by Contract Administrator provided that:
  - .1 Sodded areas are properly established.
  - .2 Sod is free of bare and dead patches.
  - .3 No surface soil is visible from height of 1500 mm when grass has been cut to height of 75 mm.
  - .4 Sodded areas have been cut a minimum of 2 times prior to acceptance.
- .2 Areas sodded in fall will be accepted in following spring one month after start of growing season provided acceptance conditions are fulfilled.

#### **3.4 CLEANING**

- .1 Upon completion of installation, remove surplus materials, rubbish, tools and equipment barriers.

END OF SECTION

## **PART 1 - GENERAL**

### **1.1 WORK INCLUDED**

- .1 Preparation of planting beds, spreading of topsoil and planting mix prior to planting operations.
- .2 Plant material.
- .3 Pruning, guying and mulching of trees, shrubs and perennials.
- .4 Protection of trees, shrubs and surrounding areas.
- .5 Cleaning and reinstatement of the area of Work.
- .6 Warranty of plant material.

### **1.2 RELATED SECTIONS**

- .1 Section 32 91 19.13 – Topsoil Placement
- .2 Section 32 92 23 – Sodding

### **1.3 REFERENCES**

- .1 Canadian Nursery and Landscape Association: Canadian Standards for Nursery Stock 8th Edition, 2008
- .2 ANSI Z-133-1; American Standards for Tree Care Operations
- .3 ANSI A-300; Tree Pruning Guidelines
- .4 Landscape Ontario Horticultural Trades Association, Landscape Standards
- .5 Ontario Provincial Standards: OPS 801

### **1.4 QUALITY ASSURANCE**

- .1 Soil mediums (Topsoil; Planting Mixes) and organic amendments must be tested by an OMAFRA accredited agency and approved prior to use. Test topsoil for P, K, Ca and Mg, minor element values, soluble salt content, organic matter, texture and pH value. Submit test results and analysis including recommendations for amendments and fertilizer to the Landscape Architect.
- .2 The Work will be carried out by specialist firms engaged in the type of work specified and using workers skilled in the various aspects of tree and shrub growing and transplanting.
- .3 No substitutions for plant material as indicated on planting plan will be allowed unless written approval has been obtained from the Owner as to type, variety and size. Proposed substitutions must be of similar species and of equal size as those originally specified.

## 1.5 DELIVERY STORAGE AND HANDLING

### .1 Delivery

- .1 Plant material should be protected during delivery to prevent damage to branches, root ball or desiccation of leaves.
- .2 Movement of container grown, ball and burlap (B&B) and wire-basketed (WB) plants should be restricted to closed van or well-covered truck with mesh tarpaulin or similar material to protect the leaves or needles from windburn or desiccation. If plants will be in transit for more than one day, they should be unloaded at interim points and stored away from direct sun for 24 hours at each interim point to avoid burning. When plants may be subject to wind during transportation and storage, tarpaulins and other protective measures may be supplemented by spraying the foliage with an antidesiccant prior to shipping.
- .3 Unloading Procedures
  - .1 Pots / Containers: Should be handled by the container only to reduce breakage of branches, leaves and root ball. Container plants will not be held by the tops, stems or trunks.
  - .2 Ball & Burlap: Should be handled with caution to maintain the firmness of the root balls. Protect against damage to trunk, stems and branches.
  - .3 All plants should be unloaded and checked immediately upon arrival and watered if necessary. The supplier should be notified immediately both verbally and in writing of any plant damage.
  - .4 Plant material will not be dropped, thrown or handled roughly.

### .2 Handling and Storage

- .1 Plants and roots will be kept in a moist condition at all times. All plants will be well protected against damage, extreme temperatures, desiccation and theft.
- .2 Protection Against Stem and Branch Damage
  - .1 If damage occurs, it will be reported to the Authority immediately. If the Authority determines that the plant is acceptable despite the damage, proposed corrective measures should be carried out in accordance with arboricultural practices recognized by the International Society of Arboriculture and Landscape Ontario.
- .3 During Growing Season
  - .1 All plants in containers, balled & burlapped, or wire basket, if not planted immediately, will be stored in a secure upright position. Care should be taken to provide enough space between plants so that light reaches all around to the bottom of the plant in order to avoid sunscald or burning when the plants are planted out.
  - .2 Balled & Burlapped Plants: Special attention should be given to the rootball, and unless weather is rainy or cool, rootballs will be protected by heeling-in into material suitable (Examples: straw, peat moss, topsoil) to protect them from drying out. Plants intended to be planted in the open will not be kept stored in a building or any area of low light intensity for a prolonged period. All plants will be kept well watered and protected from extreme temperatures.
  - .3 Containerized plants will be covered in a protective medium such as straw, peat moss or topsoil in extreme weather such as freezing or high dry heat. Plants will not be kept stored in a building, truck, or any area of low light intensity for a prolonged period during the growing season.
  - .4 Plants will not be taken directly from the greenhouse and planted in a drastically different environment. Such plants will be acclimatized or "hardened off" against the environmental conditions of their final planting location.

- .5 Preparation for the new environment should include an appropriate period of storage in an intermediate environment, managing fertilizer applications to avoid excessive growth, and a graduated watering program.
- .4 During Dormant Period
  - .1 Plants will be cared for according to the species requirements for winter protection, geographic location and hardiness.

## 1.6 ACCEPTANCE

- .1 Growing medium, fertility levels, depths and surface grading are as specified.
- .2 Plant quantities, species, sizes, quality and locations are as shown in the contract documents or as otherwise specified. All approved substitutions will be noted. An approved list of substitutions will be provided to the Landscape Architect at the time of acceptance.
- .3 All plants are installed properly, vertical and at the correct level relative to the finished grade.
- .4 Pruning is completed where required. All pruning cuts will be made with a sharp tool.
- .5 Mulch is in place as required. Unmulched areas are cultivated to leave a loose, friable, water permeable surface. All planted areas are free of visible weeds, and substantially free of underground weed parts.

## 1.7 WARRANTY

- .1 All shrubs planted will be under warranty for a period of 24 months commencing on the Date of Acceptance.
- .2 All plant materials used as replacement for unacceptable plant materials will be of the same quality and requirements prescribed for original material.
- .3 A plant will be assumed to be acceptable when it is structurally sound, when it is well furnished with living foliage, when it has normal colour, when it shows adequate annual growth and formation of buds and when it is free from blight of any description. Plant material which has exhibits die back of more than 10% of its branch area or has regrown from a bud or shoot will be considered dead and unacceptable.
- .4 Plants which have died during the period of warranty will be replaced at no cost to the Owner as soon as possible. Dead plant material replaced under warranty will be removed from the Work site at the Contractor's expense.
- .5 Plant material replaced under warranty will conform to all specifications of the original contract including the warranty of 24 months from the date of planting.
- .6 Replacement of materials broken or damaged due to circumstances beyond the Contractor's control after completion will not be an obligation under this warranty. The Contractor is responsible for watering during severe drought and will be considered as being within the control of the Contractor during the warranty period.

## **PART 2 - PRODUCTS**

### **2.1 PLANT MATERIAL**

- .1 Plant material: comply with The Canadian Nursery and Landscape Association Canadian Standards for Nursery Stock, Eighth Edition, 2008, referring to:
  - .1 Standard container sizes.
  - .2 Digging standards.
  - .3 Rootball diameters, depths, weights.
  - .4 Recommended container sizes by plant type.
  - .5 Height relationship to caliper by type size and development of plant material and root ball.
  - .6 Age of plant.

### **2.2 PLANT TOPSOIL**

- .1 Topsoil will be fertile, friable, topsoil, free of: fragments larger than 75 mm in size; stones over 30mm in diameter; debris; plants or their roots; sticks; noxious weed plants/stolons/seeds; salts; soil sterilants; chemical contaminants; or other materials detrimental to plant growth.
- .2 Topsoil will have the following characteristics: textural class of sandy loam; pH range of 6.0 – 7.5; not less than 5.0% Organic Matter; salt conductivity, salt less than 2.0 ms/cm (millisiemens/cm) Total Salts. Topsoil not meeting the minimum specification must be amended and retested. Fertilizer and mineral amendments must be made as per soil testing agency recommendations.
- .3 Topsoil will not be moved, delivered or worked on while in a frozen, wet or muddy state or condition.

### **2.3 PLANTING MIXES**

- .1 Planting Mix will be thoroughly combined prior to placement in planting bed areas to the following proportions: 4 parts approved topsoil and 1 part organic amendment (compost, manure, peatmoss, etc.).
- .2 Amendments will have the following characteristics: pH range of 6.0 – 7.5; a minimum of 60% Organic Matter; salt conductivity, salt less than 2.0 ms/cm (millisiemens/cm) Total Salts; maximum moisture content of 35%.
- .3 Compost and manure will meet the standards found in the Interim Guidelines for the Production and Use of Aerobic Compost in Ontario published by the Ontario Ministry of Environment (MOE), and will be virtually free from all viable weed seeds, or other plant reproductive parts, pathogens, chemicals or toxic contaminants. Physical contaminants such as rock, plastic, metal or glass will be less than 0.5%. Total carbon to nitrogen ratio in the resulting growing medium will not exceed 30:1.
- .4 Mixes containing a significant amount of peat moss will not be permitted to dry out. The moisture content of the peat moss at the time of mixing will be not less than 60% to 75%.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- .1 Verify field conditions are ready to receive work.
- .2 Clearly identify all plant material upon site delivery, using labels indicating species, size and supplier.
- .3 Beginning of installation implies acceptance of existing conditions.
- .4 Co-ordinate operations with appropriate trades and work.
- .5 Keep site clean and planting holes drained.
- .6 Erect physical protection barriers, silt fences, shade or erosion protection at the edge of the protection boundaries before any work occurs on site.
- .7 Physical protection barriers will meet all applicable municipal by laws and regulatory requirements.
- .8 Protect adjacent walls, walks and utilities from damage or staining. Remove soil and debris spilled onto pavement immediately.

#### **3.2 PLANTING TIME AND PREPARATION FOR PLANTING**

- .1 Perform planting during periods suitable with respect to weather conditions and locally accepted practice. Do NOT plant bare root plant material until all evidence of frost has left the ground site.
- .2 Bareroot material will not be planted between May 15 and October 15. Plant material imported from region with warmer climatic conditions may only be planted in early spring.
- .3 Ensure that watering facilities are available. Take particular care and use anti-desiccant when planting during heat of summer.
- .4 Plant only under conditions that are conducive to health and physical conditions of plants.
- .5 Plant material noted for spring planting only must be planted in dormant period.
- .6 Excavate planting beds to a depth of 450 mm below the top of the planting bed curb. "Woodland" beds will be filled with 400 mm of approved topsoil with an allowance for 100 mm of mulch and settlement. All other beds will receive approved topsoil and planting mix with one of the following methods.
- .7 Place 350 mm of approved topsoil followed by 50 mm of approved organic amendment. Rototill or otherwise thoroughly mix the amendment into the top 150 to 200 mm of topsoil.
- .8 Place 200 mm of approved topsoil followed by 200 mm of approved planting mix. Lightly rototill or otherwise loosely combine the planting mix with some of the topsoil below to prevent sharp distinction in soil types.

#### **3.3 PLANTING**

- .1 Planting will not be performed during weather conditions that may adversely affect material.
- .2 Installer will be a specialist in installing and planting landscape products with experience performing landscape work.

- .3 Plants will be planted so that after settlement the level of the adjacent growing medium surface matches the level of the original growing medium surface in the nursery. The soil mark on the stem or container soil level is an indication of this, and it will be maintained on the finished level, allowing for settling of the growing medium after planting. The total depth of the root ball will be planted in growing medium.
- .4 Plants will be set plumb in the planting beds or in the centre of the pits, except where the plant's character requires variation from this.
- .5 Root balls will be placed on the undisturbed subgrade to prevent settling.
- .6 If no other factors come into play, the plant should be oriented in the same direction that it was grown in the nursery. Face the lowest branch away from the greatest traffic (pedestrian and vehicular); and position the plant for best viewing.
- .7 Growing medium will be placed preferably by hand in layers around the roots or ball. Each layer will be carefully tamped so as to avoid injuring the roots or ball, or disturbing the position of the plant. The hole should be backfilled and gently tamped so that no air pockets are left around the ball.
- .8 When growing medium is up to about two-thirds of the rootball height, all ties will be cut and the top one-third of burlap on B&B plants will be cut off or folded back carefully, so as not to disturb the rootball integrity. No burlap will show above grade.
- .9 All string, rope, burlap and other restricting elements will be cut and removed out to the perimeter of the rootball. All wire basket handles will be cut off flush with the top ring or folded back down into the planting hole. Wire baskets should not be removed. Any visible portion should be folded down away from the rootball and buried. If the wire basket is oversized such that the top wire is higher, then basket will be cut back. No wires will protrude into the top 100 mm of soil.
- .10 Top lacing will not be left in place at the time of planting.
- .11 A 100 mm raised saucer should be constructed over the rootball to enhance water infiltration. All planting hole depths should only be dug deep enough to accommodate the root system or root mass at the desired depth relative to the surrounding grade. Plant tree with the root collar at the same level as the surrounding ground.

### **3.4 WATERING AND PRUNING**

- .1 Watering will be carried out when required and with sufficient quantities relative to specific plant needs to prevent plants and the underlying growing medium from drying out. Plants will be thoroughly watered at the time of planting and continue throughout the warranty period as required for plant establishment and vigor.
- .2 Pruning at the time of planting will be limited to the minimum necessary to remove dead, diseased, broken or injured branches.
- .3 Any corrective pruning (double leader) will be done in such a manner as to preserve the natural character of the plants.
- .4 Only clean, sharp tools will be used. Tools should be sterilized between cuts of different plants.
- .5 All cuts will be clean and cut to the branch collar, leaving no stubs.

END OF SECTION

## **PART 1- GENERAL**

### **1.1 SECTION INCLUDES**

- .1 Materials and installation for water mains, hydrants, valves, valve boxes, and valve chambers, including service connections.

### **1.2 RELATED SECTIONS**

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 03 30 00 - Cast-in-Place Concrete.
- .3 Section 01 74 21 – Construction/Demolition Waste Management and Disposal.
- .4 Section 01 78 00 - Closeout Submittals.
- .5 Section 31 23 33.01 - Excavating, Trenching and Backfilling.

### **1.3 REFERENCES**

- .1 City of Guelph Linear Infrastructure Standards (2018) (CoGLIS)
  - .1 Section 1 – Standard Specifications: SS-200
- .2 Specifications below are to be used except as modified by CoGLIS
- .3 American National Standards Institute/American Water Works Association (ANSI/AWWA)
  - .1 ANSI/AWWA B300-10, Standard for Hypochlorites.
  - .2 ANSI/AWWA B301-10, Standard for Liquid Chlorine.
  - .3 ANSI/AWWA B303-10, Standard for Sodium Chlorite.
  - .4 ANSI/AWWA C104/A21.4-08, Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings.
  - .5 ANSI/AWWA C105/A21.5-10, Standard for Polyethylene Encasement for Ductile-Iron Pipe Systems.
  - .6 ANSI/AWWA C111/A21.11-07, American National Standard for Rubber-Gasket Joints for Ductile-Iron and Fittings.
  - .7 ANSI/AWWA C110/A21.10-08, American National Standard for Ductile-Iron and Gray Iron Fittings for Water.
  - .8 ANSI/AWWA C150/A21.50-08, Standard for Thickness Design of Ductile-Iron Pipe.
  - .9 ANSI/AWWA C151/A21.51-09, Standard for Ductile-Iron Pipe, Centrifugally Cast.
  - .10 ANSI/AWWA C153/A21.53-11, Standard for Ductile-Iron Compact Fittings.
  - .11 ANSI/AWWA C200-05, Standard for Steel Water Pipe - 6 Inch (150 mm) and Larger.
  - .12 ANSI/AWWA C203-08, Standard for Coal Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot Applied.
  - .13 ANSI/AWWA C205-07, Standard for Cement-Mortar Protective Lining and Coating for Steel Water Pipe - 4 Inch (100 mm) and Larger - Shop Applied.
  - .14 ANSI/AWWA C206-11, Standard for Field Welding of Steel Water Pipe.

- .15 ANSI/AWWA C207-07, Standard for Steel Pipe Flanges for Waterworks Service, 4 Inch through 144 Inch (100 mm through 3,600 mm).
- .16 ANSI/AWWA C208-07, Standard for Dimensions for Fabricated Steel Water Pipe Fittings.
- .17 ANSI/AWWA C300-11, Standard for Reinforced Concrete Pressure Pipe, Steel-Cylinder Type.
- .18 ANSI/AWWA C301-07, Standard for Prestressed Concrete Pressure Pipe, Steel-Cylinder Type.
- .19 ANSI/AWWA C303-08, Standard for Concrete Pressure Pipe, Bar-Wrapped, Steel-Cylinder Type.
- .20 ANSI/AWWA C500-09, Standard for Metal-Seated Gate Valves for Water Supply Service.
- .21 ANSI/AWWA C502-05, Standard for Dry-Barrel Fire Hydrants.
- .22 ANSI/AWWA C504-10, Standard for Rubber-Seated Butterfly Valves.
- .23 ANSI/AWWA C509-09, Standard for Resilient-Seated Gate Valves for Water Supply Service.
- .24 ANSI/AWWA C510-07, Standard for Double Check Valve Backflow Prevention Assembly.
- .25 ANSI/AWWA C600-10, Standard for Installation of Ductile-Iron Water Mains, and Their Appurtenances.
- .26 ANSI/AWWA C602-11, Standard for Cement-Mortar Lining of Water Pipelines - 4 Inch (100 mm) and Larger.
- .27 ANSI/AWWA C651-05, Standard for Disinfecting Water Mains.
- .28 ANSI/AWWA C800-05, Standard for Underground Service Line Valves and Fittings.
- .29 ANSI/AWWA C900-07, Standard for Polyvinyl Chloride (PVC) Pressure Pipe, and Fabricated Fittings, 4 Inch through 12 Inch (100 mm - 300 mm), for Water Transmission and Distribution.
- .30 ANSI/AWWA C905-10, Standard for Polyvinyl Chloride (PVC) Pressure Pipe, and Fabricated Fittings, 350 mm Through 1,200 mm (14 in. Through 48 in.), for Water Transmission and Distribution.
- .31 ANSI/AWWA C907-12, Standard for Injection Molded Polyvinyl Chloride (PVC) Pressure Fittings, 100 mm Through 300 mm (4 in. Through 12 in.), for Water Transmission and Distribution.
- .32 ANSI/AWWA C909-09, Standard for Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe, 100 mm Through 600 mm (4 in. Through 24 in.), for Water Transmission and Distribution.
- .4 American Society for Testing and Materials International, (ASTM)
  - .1 ASTM A 53/A 53M-10, Standard Specification for Pipe, Steel, Black and Hot Dipped, Zinc Coated, Welded and Seamless.
  - .2 ASTM A 123/A 123M-09, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
  - .3 ASTM A 307-10, Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile.
  - .4 ASTM B 88M-05(2011), Standard Specification for Seamless Copper Water Tube Metric.
  - .5 ASTM C 117-04, Standard Test Methods for Material Finer Than 0.075 mm (No. 200) Sieve in Mineral Aggregates by Washing.
  - .6 ASTM C 136-06, Standard Method for Sieve Analysis of Fine and Coarse Aggregates.
  - .7 ASTM C 478M-11, Standard Specification for Precast Reinforced Concrete Manhole Sections Metric.
  - .8 ASTM D 698-07e1, Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft<sup>2</sup> (600 kN-m/m<sup>3</sup>)).
  - .9 ASTM D 2310-06, Standard Classification for Machine-Made "Fiberglass" (Glass-Fiber-Reinforced Thermosetting Resin) Pipe.
  - .10 ASTM D 2657-07, Standard Practice for Heat Fusion Joining of Polyolefin Pipe and Fittings.
  - .11 ASTM D 2992-06, Standard Practice for Obtaining Hydrostatic or Pressure Design Basis for "Fiberglass" (Glass-Fiber-Reinforced Thermosetting Resin) Pipe and Fitting.
  - .12 ASTM D 2996-01(2007) e1, Standard Specification for Filament-Wound "Fiberglass" (Glass-Fiber-Reinforced Thermosetting Resin) Pipe.

- .13 ASTM F 714-10, Standard Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter.
- .14 ASTM C 618-08a, Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
- .5 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-8.1-88, Sieves, Testing, Woven Wire, Inch Series.
  - .2 CAN/CGSB-8.2-M88, Sieves, Testing, Woven Wire, Metric.
  - .3 CAN/CGSB-34.1-94, Pipe, Asbestos Cement, Pressure.
  - .4 CGSB 41-GP-25M-77, Pipe, Polyethylene, for the Transport of Liquids.
  - .5 CAN/CGSB-1.88-92, Gloss Alkyd Enamel, Air Drying and Baking.
- .6 American Water Works Association (AWWA)/Manual of Practice
  - .1 AWWA M9-2008, Concrete Pressure Pipe.
  - .2 AWWA M11-2004, Steel Pipe - A Guide for Design and Installation.
  - .3 AWWA M17-2006, Installation, Field Testing, and Maintenance of Fire Hydrants.
- .7 Canadian Standards Association (CSA International)
  - .1 CAN/CSA-A257 Series-09, Standards for Concrete Pipe (Consists of A257.0, A257.1, A257.2, A257.3 and A257.4).
  - .2 CAN/CSA-A3000-08, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).
  - .3 CSA G30.18-09, Carbon and Steel Bars for Concrete Reinforcement.
  - .4 CSA B137 Series-09, Thermoplastic Pressure Piping Compendium. (Consists of B137.0, B137.1, B137.2, B137.3, B137.4, B137.4.1, B137.5, B137.6, B137.8, B137.9, B137.10, B137.11 and B137.12).
  - .1 CSA B137.3-09, Rigid Polyvinyl Chloride (PVC) Pipe for Pressure Applications.
- .8 Underwriters' Laboratories of Canada (ULC)
  - .1 CAN/ULC-S520-07, Standard for Fire Hydrants.
  - .2 CAN4-S543-1984, Internal-Lug, Quick Connect Couplings for Fire Hose.
- .9 Ontario Provincial Standard Specifications (OPSS)
  - .1 OPSS 441, Construction Specification for Watermain Installation in Open Cut.
  - .2 OPSS 1010, Material Specification for Aggregates – Base, Sub-base, Select Subgrade, and Backfill Material.
- .10 Ontario Provincial Standard Drawings (OPSD)
  - .1 OPSD 217.050, Access to Hydrant Across Ditch.
  - .2 OPSD 1103.010, Concrete Thrust Blocks for Tees, Plugs, and Horizontal Bends.
  - .3 OPSD 1103.020, Concrete Thrust Blocks for Vertical Bends.
  - .4 OPSD 1105.010, Hydrant Installation.

## **1.4 SUBMITTALS**

- .1 Submit shop drawings in accordance with Section 01 33 00.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for distribution piping materials and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2 Pipe certification to be on pipe.
- .3 Shop Drawings:
  - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
  - .2 Submit complete drawings and construction schedule for water mains 600 mm diameter and larger. Include method for installation of water main.
- .4 Samples:
  - .1 Submit manufacturer's test data and certification that pipe materials meet requirements of this section 4 weeks minimum prior to beginning work. Include manufacturer's drawings, information and shop drawings where pertinent.
- .5 Pipe certification to be on pipe.
- .6 For all watermain sections with a nominal diameter larger than 300 mm, a minimum of fifteen (15) days before commencing the installation of watermain, the Contractor shall supply, for the selected pipe manufacturer, a Construction Report prepared and sealed by a professional engineer. This report shall include, but is not limited to:
  - .1 A letter of product compliance.
  - .2 Pipe design calculations.
  - .3 A summary of required fittings and methods of restraint.
  - .4 An installation guide.
  - .5 Shop drawings, including restraint lengths, etc.

## **1.5 CLOSEOUT SUBMITTALS**

- .1 Provide data to produce record drawings, including directions for operating valves, list of equipment required to operate valves, details of pipe material, location of air and vacuum release valves, hydrant details, maintenance and operating instructions in accordance with Section 01 78 00.
  - .1 Include top of pipe, horizontal location of fittings and type, valves, valve boxes, valve chambers and hydrants.

## **1.6 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate waste materials for recycling in accordance with Section 01 74 21.
- .2 Divert unused aggregate materials from landfill to facility for reuse as approved by the Contract Administrator.
- .3 Dispose of unused disinfection material at official hazardous material collections site approved by the Contract Administrator.

- .4 Do not dispose of unused disinfection material into sewer system, into streams, lakes, onto ground or in other location where they will pose health or environmental hazard.
- .5 Fold up metal banding, flatten and place in designated area for recycling.

## **1.7 SCHEDULING OF WORK**

- .1 Schedule Work to minimize interruptions to existing services.
- .2 Submit schedule of expected interruptions to Contract Administrator, University of Guelph Representative and the City of Guelph for approval and adhere to interruption schedule as approved by the City of Guelph in accordance with Section 01 11 00.
- .3 Notify Contract Administrator, University of Guelph Representative, the City of Guelph and Guelph Fire Chief a minimum of 48 hours in advance of any planned interruption in service or water supply to hydrants. Emergency Services to be notified.
- .4 Do not interrupt water service for more than 3 hours and confine this period between 10:00 and 16:00 local time unless otherwise authorized.
- .5 Notify Contract Administrator, University of Guelph Representative, the City of Guelph and Guelph Fire Chief of any accidental interruption of water supply to hydrants.
- .6 Provide "Out of Service" sign on hydrant not in use.
- .7 Advise Contract Administrator, University of Guelph Representative, local and/or Campus police department and the City of Guelph of anticipated interference with movement of traffic on campus/municipal roads.

## **PART 2 – PRODUCTS**

### **2.1 PIPE, JOINTS AND FITTINGS**

- .1 Polyvinyl chloride pressure pipe: to ANSI/AWWA C900, pressure class 150, DR 18, 1 MPa gasket bell end.
  - .1 CSA-B137.3, PVC series 160, 1.1 MPa elastomeric gasket coupling.
- .2 Ductile iron fittings: to ANSI/AWWA C153/A21.53, and for pipe diameters larger than NPS4 cement mortar lined to ANSI/AWWA C104/A21.4.

### **2.2 VALVES AND VALVE BOXES**

- .1 Valves to open clockwise.
- .2 Gate valves: to ANSI/AWWA C509, standard iron body, bronze mounted wedge valves with non-rising stems, suitable for 1 Pa with flanged joints.
- .3 All gate valves to be supplied with either a two-part spray epoxy coating or a fusion bonded epoxy coating, factory applied to both the interior and exterior surfaces of the valve as per ANSI/AWWA C550.

- .4 The pressure rating for gate valves to be 1380 kPa for valves 75 mm to 300 mm inclusive.
- .5 Nuts and bolts for valve bodies/bonnets and gland rings to be Type 316 stainless steel.
- .6 One-piece plastic valve boxes (Mueller MVB Composite Valve Box or approved equal) adjustable over minimum of 450 mm complete with valve operating extension rod, 30 mm minimum diameter, 25 x 25 mm cross section, of such length that when set on valve operating nut top of rod will not be more than 150 mm below cover.
- .7 Base to be large round type with minimum diameter of 300 mm.
- .8 Top of box to be marked "WATER"/"EAU".
- .9 used in conjunction with a 100mm road leveller (Bibby VB717 or approved equal).
- .10 The valve box castings must have a tensile strength of not less than 138 MPa.
- .11 Valve boxes must be solid with clean surfaces, free from scales, bumps, flows, blow holes, or other defects.
- .12 After cleaning and inspections, valve boxes must be thoroughly coated with an approved casting paint.

## **2.3 PIPE BEDDING AND SURROUND MATERIAL**

- .1 Granular 'A' material to OPSS 1010.

## **2.4 BACKFILL MATERIAL**

- .1 In accordance with Section 31 23 33.01.

## **2.5 PIPE DISINFECTION**

- .1 Undertake disinfection of water mains in accordance with ANSI/AWWA C651.

## **PART 3 - EXECUTION**

### **3.1 PREPARATION**

- .1 Clean pipes, fittings, valves, hydrants, and appurtenances of accumulated debris and water before installation.
- .2 Inspect materials for defects to approval of University of Guelph Representative and the City of Guelph.
- .3 Remove defective materials from site as directed by Contract Administrator and the City of Guelph.

- .4 All pipe up to and including 600 mm diameter shall be delivered to the Work Area with end covers and a tamper evident seal on only the bell end. These components shall adhere sufficiently to withstand the stresses caused during shipment.
- .5 Pipe delivered to the construction site with damaged or missing end covers shall be field cleaned to remove all undesirable material along the entire length of the interior of the pipe and the end covers reinstalled.

### **3.2 TRENCHING**

- .1 Do trenching work in accordance with Section 31 23 33.01.
- .2 Trench alignment and depth require Contract Administrator and the City of Guelph's approval prior to placing bedding material and pipe.
- .3 Trench depth to provide cover over pipe of not less than 1.9 m from finished grade.
- .4 Excavation for the installation of watermain shall be according to OPSS 401.

### **3.3 CONCRETE BEDDING AND ENCASEMENT**

- .1 Do concrete work in accordance with Section 03 30 00 - Cast-in-Place Concrete.
- .2 Place concrete to details as directed by Contract Administrator and the City of Guelph.
- .3 Pipe may be positioned on concrete blocks to facilitate placing of concrete. When necessary, rigidly anchor or weight pipe to prevent flotation when concrete is placed.
- .4 Do not backfill over concrete within 24 hours after placing.
- .5 Concrete for thrust blocks and fittings and appurtenance supports shall be according to OPSS 1350.

### **3.4 GRANULAR BEDDING**

- .1 Place granular bedding material in uniform layers not exceeding 150 mm compacted thickness to depth of 150 mm below bottom of pipe.
- .2 Do not place material in frozen condition.
- .3 Shape bed true to grade to provide continuous uniform bearing surface for pipe.
- .4 Shape transverse depressions in bedding as required to suit joints.
- .5 Compact each layer full width of bed to at least 95% SPMD to ASTM D 698.
- .6 Fill authorized or unauthorized excavation below design elevation of bottom of specified bedding in accordance with Section 31 23 33.01 with compacted bedding material.
- .7 Backfilling and compacting shall be according to OPSS 401.

### 3.5 PIPE INSTALLATION

- .1 Lay pipes to manufacturer's standard instructions and specifications. Do not use blocks except as specified.
- .2 Join pipes in accordance with ANSI/AWWA C600, ANSI/AWWA C605, and manufacturer's recommendations.
- .3 Handle pipe by methods recommended by pipe manufacturer. Do not use chains or cables passed through pipe bore so that weight of pipe bears on pipe ends.
- .4 Lay pipes on prepared bed, true to line and grade.
  - .1 Ensure barrel of each pipe is in contact with shaped bed throughout its full length.
  - .2 Take up and replace defective pipe.
  - .3 Correct pipe which is not in true alignment or grade or pipe which shows differential settlement after installation greater than 10 mm in 3 m.
- .5 Face socket ends of pipe in direction of laying. For mains on grade of 2% or greater, face socket ends up-grade.
- .6 Do not exceed permissible deflection at joints as recommended by pipe manufacturer.
- .7 Keep jointing materials and installed pipe free of dirt and water and other foreign materials.
  - .1 Whenever work is stopped, install a removable watertight bulkhead at open end of last pipe laid to prevent entry of foreign materials.
- .8 Position and join pipes with equipment and methods approved by the Contract Administrator and the City of Guelph.
- .9 Cut pipes in approved manner as recommended by pipe manufacturer, without damaging pipe or its coating and to leave smooth end at right angles to axis of pipe.
- .10 Bevel or taper ends of PVC pipe to match fittings.
- .11 Align pipes before jointing.
- .12 Install gaskets to manufacturer's recommendations. Support pipes with hand slings or crane as required to minimize lateral pressure on gasket and maintain concentricity until gasket is properly positioned.
- .13 Avoid displacing gasket or contaminating with dirt or other foreign material.
  - .1 Remove disturbed or contaminated gaskets.
  - .2 Clean, lubricate and replace before jointing is attempted again.
- .14 Complete each joint before laying next length of pipe.
- .15 Minimize deflection after joint has been made.
- .16 Apply sufficient pressure in making joints to ensure that joint is completed to manufacturer's recommendations.
- .17 Ensure completed joints are restrained by compacting bedding material alongside and over installed pipes or as otherwise approved by the Contract Administrator and the City of Guelph.

- .18 When stoppage of work occurs, block pipes in an approved manner to prevent creep during down time.
- .19 Recheck plastic pipe joints assembled above ground after placing in trench to ensure that no movement of joint has taken place.
- .20 Do not lay pipe on frozen bedding.
- .21 Do hydrostatic and leakage test and have results approved by the University of Guelph Representative and the City of Guelph before surrounding and covering joints and fittings with granular material.
- .22 Backfill remainder of trench.

### 3.6 VALVE INSTALLATION

- .1 New isolation water valve installation is to be installed to City standards and manufacturer's recommendations at the location indicated. The city may require the work to take place on a Sunday. The Contractor will be required to provide five (5) days written notice to the affected water users. The Contractor shall note that the final main connections to existing watermain shall be performed by the Contractor after completion of the required testing and Chlorination/disinfection of the new system. The Contractor shall provide the City Waterworks Department forty eight hours' notice to permit City Personnel to inspect the installation.
- .2 Support valves located in valve boxes or valve chambers by means of concrete located between valve and solid ground. Bedding same as adjacent pipe. Maximum length of pipe on each end of valve shall be 1 m. Valves not to be supported by pipe.

### 3.7 SERVICE CONNECTIONS

- .1 Terminate building water service 1 m outside building wall at property line opposite point of connection to main.
  - .1 Install coupling necessary for connection to building plumbing.
  - .2 If plumbing is already installed, make connection, otherwise cap or seal end of pipe and place temporary marker to locate pipe end.
- .2 Do not install service connections until satisfactory completion of hydrostatic and leakage tests of watermain.
- .3 Construct service connections at right angles to watermain unless otherwise directed. Locate curb stops 300 mm inside roadway allowance.
- .4 Tappings on PVC pipe to be either PVC valve tees or bronze type service clamps, strap type with "O" ring seal cemented in place.
- .5 Employ only competent workmen equipped with suitable tools to carry out tapping of mains, cutting and flaring of pipes.
- .6 Tap main at 2:00 o'clock or 10:00 o'clock position only; not closer to joint nor closer to adjacent service connections than recommended by manufacturer, or 1 m, whichever is greater.

- .7 Leave corporation stop valves fully open.
- .8 In order to relieve strain on connections, install service pipe in "Goose Neck" for "laid over" into horizontal position.
- .9 Install curb stop with corporation box on services NPS 2 or less in diameter.
  - .1 Set box plumb over stop and adjust top flush with final grade elevation.
  - .2 Leave curb stop valves fully closed.
- .10 Place temporary location marker at ends of plugged or capped unconnected water lines.
  - .1 Each marker to consist of 38 x 89 mm stake extending from pipe end at pipe level to 600 mm above grade.
  - .2 Paint exposed portion of stake red with designation "WATER SERVICE LINE" in black.

### **3.8 THRUST BLOCKS AND RESTRAINED JOINTS**

- .1 For thrust blocks: do concrete Work in accordance with Section 03 30 00 – Cast-In-Place Concrete.
- .2 Place concrete thrust blocks between valves, tees, plugs, caps, bends, changes in pipe diameter, reducers, hydrants and fittings and undisturbed ground as per OPSD 1103.010 and OPSD 1103.020.
- .3 Keep joints and couplings free of concrete.
- .4 Do not backfill over concrete within 24 hours after placing.
- .5 For restrained joints: only use restrained joints approved by the Contract Administrator and the City of Guelph with a working pressure rating at least equal to the full rated pressure of the installed pipe, with a minimum 1.5:1 safety factor.

### **3.9 HYDROSTATIC AND LEAKAGE TESTING**

- .1 Provide labour, equipment and materials required to perform hydrostatic and leakage tests hereinafter described.
- .2 Notify the City of Guelph at least 24 hours in advance of proposed tests.
  - .1 Perform tests in accordance with OPSS 441 in presence of City of Guelph Representative.
- .3 Where section of system is provided with concrete thrust blocks, conduct tests at least 5 days after placing concrete.
- .4 Test pipeline in sections not exceeding 365 m in length, unless otherwise authorized by the City of Guelph.
- .5 Leakage testing to be completed between 8:00 a.m. and 4:30 p.m.
- .6 Open valves.
- .7 Expel air from main by slowly filling main with potable water.

- .8 Examine exposed pipe, joints, fittings and appurtenances while system is under pressure, and correct for leakage as necessary.
- .9 Remove joints, fittings and appurtenances found defective and replace with new sound material and make watertight.
- .10 Repeat hydrostatic test until defects have been corrected.
- .11 Apply hydrostatic test pressure of 1035 kPa after complete backfilling of trench, based on elevation of lowest point in main and corrected to elevation of test gauge, for period of 2 hours.
- .12 Define leakage as amount of water supplied from water storage tank in order to maintain test pressure for 2 hours.
- .13 Do not exceed allowable leakage of 1.079 L/day/km/mm diameter of pipe, including lateral connections.
- .14 Locate and repair defects if leakage is greater than amount specified.
- .15 Repeat test until leakage is within specified allowance for full length of water main.

### **3.10 PIPE SURROUND**

- .1 Upon completion of pipe laying and the City of Guelph has inspected Work in place, surround and cover pipes as indicated.
- .2 Hand place surround material in uniform layers not exceeding 150 mm compacted thickness as indicated.
- .3 Place layers uniformly and simultaneously on each side of pipe.
- .4 Do not place material in frozen condition.
- .5 Compact each layer from pipe invert to backfill, 95% SPMDD to ASTM D 698.

### **3.11 BACKFILL**

- .1 Place backfill material, above pipe surround, in uniform layers not exceeding 150 mm compacted thickness up to grades and in accordance with Section 31 23 33.01 – Excavating, Trenching and Backfilling.
- .2 Do not place backfill in frozen condition.
- .3 Under paving and walkways, compact subgrade fill below granular sub-base to 100% SPMDD. In other areas, compact to 95% SPMDD.

### 3.12 FLUSHING AND DISINFECTING

- .1 Flushing and disinfecting operations: witnessed by the City of Guelph Representative.
  - .1 Notify the City of Guelph Representative and the University of Guelph at least 4 days in advance of proposed date when disinfecting operations will begin.
- .2 Flush water mains through available outlets with a sufficient flow of potable water to produce velocity of 1.5 m/s, within pipe for minimum 10 minutes, or until foreign materials have been removed and flushed water is clear.

- .3 Flushing flows as follows:

Pipe Size NPS	Flow (L/s) Minimum
6 and below	38
8	75
10	115
12	150

- .4 Provide connections and pumps for flushing as required.
- .5 Open and close valves, hydrants and service connections to ensure thorough flushing.
- .6 After flushing is completed, water from the existing distribution system is to be allowed to flow at a controlled rate into the new pipeline. Liquid chlorine solution is to be introduced so that the chlorine is distributed throughout and the chlorine concentration is 50 mg/L minimum and 200 mg/L maximum. The system shall be left charged with chlorine for 24 hours.
- .7 The City of Guelph Representative will arrange for sampling and testing for chlorine residual. If the chlorine residual is 25 mg/L or more, the section is to be flushed with water from the distribution system. If the test result is below 25 mg/L, the flushing and disinfection procedure is to be repeated until satisfactory.
- .8 24 hours after the system has been recharged, the City of Guelph Representative will arrange for sampling and testing for 24 hr and 48 hr bacteriological testing. The Contractor is to coordinate and assist this testing. If the test results show contamination, the flushing and disinfection procedure is to be repeated in its entirety.

### 3.13 SURFACE RESTORATION

After installing and backfilling over watermain, restore surface as directed by the City of Guelph and the University of Guelph Representatives.

END OF SECTION

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## **Appendix 'A'**

### **Designated Substances Survey and Perchlorate Detection in Fume Hoods, OVC – Former VMI Building**

Prepared by LEX Scientific Inc., June 2018 (LEX Project No. 01180066)



**SOLUTIONS**  
*FOR A WORKING WORLD*

LEX Project No. 01180066

## **University of Guelph – Physical Resource Dept.**

Designated Substance Survey and Perchlorate  
Detection in Fume Hoods

OVC - Former VMI Building

June 2018



### **Prepared by:**

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June 26, 2018  
LEX Project No. 01180066

Mr. Peter Ibrajev  
University of Guelph – Physical Resource Dept.  
J.C. Hersey Building, 117 College Avenue East, Guelph ON, N1G 2W1

**Re: Designated Substance Survey and Perchlorate Detection in Fume Hoods  
OVC - Former VMI Building**

Dear Mr. Ibrajev:

LEX Scientific Inc. (LEX) was retained by University of Guelph – Physical Resource Dept. to conduct a Designated Substances Survey (DSS) for the Ontario Veterinary College OVC - Former VMI Building located at 50 College Ave, West, Guelph ON. The survey was conducted in support of planned renovations and included the inspection of asbestos-containing materials (ACMs), the investigation of potential lead and mercury-containing materials within the building, and the inspection for other designated substances. In addition to the DSS, LEX tested the interior of fume hoods located in the facility for potential perchlorate residues.

This designated substance survey was conducted to ensure compliance with Section 30(1) of the Occupational Health and Safety Act which states:

*“Before beginning a project, the owner shall determine whether any designated substances are present at the project site and shall prepare a list of all designated substances that are present at the site.”*

On behalf of LEX, we would like to thank you for the opportunity to serve you. If you have any questions regarding this report or any health and safety issue, please call us at (519).824.7082.

Yours truly,

**LEX Scientific Inc.**

A handwritten signature in black ink, appearing to read 'D. Humphrey', written over a horizontal line.

Daniel Humphrey, B.B.R.M.  
Environmental Technologist

A handwritten signature in blue ink, appearing to read 'E. Hoffbauer', written over a horizontal line.

Eric Hoffbauer, P.Eng.  
Project Manager – Consulting Services

## Executive Summary

University of Guelph – Physical Resource Dept. retained LEX to conduct a DSS of the OVC - Former VMI Building. The survey was requested to quantify the designated substances on the premises before renovations are scheduled to begin. In addition, fume hoods in the facility were tested for perchlorate residues.

### Summary of Designated Substances and Hazardous Materials

Designated Substance Observed	Material	Location	Approximate Quantity
Asbestos	Black mastic	Black mastic was found throughout the building <b>except</b> where there is terrazzo flooring, concrete flooring or beneath LEX samples 07, 27, 29. <i>*Note LEX samples 07, 27, 29 may have areas within the building where black mastic is present that was not observed by LEX.</i>	18,000 sq. ft.
Asbestos	Vinyl Flooring Tile (VFT) – Olive with white streaks 9x9	138A, 138B, 215, 215A, 215B, 215C, 215D, 216, 112, C201	256 sq. ft.
Asbestos	VFT – Brown with white streaks 9x9	132A, 221, Penthouse Mechanical Room 222 (Bottom of stairs), 209, 209A, 210, 210A, 210B, 210C,	612 sq. ft.
Asbestos	VFT – Grey with white streaks 9x9	128, 117A, 117B, 125B, 125A, 125, 126B, 126D, 214A, 214B, 215, 215A, 215B, 111, 203, 203A, 206A, 206B, 206C	2223 sq. ft.
Asbestos	VFT – Green/Blue	126	270 sq. ft.
Asbestos	VFT – White with green streaks 9x9	132B, 126D	160 sq. ft.
Asbestos	VFT – Teal with white 9x9	119	96 sq. ft.
Asbestos	VFT – Grey with black 9x9	123, 124	432 sq. ft.

Designated Substance Observed	Material	Location	Approximate Quantity
Asbestos	VFT – Black with white streaks	204B	40 sq. ft.
Asbestos	VFT – Brown with multicolour streaks 9x9	203, 208, 210, 210A, 210B, 210C	912 sq. ft.
Asbestos	VFT – Blue with white streaks 9x9	215, 215A, 215B, 215C, 215D, 216, 223, 204B, 213, 213A, 213B, 213C	839 sq. ft.
Asbestos	VFT – White with brown streaks 9x9	215C, 215D, 216, 219A, 219B, 220, 102, 203B, 207, 207B	1489 sq. ft.
Asbestos	VFT – Red with white streaks 9x9	219, 219A, 219B, 219C, 128, 209, 209A, C201	700 sq. ft.
Asbestos	VFT – Army green with white streaks	213, 213A, 213B, 213C	170 sq. ft.
Presumed Asbestos	Sink undercoating - Gold	209, 209A	2 units
Asbestos	Parged pipe fittings	128, 130, 132, 133, 135, 138, 138A, 138B, 139, 139A, 140, 140A Washroom 130, Washroom 117, 117A, 117B, 119, Sewage Room 120A, 123, 125A, 125B, 126, 126A, 126E, 127, Washroom 116, 116, 109, 109A, 109B, 102, 128, 124, 113A, Corridor 102, Corridor 103, 203, 204B, 206B, 206C, 209, 209A, 223, Corridor 201, Penthouse Mechanical Room 222	411 fittings
Presumed Asbestos	Parged pipe wrapping	Penthouse Mechanical Room 222, Sewage Room 120A	6000 sq. ft.
Presumed Asbestos	Transite Board	138	70 sq. ft.
Asbestos	Parged pipe fittings – <b>Inaccessible</b> ceiling hatch	129, 132A, 132B, 132C, 117A, 117B, 121, 126D, Washroom 202, 201, Atrium 202,	Unknown

Designated Substance Observed	Material	Location	Approximate Quantity
		Corridor 100, all stairwells	
Mercury	Fluorescent light bulbs	Throughout Entire Building	1137 units
Polychlorinated Biphenyls (PCB)	Light ballasts	Throughout Entire Building	578 units
Lead	Copper and cast-iron pipe solder	Found in ceiling spaces, beneath laboratory work benches, and in corridors	Throughout Entire Building
Lead	Lead containing paint	Throughout Entire Building	N/A

No perchlorate residues were detected by LEX on the interior surfaces of the fume hoods.

### Summary of Recommendations

- Any ACM that may be disturbed during the renovation should be removed by a qualified abatement contractor prior to initiation of renovations.
- Any lead containing materials disturbed during the renovations should be completed using the Ontario Ministry of Labour guideline *Lead on Construction Projects*.
- It is recommended that a copy of this DSS should be kept on-site during any renovation or demolition activities. It should also be provided to all contractors who may disturb any of the designated substances mentioned in this report.
- Coring, sawing or breaking of materials such as concrete, brick and mortar should be considered silica-containing and should be done with appropriate dust suppression methods and proper respiratory protection and following Guideline - Silica on Construction Projects (published September 2004 and revised April 2011).
- Any fluorescent light tubes that will be removed should be collected and disposed of by being sent to an appropriate recycling facility. Fluorescent tubes should be packed in a rigid container to mitigate any circumstances that may result in breaking of light tubes and release of mercury vapour. Broken light tubes should also be packed in the same container for disposal.
- Any light ballasts that will be removed should be collected from the site, checked for PCB content and disposed of by sending to an appropriate facility. LEX has a directory of ballast types and manufacturers and has staff that can assist in sorting any light ballasts removed during renovations as PCB and non-PCB containing for appropriate disposal.

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# 1 Introduction

The University of Guelph – Physical Resource Dept. retained LEX to conduct a DSS at the OVC - Former VMI Building. In addition, LEX performed perchlorate detection testing in fume hoods that were located within the scope of work to determine if there were any perchlorate residues present. This building is a multi-use, multi-storey building and was used by the Ontario Veterinary College (OVC) as their Veterinary Microbiology and Immunology facility.

The DSS assessment was performed by Dan Humphrey, B.B.R.M (Env Mgmt.), Environmental Technologist and Jarrett Deneau, B.Sc. Environmental Technologist between May 14-18, 2018. The survey included the inspection of asbestos-containing materials (ACMs), the investigation of potential lead and mercury-containing materials within the building and the inspection for other designated substances. It is understood that the survey was requested to quantify the designated substances on the premises prior to initiation of planned renovations.

The survey included the inspection of asbestos-containing materials (ACMs), the investigation of potential lead and mercury-containing materials within the building and the inspection for other designated substances. The scope of work encompassed all floors, walls, ceilings, and interior finishes of the building. LEX conducted semi-invasive sampling and visual identification during the survey.

Within the limitations presented, the survey has been completed and the results are contained in this report. All work was performed according to the Regulation respecting Asbestos on Construction Projects and in Buildings and Repair Operations (Ontario Regulation 278/05); Designated Substances in the Workplace (Ontario Regulation 490/09) - made under the Occupational Health and Safety Act.

## 2 Definition of Designated Substances and Applicable Guidelines

### 2.1 Asbestos Containing Material (ACM)

Ontario Regulation 278/05 Section 1 and 3 (4) defines an ACM as being a material that contains 0.5 percent or more asbestos by dry weight. ACMs have been proven to cause diseases like mesothelioma, asbestosis and lung cancer. Health Canada states that asbestos fibres pose significantly less health risks if they are in tightly bound or in enclosed form. Any form of alteration or renovation to the ACM needs to be performed by certified professional.

Ontario Regulation 278/05 requires that final clearance air monitoring be conducted following all Type III Asbestos Removal Operations to ensure the work enclosure is clean and is suitable for worker/tenant re-occupancy. The Type III work enclosure “passes the clearance test only if every air sample collected has a concentration of fibres that does not exceed 0.01 fibres per cubic centimetre of air”.

### 2.2 Lead

Lead is used in a wide variety of products including the manufacture of storage batteries, plastic stabilizers and paints, ammunition, cable coverings in the power and communication industries, and lead sheet for roofing.



Acute exposure to lead by inhalation or ingestion may cause headache, fatigue, nausea, abdominal cramps, and joint pain and bloody diarrhoea. Chronic (long term) exposure to lead by inhalation or ingestion can cause reduced haemoglobin production, reduced life span, disturbances to vision and kidney damage. Lead exposure may also cause harmful effects on pregnancy and reproduction, is mutagenic and possibly carcinogenic to humans.

O. Reg. 490/09 limits occupational exposure to elemental lead to 0.05 mg/m<sup>3</sup> TWA (8 hour) for workers, but excludes construction projects. However, the Ministry of Labour Guideline - *Lead On Construction Projects* (published September 2004 and revised April 2011) requires an equivalent level of protection to be implemented. Adopting the exposure limit value for workers on construction projects would be a prudent practice.

Lead was also historically used in solder for interior plumbing. However, lead has been banned for use in solder since approximately 1990. Lead piping was also used in plumbing for buildings constructed before 1975. Building age can be used to determine the presence of lead piping or lead containing solder in plumbing systems.

## 2.3 Mercury

Mercury and mercury compounds are known to cause central nervous system impairment as well as kidney damage. Mercury in the elemental form was historically used in various applications including in buildings as part of thermostat switches and light switches. Mercury is also used in fluorescent lighting tubes.

Ontario Regulation 490/09 – Designated Substances limits worker exposure to mercury and mercury compounds to 0.01 mg/m<sup>3</sup>. *Ontario Regulation 347 - General Waste Management*, encourages the recycling of “common mercury wastes” including mercury-containing lamps and thermostats.

## 2.4 Silica

Silica, or silicon dioxide (SiO<sub>2</sub>), is a mineral constituting about 60% of the earth’s crust. The regulated forms of crystalline silica are quartz, cristobalite, tridymite, and tripoli.

Silica sand and gravel are commonly used in road construction, buildings (concrete), ceramic and refractory materials. Respiratory impairment and disease among workers exposed to mineral dusts have been historically documented. Silicosis (or silica-induced pneumoconiosis) is the result of deposition of crystalline silica particles in the lung tissue. Prolonged and continued exposure to silica dust may cause progressive silicosis resulting in respiratory failure.

O. Reg. 490/09 limits occupational exposure limit for crystalline silica, quartz/ tripoli at 0.1 mg/m<sup>3</sup> TWA (8-hour) and cristobalite at 0.05 mg/m<sup>3</sup> TWA (8 hour).

## 2.5 Other Designated Substances

The other designated substances are:

- Acrylonitrile;
- Arsenic;
- Benzene;
- Ethylene Oxide;
- Isocyanates; and
- Vinyl Chloride.



- Coke Oven Emissions;

## 2.6 Perchlorate Compounds

Perchlorate is a naturally occurring and man-made material commonly used as an oxidizer in solid propellants, munitions, fireworks, airbag initiators, matches and signal flares. It is also used in some electroplating operations and found in some disinfectants and herbicides (United States Environmental Protection Agency [EPA], 2014). The presence of perchlorates inside a fume hood may present an explosion hazard under certain conditions if the fume hood is exposed to a physical shock.

## 2.7 Semi-invasive Sampling

For the purpose of this report semi-invasive sampling included visual inspections of building materials, sampling of wall finishes and pulling up corners of carpet tiles to exam flooring underneath without leaving evidence of extensive of disturbances. Since LEX staff were able to access and inspect the wall spaces from areas above the ceiling, coring was not required to identify if loose fill insulation was present in wall cavities. LEX was able to see into wall cavities at three different locations across the two wings.

# 3 Survey Methodology

## 3.1 Building Surveyed

Table 1 summarizes the rooms and building(s) surveyed as part of this DSS.

**Table 1 Inspection Location Summary**

Building Address	Areas Surveyed	Areas Excluded from Survey
50 College Ave, West, Guelph ON – Wing B and C	First Floor Second Floor Penthouse (Mechanical Room) Basement rooms 120A (Mechanical Room) and 120B (Sewage Room) Corridors C100, C101, C102, C103, C201, C202, AT202 Stairwells ST101, ST102, ST103, ST201, ST202, ST203, ST205	Rooms 109D (Cooler), 109E (Freezer), 207A (Cold Room), 202 (Cold Room), 204A (Storage), EL200

## 3.2 Survey Methodology

A walk-through visual inspection and non-invasive sampling was performed to determine the condition of asbestos containing materials (ACM) and the presence of all other Designated Substances. In addition, areas of the building where flooring carpet tile were present LEX pulled up corners of carpet tiles to examine flooring materials below. The materials of interest included, but were not limited to:



1. Thermal System Insulation (**TSI**) including pipe insulation, pipe fittings, boiler insulation, and duct insulation.
2. Surfacing materials including spray-on fireproofing, troweled-on material and decorative coatings.
3. Miscellaneous materials including vibration cloth, transite board or pipes, asbestos cement composite, ceiling tiles, and floor tiles.
4. Deteriorating paint coatings on walls, ceilings, pipes etc.
5. Mercury-containing electrical switches, lights and thermostats.

Representative bulk samples were collected of suspect ACM present in the building. Two representative paint samples were taken from surfaces with deteriorating/peeling paint in the areas inspected and were analysed for lead content. Visual identification of mercury-containing materials such as electrical switches and thermostats was conducted during the survey.

Details of fume hood usage by staff and students is not known. Since historical perchloric acid usage can result in perchlorate residues present in the fume hoods which can present an explosive hazard, testing for perchlorates was conducted in response to anticipated renovation plans for the building. Perchlorate testing was conducted in the fume hoods located to the following rooms:

- 209 (1 fume hood identified)
- 206B (1 fume hood identified)
- 213A (1 fume hood identified)
- 123 (1 fume hood identified)

Three tests were completed per fume hood following stated methodology. Test locations included interior left paneling, interior right paneling, and interior top paneling of each fume hood. The perchlorate testing in the fume hoods was conducted using a testing method involving methyl blue dye solution. Distilled water was sprayed on the interior surfaces of the fume hood and allowed to wash down the sides. A cotton tipped swab was then moistened with the water from the side of the fume hood and placed on a sterile piece of filter paper. A small amount of methyl blue dye solution was then dropped onto the swab and filter paper. When perchlorate is present, the methyl blue reacts to form violet precipitates.

### 3.3 Survey Impediments

The following impediments were encountered during the survey:

- Inaccessible locks on rooms 109D (Cooler), 109E (Freezer), 207A (Cold Room), 202 (Cold Room), 204A (Storage).
- Limited view, or inaccessible ceiling hatches in some rooms throughout the survey. For room by room notes refer to Appendix E.
- Inaccessible elevator shaft (EL 200).

\*Note: LEX was able to gain access to cold room 136B. It was reported to LEX by Mr. Peter Ibrajev that this cold room is representative of the other cold/freezer rooms within the building that were inaccessible during the investigation.

### 3.4 Laboratory Analysis

Each bulk sample submitted to the LEX Laboratory was analysed as per EPA method 600/R-93/116 and was performed in compliance with the Code for the Determination of Asbestos from Bulk Samples found in the Regulation regarding Asbestos on Construction Projects and in Buildings and Repair Operations - made under the Occupational Health and Safety Act, Ontario Regulation 278/05.

LEX is accredited by the National Voluntary Laboratory Accreditation Program (NVLAP) and by the National Institute of Standards and Technology. The National Voluntary Laboratory Accreditation Program is a United States based laboratory accreditation for analyzing bulk materials for asbestos content. Our NVLAP Lab Code number is 101949.

Paint chip samples were analyzed by Maxxam Analytics for lead content.

## 4 Results and Discussion

### 4.1 Survey Visual Observations

The following observations were made during the investigation:

- LEX observed cast iron and copper piping throughout the building.
- LEX observed fluorescent light bulbs throughout the building.
- LEX observed a water leak in room 125B. In addition, water damage was observed on ceiling tiles in 125A.
- LEX observed some parged pipe fitting/insulation remediation efforts in basement room 120, the Penthouse Mechanical Room, and corridor C102.
- Invasive coring of exterior walls was avoided by LEX since there were multiple locations where wall cinder blocking was damaged and visual inspections of the wall cavity could be made. No suspect ACM materials were observed by LEX in these areas.

### 4.2 Asbestos Containing Materials

#### 4.2.1 Bulk Sampling Results

**Table 2** below, summarizes the analytical laboratory results of homogeneous materials collected from OVC - Former VMI Building. Note that the locations listed below pertain only to the physical samples submitted for lab analysis.

**Table 2 Summary of Homogenous Materials Collected**

Sample ID	Sample Location	Description	Friability	% Fibrous Asbestos Content
01	C100, 140, 138A, ST101, ST103, 110, 101	Plaster (Scratch and Finish Layers)	No	Non-containing
02	C100	Ceiling Tile (CT) – Large/Small Pinholes	Yes	Non-containing
03	C100	CT – Glue Pucks 9x9	Yes	Non-containing
04	C100	CT – Rough	Yes	Non-containing
05	140, 139, 135	Window Caulking (White)	No	Non-containing
06	135, 140, 132	Baseboard Mastic #1 (BBM)	No	Non-containing
07	140, 132	VFT – Brown with Grey and Mastic - Orange	No	Non-containing
08	128	Parged Pipe Fitting	Yes	50% Chrysotile
09*	139, 135	Tar Duct Insulation	Yes	<0.5 Chrysotile - - Considered non-ACM
10	139A	Sink Undercoat – Blue	No	Non-containing
11	138, 125B, 125A	BBM #2	No	Non-containing
12	138, 127	VFT – White with Black	No	Non-containing
		Black mastic	No	1% Chrysotile
13	138A, 138B	VFT – Olive with White Streaks 9x9	No	0.5% Chrysotile
		Black mastic	No	1% Chrysotile
14	138	VFT – White with Grey	No	Non-containing
		Black mastic	No	1% Chrysotile
15	136, 133, 206, 204, 113	Drywall Joint Filling Compound (DWJFC)	No	Non-containing
16	132, 132B	Carpet Tile Mastic (Yellow)	No	Non-containing
17	132A	VFT – Brown with White Streaks 9x9	No	0.5% Chrysotile
		Black mastic	No	1% Chrysotile
18	128	VFT – Grey with White Streaks 9x9	No	0.5% Chrysotile

Sample ID	Sample Location	Description	Friability	% Fibrous Asbestos Content
		Black mastic	No	1% Chrysotile
19	126	VFT – Green/Blue	No	0.5% Chrysotile
		Black mastic	No	1% Chrysotile
20	126D	VFT – White with Green Streaks 9x9	No	2% Chrysotile
		Black mastic	No	1% Chrysotile
21	126E, 126, 126D	Leveling Compound - Grey	No	Non-containing
22	126	Flexible Pipe Insulation	No	Non-containing
23	119	VFT – Teal with White 9x9	No	1% Chrysotile
		Black mastic	No	1% Chrysotile
24	123	VFT – Beige with Brown	No	Non-containing
		Black mastic	No	1% Chrysotile
25	123, 124	VFT – Grey with Black 9x9	No	1% Chrysotile
		Black mastic	No	1% Chrysotile
26	123, 124	VFT – Oatmeal Pattern	No	Non-containing
		Black mastic	No	1% Chrysotile
27	203	VFT – Purple with White Speckles	No	Non-containing
28	125A	Sink Undercoat - White	No	Non-containing
29	203	VFT – Cream	No	Non-containing
30	203	VFT – Brown with Multi-Colour Streaks 9x9	No	0.5% Chrysotile
		Black mastic	No	1% Chrysotile
31	203B	VFT – White with Brown Streaks 9x9	No	1% Chrysotile
		Black mastic	No	1% Chrysotile
32	204B	VFT – Blue with White Streaks 9x9	No	0.5% Chrysotile
		Black mastic	No	1% Chrysotile
33	204B	VFT – Black with White Streaks	No	6% Chrysotile
		Black mastic	No	1% Chrysotile
34	204B	VFT – Grey with Black Streaks	No	Non-containing
		Black mastic	No	1% Chrysotile

Sample ID	Sample Location	Description	Friability	% Fibrous Asbestos Content
35	206	CT – Bumps with Pinholes 2x4	Yes	Non-containing
36	209	VFT – Red with White Streaks 9x9	No	1% Chrysotile
		Black mastic	No	1% Chrysotile
37	209	VFT – Red/Orange	No	Non-containing
		Black mastic	No	1% Chrysotile
38	213	VFT – Dark Multi-Coloured Red	No	Non-containing
		Black mastic	No	1% Chrysotile
39	101	VFT – Army Green with White	No	1% Chrysotile
		Black mastic	No	1% Chrysotile
40	105	CT – Texture with Pinholes and Fissures 2x2	Yes	Non-containing
41	105	Black Pipe Insulation	No	Non-containing
42	112	VFT – Multi-Grey	No	Non-containing
		Black mastic	No	1% Chrysotile
43	113	Vinyl Flooring Sheet (VFS) – Dark Grey	No	Non-containing
44	111	VFT – Tan and Brown	No	Non-containing
		Black mastic	No	1% Chrysotile

Notes:

1. Shaded samples are asbestos containing.
2. Containing black mastic was sampled under LEX sample ID 12. Black mastic was observed by LEX under all VFT's within scope of work **except** for VFT LEX samples 07, 27, 29. However, the extent to which black mastic was observed was limited to only the areas where LEX sampled VFT. (Observable extent of black mastic in each room was restricted due to our inability to look under every VFT in each room.)
3. \* - samples found with <0.5% asbestos content are **not** considered to be asbestos containing per O.Reg. 278/05.

**Appendix A** contains the summary photolog of sampled and noteworthy materials. Refer to **Appendix B** for the Laboratory Certificates of Analysis for bulk asbestos materials sampled.

#### 4.2.2 Asbestos Containing Materials Quantification

**Appendix D** contains a listing and quantification of all ACM observed in the OVC - Former VMI Building.

## 4.3 Lead Containing Materials

### 4.3.1 Lead Based Paint and Mortar

**Table 3** below, summarizes the results of the paint coat sampling. The lead concentrations are expressed in milligram lead per kilogram of paint (mg/kg) as well as in percent lead. Paint samples are to be considered lead-based, if they contain greater than 0.5% lead on a mass basis. Paint samples are considered lead-containing if they consist of less than 0.5% lead on a mass basis.

**Table 3 Summary of Paint Sample Laboratory Analysis**

Sample ID	Sample Location	Description and Colour	Lead Content (mg/kg)	Lead Content (%)
L-01	138	Grey Paint	2600	0.260
L-02	223	Beige Paint	290	0.029

Beige paint was present in the majority of the window frame areas and some walls throughout the building. Grey paint was located throughout the building on the interior of exterior walls. Both paint samples collected were found to be lead-containing rather than lead based. The samples collected would be considered representative of the paint encountered within the building. Refer to **Appendix C** for the Laboratory Certificates of Analysis of lead in paint chip samples.

### 4.3.2 Other Lead-Containing Materials

**Lead-Containing Solder** - All solder if present, are to be presumed lead-containing. All joints on cast iron sewer pipes are also to be presumed lead-containing. Disturbance of any lead-containing materials should only be done according to the *Guideline Lead On Construction Projects* (April 2011).

## 4.4 Mercury

Mercury-containing thermostats were not observed in the building. All fluorescent light tubes present should be considered to contain mercury.

## 4.5 Silica

No samples were collected for silica during the survey. Coring, sawing or breaking of materials such as concrete, brick and mortar should be considered silica-containing and should be done with appropriate dust suppression methods and proper respiratory protection and following *Guideline - Silica on Construction Projects* (published September 2004 and revised April 2011).

## 4.6 Other Designated Substances

The following designated substances were not observed at the building:

- Acrylonitrile;
- Arsenic;
- Benzene;
- Coke Oven Emissions;
- Ethylene Oxide;
- Isocyanates; and
- Vinyl Chloride.

## 4.7 Perchlorate

**Table 4** below summarizes the results of the testing for the presence of perchlorates in the fume hoods.

**Table 4 Perchlorate Presence in Fume Hoods**

Room Number	Violet Precipitate Formed
123	No
206B	No
209	No
213A	No

No violet colouring or precipitates were observed on any of the filter papers or swabs. A total of three test were completed at each fume hood. Refer to **Appendix A** for representative perchlorate test results.

Based on these results, perchlorates were not detected on any of the interior surfaces of the fume hoods tested.

It should be noted, that only the accessible interior surfaces of the fume hood were tested. No tests were conducted inside the fume hood ducting. Exhaust ducting for the fume hood may still pose an explosion hazard upon physical shock, due to presence of perchlorates. Even though perchlorates were not detected, precautionary work procedures should be used.

## 5 Conclusions

1. LEX sample 08 (Parged Pipe Fitting), found throughout the building, was determined to be an asbestos containing material. Some parged pipe fitting remediation efforts were observed by LEX throughout the building.
2. Parged pipe wrapping found in the Sewage Room 120A and the Penthouse Mechanical room 222 were presumed to be asbestos containing. Some parged pipe wrapping remediation efforts were observed within these rooms.
3. Transite bench boards found in room 138 were presumed to be asbestos containing.
4. Lex sample 12, black VFT mastic, found under most of the flooring tiles throughout the building, was found to be an asbestos containing material.
5. Lex VFT sample 13 (Olive with White Streaks 9x9) was found to be an asbestos containing material.
6. Lex VFT sample 17 (Brown with White Streaks 9x9) was found to be an asbestos containing material.
7. Lex VFT sample 18 (Grey with White Streaks 9x9) was found to be an asbestos containing material.
8. Lex VFT sample 19 (Green/Blue) was found to be an asbestos containing material.



9. Lex VFT sample 20 (White with Green Streaks 9x9) was found to be an asbestos containing material.
10. Lex VFT sample 23 (Teal with White 9x9) was found to be an asbestos containing material.
11. Lex VFT sample 25 (Grey with Black 9x9) was found to be an asbestos containing material.
12. Lex VFT sample 30 (Brown with Multi-coloured Streaks 9x9) was found to be an asbestos containing material.
13. Lex VFT sample 31 (White with Brown Streaks 9x9) was found to be an asbestos containing material.
14. Lex VFT sample 32 (Blue with White 9x9) was found to be an asbestos containing material.
15. Lex VFT sample 33 (Black with White Streaks) was found to be an asbestos containing material.
16. Lex VFT sample 36 (Red with White 9x9) was found to be an asbestos containing material.
17. Lex VFT sample 39 (Army Green with White) was found to be an asbestos containing material.
18. Gold sink undercoating's were observed in rooms 209 and 209B and are presumed to be asbestos containing.
19. Fluorescent light bulbs were observed throughout the building and are presumed to be mercury containing.
20. No presence of perchlorates was found on the interior surfaces of the fume hoods.

## 6 Recommendations

1. Any ACM that may be disturbed during the renovation should be removed by a qualified abatement contractor prior to initiation of renovations.
2. Any lead containing materials disturbed during the renovations should be completed using the Ontario Ministry of Labour guideline *Lead on Construction Projects*.
3. It is recommended that a copy of Designated Substances Survey should be kept on-site during any renovation or demolition activities. It should also be provided to all contractors who may disturb any of the designated substances mentioned in this report.
4. Coring, sawing or breaking of materials such as concrete, brick and mortar should be considered silica-containing and should be done with appropriate dust suppression methods and proper respiratory protection and following Guideline - Silica on Construction Projects (published September 2004 and revised April 2011).
5. Any fluorescent light tubes that will be removed should be collected and disposed of by being sent to an appropriate recycling facility. Fluorescent tubes should be packed in a rigid container to mitigate any circumstances that may result in breaking of light tubes and

release of mercury vapour. Broken light tubes should also be packed in the same container for disposal.

6. Any light ballasts that will be removed should be collected from the site, checked for PCB content and disposed of by sending to an appropriate facility. LEX has a directory of ballast types and manufacturers and has staff that can assist in sorting any light ballasts removed during renovations as PCB and non-PCB containing for appropriate disposal.

## 7 References

- 1 Occupational Health and Safety Act, O. Reg 278/05 Section 18 (6) 5

## 8 Disclaimer

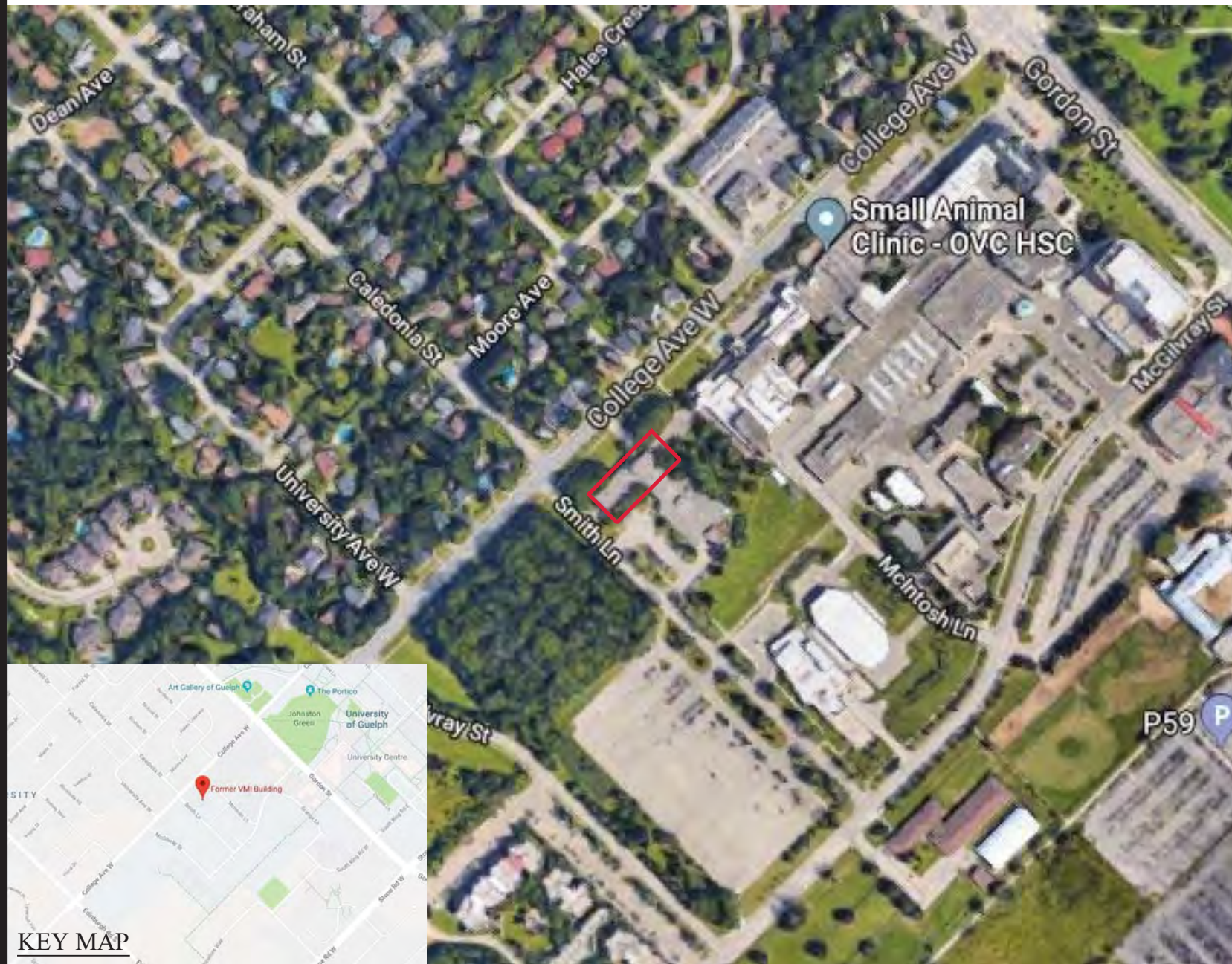
This report is prepared exclusively for the purposes, project and site location outlined in the report. The report is based on information provided to, or collected and/or obtained by LEX as indicated in the report, and applies solely to site conditions existing at the time of sampling. LEX's report represents a reasonable analysis and interpretation of available information within an agreed scope of work, schedule and budget.

LEX's liability to the Client and all claimants not party to this agreement shall be limited to injury or loss caused by negligence of LEX and/ or sub-consultants for which it is responsible. The total amount of LEX's liability for said negligence shall be limited to the lesser of the fees paid for or actual damages incurred by the Client and the Client hereby waives all claims in excess of this amount howsoever arising including any claim for contribution and indemnity which the Client may have against LEX. The Client irrevocably and unconditionally agrees to defend, indemnify and hold LEX harmless from all claims and expenses associated therewith resulting from claims brought by other parties in excess of the aforesaid limit.

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## Figures



291 Woodlawn Road W Unit B 12  
Guelph, Ontario N1H 7L6  
Phone: (519) 824-7082  
www.lexscientific.com



NORTH



Site Location

Not To Scale

Figure 1

Site Location Plan

Prepared By: DH

Date: June 19, 2018

Project:

Designated Substances

Survey - 01180066

Location:

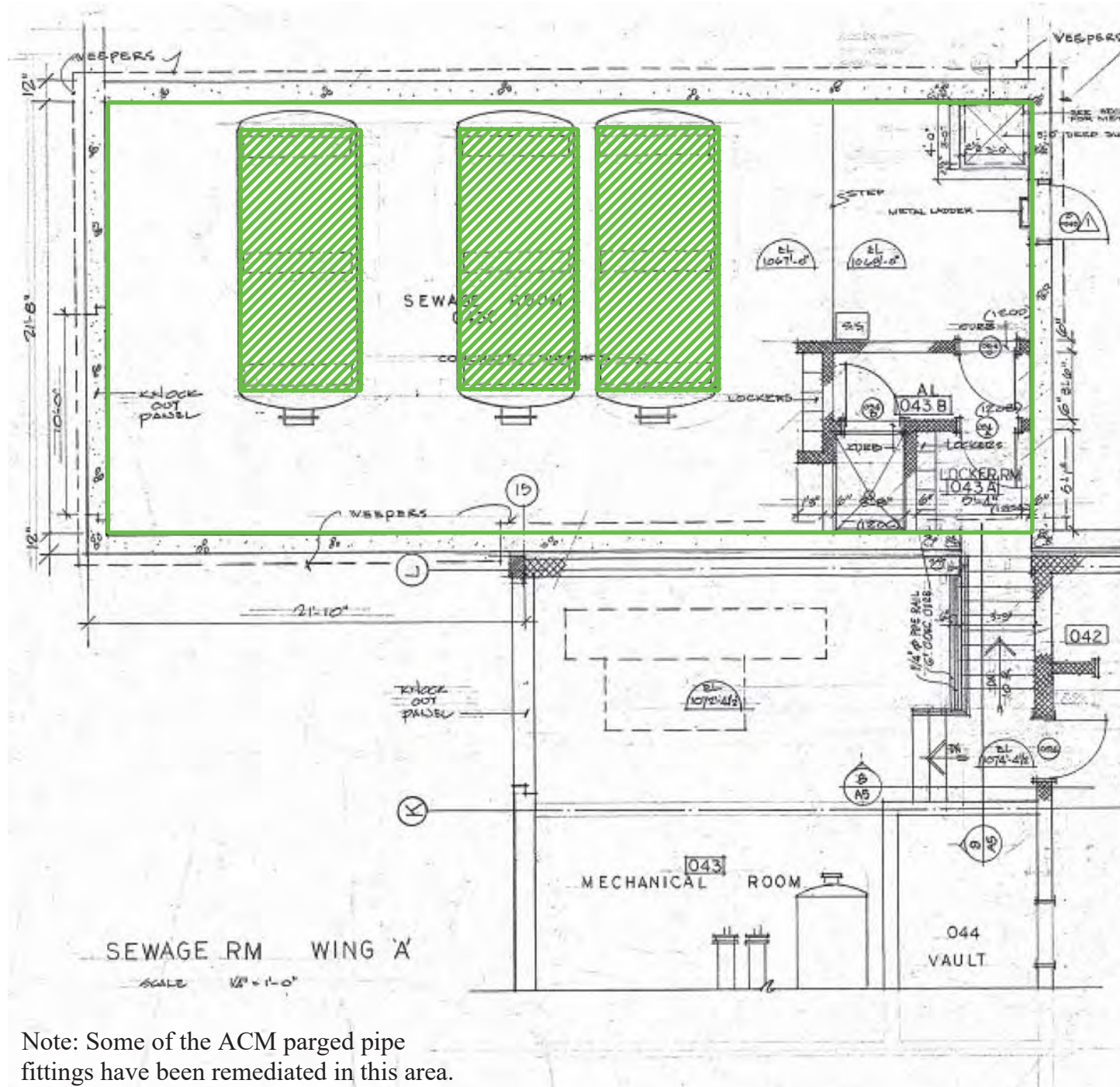
Former VMI Building

Guelph Ontario

Prepared For:



University of Guelph

KEY MAP



291 Woodlawn Road W Unit B 12  
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Phone: (519) 824-7082  
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### Legend

-  Parged Boiler Tank Wrapping
-  Parged Pipe Fittings Present

Not To Scale

### Figure 2

Sewage Room 120A

Asbestos Containing Materials

Prepared By: DH

Date: June 19, 2018

Project:

Designated Substances

Survey - 01180066

Location:

Former VMI Building

Guelph Ontario

Prepared For:






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Note: Some of the ACM parged pipe fittings have been remediated in this area.



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### Legend

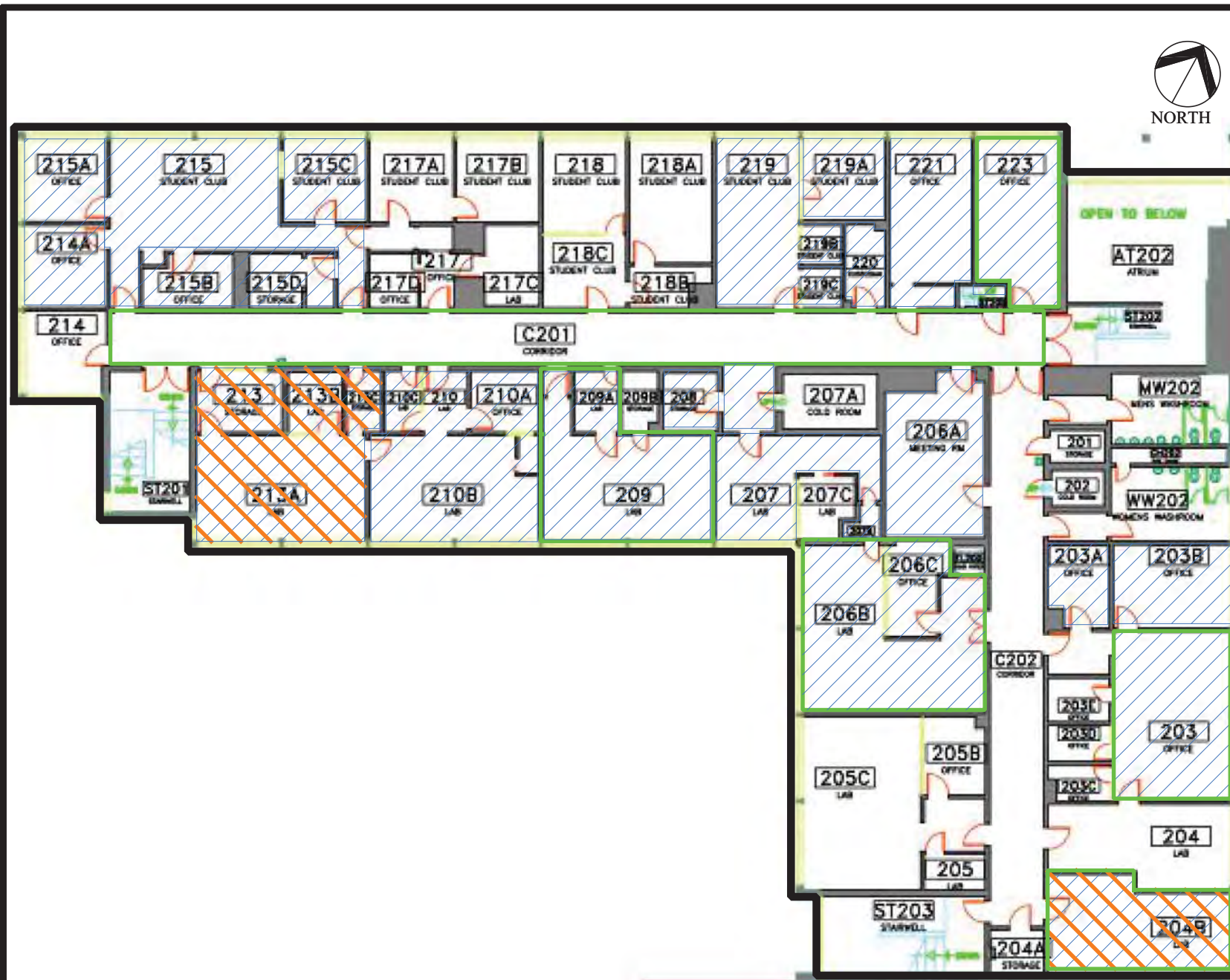
-  Scope of Work
-  Parged Pipe Fittings Present
-  Transite Bench Board Present
-  ACM 9x9 VFT
-  ACM 12x12 VFT

### Not To Scale

Figure 3  
First Floor  
Asbestos Containing Materials  
Prepared By: DH  
Date: June 19, 2018  
Project:  
Designated Substances  
Survey - 01180066  
Location:  
Former VMI Building  
Guelph Ontario  
Prepared For:  
University of Guelph







Note: All observed VFT present within the scope of work contains ACM black mastic **except** rooms 140, and 126A. For VFT sample ID refer to Appendix E.



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### Legend

-  Scope of Work
-  Parged Pipe Fittings Present
-  ACM 9x9 VFT
-  ACM 12x12 VFT

### Not To Scale

Figure 4

Second Floor

Asbestos Containing Materials

Prepared By: DH

Date: June 19, 2018

Project:

Designated Substances

Survey - 01180066

Location:

Former VMI Building

Guelph Ontario

Prepared For:



University of Guelph

Note: All observed VFT present within the scope of work contains ACM black mastic **except** room 203. For VFT sample ID refer to Appendix E.



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### Legend

-  Parged Duct/Insulation Wrapping
-  Parged Pipe Fittings Present

Not To Scale

Figure 5

Penthouse (Mechanical Room)

Asbestos Containing Materials

Prepared By: DH

Date: June 19, 2018

Project:

Designated Substances

Survey - 01180066

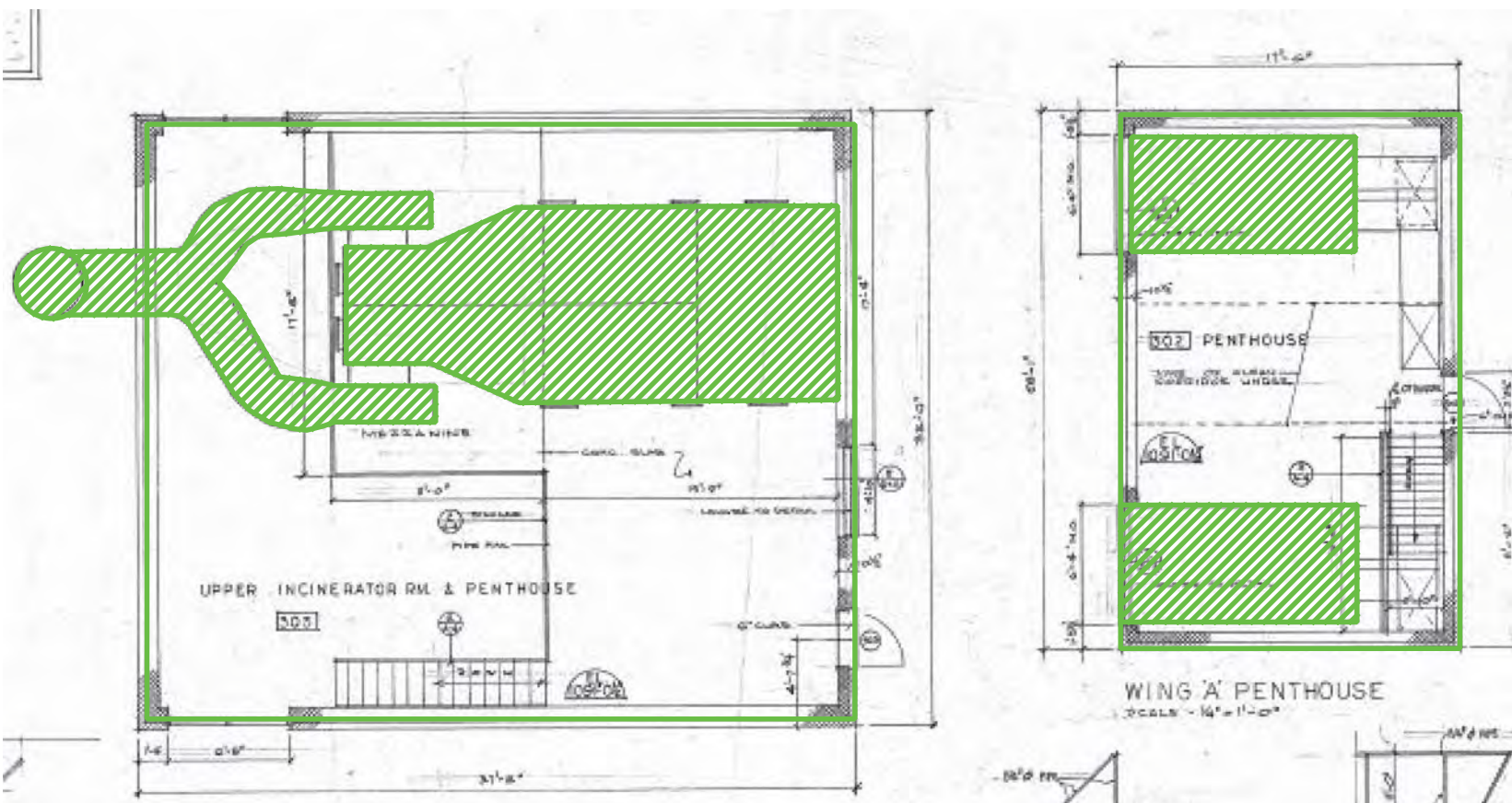
Location:

Former VMI Building

Guelph Ontario

Prepared For:

University of Guelph



Note: Additional parged duct/insulation wrapping is present that is **not** represented in this drawing. Some of the parged pipe fittings and wrapping have been remediated in this area.

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## Appendices

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## **Appendix A – Summary Photolog of Sampled and Noteworthy Materials**

## Appendix A - Summary Photolog of Sampled and Noteworthy Materials



Photo 1: Parged pipe fitting found throughout the building. **50% Chrysotile.**

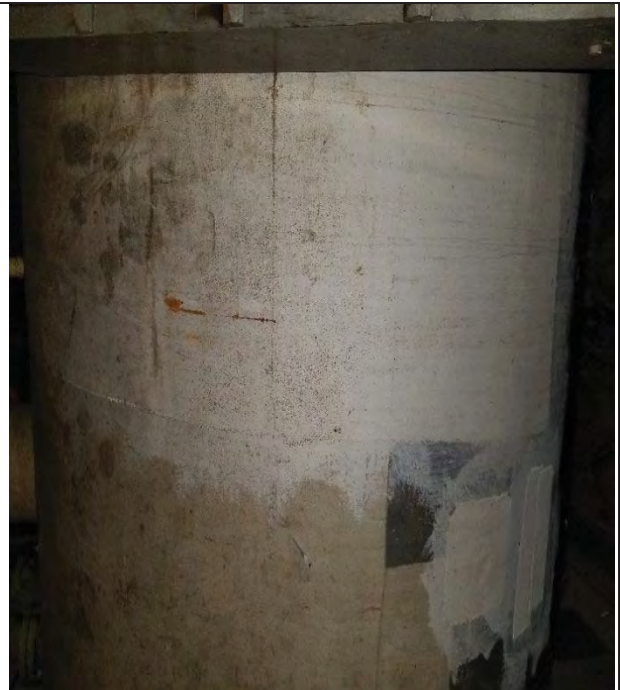


Photo 2: Parged pipe wrapping located in the Sewage Room 120A. **Presumed asbestos containing.**

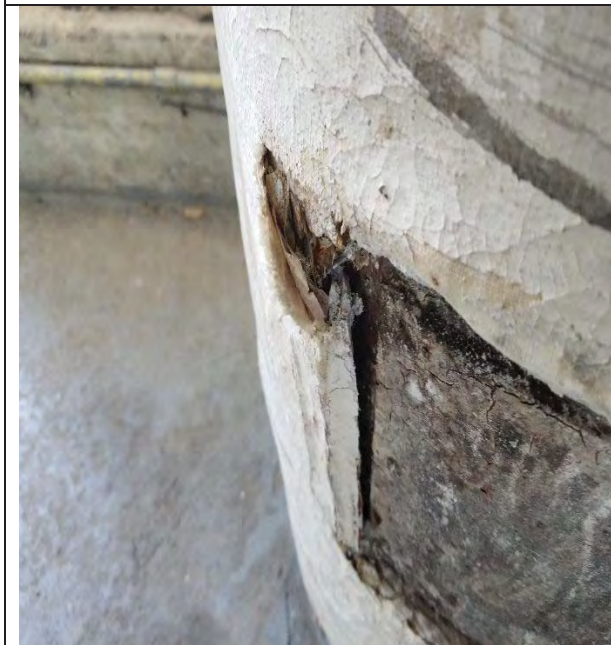


Photo 3: Parged pipe wrapping located in Penthouse 222. **Presumed asbestos containing.**



Photo 4: Black VFT mastic found throughout the building. **1% Chrysotile.**



Photo 5: VFT – Teal with white streaks (Right tile, LEX sample 23). **1% Chrysotile.**

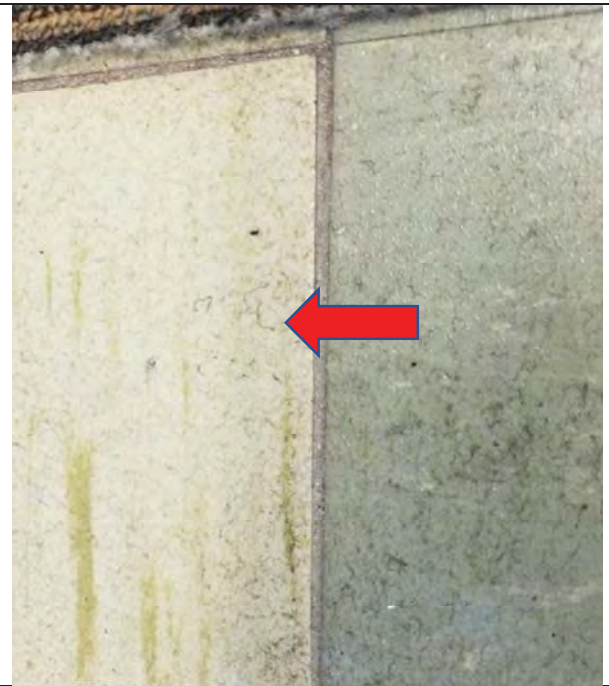


Photo 6: White with green streaks (Left tile, LEX sample 20). **2% Chrysotile.**

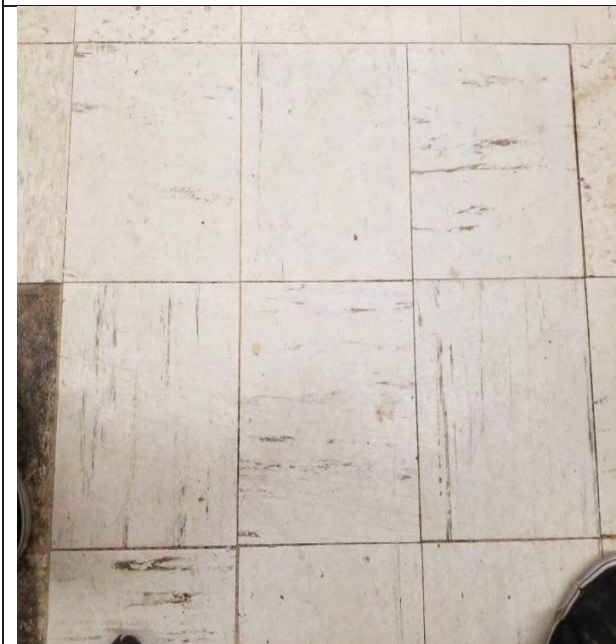


Photo 7: VFT – Grey with black streaks 9x9 (LEX sample 25). **1% Chrysotile.**



Photo 8: VFT – Brown with multi-colour streaks 9x9 (LEX sample 30). **0.5% Chrysotile.**



Photo 9: VFT – White with brown streaks 9x9 (LEX sample 31). **1% Chrysotile.**



Photo 10: VFT – Blue with white streaks 9x9 (LEX sample 32). **1% Chrysotile.**



Photo 11: VFT – Red with white streaks 9x9 (LEX sample 36). **1% Chrysotile.**

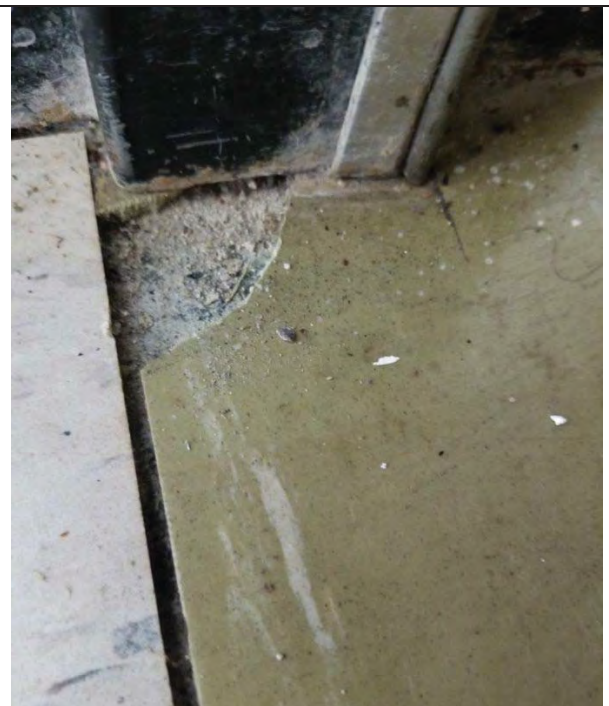


Photo 12 - VFT – Olive with white streaks 9x9 (LEX sample 13). **0.5% Chrysotile.**



Photo 13: VFT – Brown with white streaks 9x9 (LEX sample 17). **0.5% Chrysotile.**



Photo 14: VFT – Grey with white 9x9 (LEX sample 18). **0.5% Chrysotile.**



Photo 15: VFT – Green/Blue (LEX sample 19). **0.5% Chrysotile.**



Photo 16: VFT – Black with white streaks (LEX sample 33). **6% Chrysotile**



Photo 17: VFT – Army green with white (LEX sample 39). **1% Chrysotile.**



Photo 18: Transite bench board found in room 138.  
**Presumed asbestos containing.**



Photo 19: Parged wrapping remediation efforts observed in Penthouse 222.



Photo 20: Representative perchlorate test result completed in room 213A's fume hood. **No purple precipitates detected.**



Photo 21: Representative perchlorate test results completed in room 123's fume hood. **No purple precipitates detected.**

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## **Appendix B – Laboratory Certificate of Analysis – Asbestos in Bulk Samples**



**SOLUTIONS**  
FOR A WORKING WORLD

## CERTIFICATE OF ANALYSIS

<b>Company:</b>	LEX Scientific Inc.	<b>Report Date:</b>	28-May-18
<b>Contact:</b>	Mr. Dan Humphrey	<b>Analysis Date:</b>	24-May-18
<b>Client Address:</b>	291 Woodlawn Road West, Unit B-12, Guelph, ON	<b>Received Date:</b>	24-May-18
<b>Client Reference:</b>	01180066 University of Guelph - Physical Resource	<b>LEX Project Number:</b>	09180912
<b>Sampling Date:</b>	18-May-18	<b>Number of Analyses:</b>	121

### Analysis Requested Bulk Asbestos by PLM

Page 1 of 24

Analysis was performed in accordance with the method EPA/600/R-93/116, Method for the Determination of Asbestos in Bulk Building Materials adopted in Designated Substance - Asbestos on Construction Projects and in Buildings and Repair Operations - made under the Occupational Health and Safety Act Ontario Regulation 278/05. LEX Scientific Inc. is accredited by the National Voluntary Laboratory Accreditation Program (NVLAP 101949) by the National Institute of Standards and Technology for analysis of bulk materials for asbestos.

German Leal, B.Sc.  
Laboratory Manager

Fibrous Asbestos Content %		Other Materials Content %
<b>Client Sample:</b> 01-A	<b>Asbestos Detected?</b> No	
<b>LEX Sample:</b> 001.1	<b>Chrysotile:</b> None Detected	<b>Cellulose:</b> None Detected
<b>Layers Analyzed:</b> Scratch Coat	<b>Amosite:</b> None Detected	<b>MMVF:</b> None Detected
<b>Colour:</b> Grey	<b>Crocidolite:</b> None Detected	<b>Other Fibres:</b> None Detected
<b>Description:</b> Plaster (Two Layer)	<b>Other Amphiboles:</b> None Detected	<b>Non Fibrous:</b> 100
	<b>Comments:</b> N/A	

Other Amphiboles: ac=actinolite, a=anthophyllite, t-tremolite, u=unidentified  
MMVF: Man Made Vitreous Fibres: Fibreglass, Min. Wool, Rockwool, Glasswool  
PLM - method detection limit is 0.1%

Analyst

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291 Woodlawn Road West, Unit B-12, Guelph, Ontario N1H 7L6  
Phone: 519.824.7082 Toll Free: 1.800.824.7082  
e-mail: lab@lexscientific.com Website: www.lexscientific.com

		Fibrous Asbestos Content %	Other Materials Content %
<b>Client Sample:</b> 01-A	<b>Asbestos Detected?</b>	<b>No</b>	
<b>LEX Sample:</b> 001.2	<b>Chrysotile:</b>	None Detected	<b>Cellulose:</b> None Detected
<b>Layers Analyzed:</b> Finish Coat	<b>Amosite:</b>	None Detected	<b>MMVF:</b> None Detected
<b>Colour:</b> White	<b>Crocidolite:</b>	None Detected	<b>Other Fibres:</b> None Detected
<b>Description:</b> Plaster (Two Layer)	<b>Other Amphiboles:</b>	None Detected	<b>Non Fibrous:</b> 100
	<b>Comments:</b>	N/A	
<b>Client Sample:</b> 01-B	<b>Asbestos Detected?</b>	<b>No</b>	
<b>LEX Sample:</b> 002.1	<b>Chrysotile:</b>	None Detected	<b>Cellulose:</b> None Detected
<b>Layers Analyzed:</b> Scratch Coat	<b>Amosite:</b>	None Detected	<b>MMVF:</b> None Detected
<b>Colour:</b> Grey	<b>Crocidolite:</b>	None Detected	<b>Other Fibres:</b> None Detected
<b>Description:</b> Plaster (Two Layer)	<b>Other Amphiboles:</b>	None Detected	<b>Non Fibrous:</b> 100
	<b>Comments:</b>	N/A	
<b>Client Sample:</b> 01-B	<b>Asbestos Detected?</b>	<b>No</b>	
<b>LEX Sample:</b> 002.2	<b>Chrysotile:</b>	None Detected	<b>Cellulose:</b> None Detected
<b>Layers Analyzed:</b> Finish Coat	<b>Amosite:</b>	None Detected	<b>MMVF:</b> None Detected
<b>Colour:</b> White	<b>Crocidolite:</b>	None Detected	<b>Other Fibres:</b> None Detected
<b>Description:</b> Plaster (Two Layer)	<b>Other Amphiboles:</b>	None Detected	<b>Non Fibrous:</b> 100
	<b>Comments:</b>	N/A	
<b>Client Sample:</b> 01-C	<b>Asbestos Detected?</b>	<b>No</b>	
<b>LEX Sample:</b> 003.1	<b>Chrysotile:</b>	None Detected	<b>Cellulose:</b> None Detected
<b>Layers Analyzed:</b> Scratch Coat	<b>Amosite:</b>	None Detected	<b>MMVF:</b> None Detected
<b>Colour:</b> Grey	<b>Crocidolite:</b>	None Detected	<b>Other Fibres:</b> None Detected
<b>Description:</b> Plaster (Two Layer)	<b>Other Amphiboles:</b>	None Detected	<b>Non Fibrous:</b> 100
	<b>Comments:</b>	N/A	
<b>Client Sample:</b> 01-C	<b>Asbestos Detected?</b>	<b>No</b>	
<b>LEX Sample:</b> 003.2	<b>Chrysotile:</b>	None Detected	<b>Cellulose:</b> None Detected
<b>Layers Analyzed:</b> Finish Coat	<b>Amosite:</b>	None Detected	<b>MMVF:</b> None Detected
<b>Colour:</b> White	<b>Crocidolite:</b>	None Detected	<b>Other Fibres:</b> None Detected
<b>Description:</b> Plaster (Two Layer)	<b>Other Amphiboles:</b>	None Detected	<b>Non Fibrous:</b> 100
	<b>Comments:</b>	N/A	
<b>Client Sample:</b> 01-D	<b>Asbestos Detected?</b>	<b>No</b>	
<b>LEX Sample:</b> 004.1	<b>Chrysotile:</b>	None Detected	<b>Cellulose:</b> None Detected
<b>Layers Analyzed:</b> Scratch Coat	<b>Amosite:</b>	None Detected	<b>MMVF:</b> None Detected
<b>Colour:</b> Grey	<b>Crocidolite:</b>	None Detected	<b>Other Fibres:</b> None Detected
<b>Description:</b> Plaster (Two Layer)	<b>Other Amphiboles:</b>	None Detected	<b>Non Fibrous:</b> 100
	<b>Comments:</b>	N/A	

Other Amphiboles: ac=actinolite, a=anthophyllite, t=tremolite, u=unidentified  
MMVF: Man Made Vitreous Fibres: Fibreglass, Min. Wool, Rockwool, Glasswool  
PLM - method detection limit is 0.1%

Analyst



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		Fibrous Asbestos Content %	Other Materials Content %
<b>Client Sample:</b> 01-D	<b>Asbestos Detected?</b>	<b>No</b>	
<b>LEX Sample:</b> 004.2	<b>Chrysotile:</b>	None Detected	<b>Cellulose:</b> None Detected
<b>Layers Analyzed:</b> Finish Coat	<b>Amosite:</b>	None Detected	<b>MMVF:</b> None Detected
<b>Colour:</b> White	<b>Crocidolite:</b>	None Detected	<b>Other Fibres:</b> None Detected
<b>Description:</b> Plaster (Two Layer)	<b>Other Amphiboles:</b>	None Detected	<b>Non Fibrous:</b> 100
	<b>Comments:</b>	N/A	
<b>Client Sample:</b> 01-E	<b>Asbestos Detected?</b>	<b>No</b>	
<b>LEX Sample:</b> 005.1	<b>Chrysotile:</b>	None Detected	<b>Cellulose:</b> None Detected
<b>Layers Analyzed:</b> Scratch Coat	<b>Amosite:</b>	None Detected	<b>MMVF:</b> None Detected
<b>Colour:</b> Grey	<b>Crocidolite:</b>	None Detected	<b>Other Fibres:</b> None Detected
<b>Description:</b> Plaster (Two Layer)	<b>Other Amphiboles:</b>	None Detected	<b>Non Fibrous:</b> 100
	<b>Comments:</b>	N/A	
<b>Client Sample:</b> 01-E	<b>Asbestos Detected?</b>	<b>No</b>	
<b>LEX Sample:</b> 005.2	<b>Chrysotile:</b>	None Detected	<b>Cellulose:</b> None Detected
<b>Layers Analyzed:</b> Finish Coat	<b>Amosite:</b>	None Detected	<b>MMVF:</b> None Detected
<b>Colour:</b> White	<b>Crocidolite:</b>	None Detected	<b>Other Fibres:</b> None Detected
<b>Description:</b> Plaster (Two Layer)	<b>Other Amphiboles:</b>	None Detected	<b>Non Fibrous:</b> 100
	<b>Comments:</b>	N/A	
<b>Client Sample:</b> 01-F	<b>Asbestos Detected?</b>	<b>No</b>	
<b>LEX Sample:</b> 006.1	<b>Chrysotile:</b>	None Detected	<b>Cellulose:</b> None Detected
<b>Layers Analyzed:</b> Scratch Coat	<b>Amosite:</b>	None Detected	<b>MMVF:</b> None Detected
<b>Colour:</b> Grey	<b>Crocidolite:</b>	None Detected	<b>Other Fibres:</b> None Detected
<b>Description:</b> Plaster (Two Layer)	<b>Other Amphiboles:</b>	None Detected	<b>Non Fibrous:</b> 100
	<b>Comments:</b>	N/A	
<b>Client Sample:</b> 01-F	<b>Asbestos Detected?</b>	<b>No</b>	
<b>LEX Sample:</b> 006.2	<b>Chrysotile:</b>	None Detected	<b>Cellulose:</b> None Detected
<b>Layers Analyzed:</b> Finish Coat	<b>Amosite:</b>	None Detected	<b>MMVF:</b> None Detected
<b>Colour:</b> White	<b>Crocidolite:</b>	None Detected	<b>Other Fibres:</b> None Detected
<b>Description:</b> Plaster (Two Layer)	<b>Other Amphiboles:</b>	None Detected	<b>Non Fibrous:</b> 100
	<b>Comments:</b>	N/A	
<b>Client Sample:</b> 01-G	<b>Asbestos Detected?</b>	<b>No</b>	
<b>LEX Sample:</b> 007.1	<b>Chrysotile:</b>	None Detected	<b>Cellulose:</b> None Detected
<b>Layers Analyzed:</b> Scratch Coat	<b>Amosite:</b>	None Detected	<b>MMVF:</b> None Detected
<b>Colour:</b> Grey	<b>Crocidolite:</b>	None Detected	<b>Other Fibres:</b> None Detected
<b>Description:</b> Plaster (Two Layer)	<b>Other Amphiboles:</b>	None Detected	<b>Non Fibrous:</b> 100
	<b>Comments:</b>	N/A	

Other Amphiboles: ac=actinolite, a=anthophyllite, t-tremolite, u=unidentified  
MMVF: Man Made Vitreous Fibres: Fibreglass, Min. Wool, Rockwool, Glasswool  
PLM - method detection limit is 0.1%

Analyst



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		Fibrous Asbestos Content %	Other Materials Content %
<b>Client Sample:</b> 01-G	<b>Asbestos Detected?</b>	<b>No</b>	
<b>LEX Sample:</b> 007.2	<b>Chrysotile:</b>	None Detected	<b>Cellulose:</b> None Detected
<b>Layers Analyzed:</b> Finish Coat	<b>Amosite:</b>	None Detected	<b>MMVF:</b> None Detected
<b>Colour:</b> White	<b>Crocidolite:</b>	None Detected	<b>Other Fibres:</b> None Detected
<b>Description:</b> Plaster (Two Layer)	<b>Other Amphiboles:</b>	None Detected	<b>Non Fibrous:</b> 100
	<b>Comments:</b>	N/A	
<b>Client Sample:</b> 02-A	<b>Asbestos Detected?</b>	<b>No</b>	
<b>LEX Sample:</b> 008	<b>Chrysotile:</b>	None Detected	<b>Cellulose:</b> 50
<b>Layers Analyzed:</b> Sample Homogenized	<b>Amosite:</b>	None Detected	<b>MMVF:</b> 50
<b>Colour:</b> Grey/White	<b>Crocidolite:</b>	None Detected	<b>Other Fibres:</b> None Detected
<b>Description:</b> Ceiling Tile - Large/Small Pinhole	<b>Other Amphiboles:</b>	None Detected	<b>Non Fibrous:</b> None Detected
	<b>Comments:</b>	N/A	
<b>Client Sample:</b> 02-B	<b>Asbestos Detected?</b>	<b>No</b>	
<b>LEX Sample:</b> 009	<b>Chrysotile:</b>	None Detected	<b>Cellulose:</b> 50
<b>Layers Analyzed:</b> Sample Homogenized	<b>Amosite:</b>	None Detected	<b>MMVF:</b> 50
<b>Colour:</b> Grey/White	<b>Crocidolite:</b>	None Detected	<b>Other Fibres:</b> None Detected
<b>Description:</b> Ceiling Tile - Large/Small Pinhole	<b>Other Amphiboles:</b>	None Detected	<b>Non Fibrous:</b> None Detected
	<b>Comments:</b>	N/A	
<b>Client Sample:</b> 02-C	<b>Asbestos Detected?</b>	<b>No</b>	
<b>LEX Sample:</b> 010	<b>Chrysotile:</b>	None Detected	<b>Cellulose:</b> 50
<b>Layers Analyzed:</b> Sample Homogenized	<b>Amosite:</b>	None Detected	<b>MMVF:</b> 50
<b>Colour:</b> Grey/White	<b>Crocidolite:</b>	None Detected	<b>Other Fibres:</b> None Detected
<b>Description:</b> Ceiling Tile - Large/Small Pinhole	<b>Other Amphiboles:</b>	None Detected	<b>Non Fibrous:</b> None Detected
	<b>Comments:</b>	N/A	
<b>Client Sample:</b> 03-A	<b>Asbestos Detected?</b>	<b>No</b>	
<b>LEX Sample:</b> 011	<b>Chrysotile:</b>	None Detected	<b>Cellulose:</b> None Detected
<b>Layers Analyzed:</b> Sample Homogenized	<b>Amosite:</b>	None Detected	<b>MMVF:</b> None Detected
<b>Colour:</b> Brown	<b>Crocidolite:</b>	None Detected	<b>Other Fibres:</b> None Detected
<b>Description:</b> Ceiling Tile Pucks - 9x9 Glue	<b>Other Amphiboles:</b>	None Detected	<b>Non Fibrous:</b> 100
	<b>Comments:</b>	N/A	
<b>Client Sample:</b> 03-B	<b>Asbestos Detected?</b>	<b>No</b>	
<b>LEX Sample:</b> 012	<b>Chrysotile:</b>	None Detected	<b>Cellulose:</b> None Detected
<b>Layers Analyzed:</b> Sample Homogenized	<b>Amosite:</b>	None Detected	<b>MMVF:</b> None Detected
<b>Colour:</b> Brown	<b>Crocidolite:</b>	None Detected	<b>Other Fibres:</b> None Detected
<b>Description:</b> Ceiling Tile Pucks - 9x9 Glue	<b>Other Amphiboles:</b>	None Detected	<b>Non Fibrous:</b> 100
	<b>Comments:</b>	N/A	

Other Amphiboles: ac=actinolite, a=anthophyllite, t-tremolite, u=unidentified  
 MMVF: Man Made Vitreous Fibres: Fibreglass, Min. Wool, Rockwool, Glasswool  
 PLM - method detection limit is 0.1%

Analyst



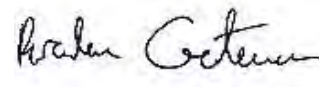
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		Fibrous Asbestos Content %	Other Materials Content %
<b>Client Sample:</b> 03-C	<b>Asbestos Detected?</b>	<b>No</b>	
<b>LEX Sample:</b> 013	<b>Chrysotile:</b>	None Detected	<b>Cellulose:</b> None Detected
<b>Layers Analyzed:</b> Sample Homogenized	<b>Amosite:</b>	None Detected	<b>MMVF:</b> None Detected
<b>Colour:</b> Brown	<b>Crocidolite:</b>	None Detected	<b>Other Fibres:</b> None Detected
<b>Description:</b> Ceiling Tile Pucks - 9x9 Glue	<b>Other Amphiboles:</b>	None Detected	<b>Non Fibrous:</b> 100
	<b>Comments:</b>	N/A	
<b>Client Sample:</b> 04-A	<b>Asbestos Detected?</b>	<b>No</b>	
<b>LEX Sample:</b> 014	<b>Chrysotile:</b>	None Detected	<b>Cellulose:</b> 60
<b>Layers Analyzed:</b> Sample Homogenized	<b>Amosite:</b>	None Detected	<b>MMVF:</b> 40
<b>Colour:</b> Grey/White	<b>Crocidolite:</b>	None Detected	<b>Other Fibres:</b> None Detected
<b>Description:</b> Ceiling Tile - Rough	<b>Other Amphiboles:</b>	None Detected	<b>Non Fibrous:</b> None Detected
	<b>Comments:</b>	N/A	
<b>Client Sample:</b> 04-B	<b>Asbestos Detected?</b>	<b>No</b>	
<b>LEX Sample:</b> 015	<b>Chrysotile:</b>	None Detected	<b>Cellulose:</b> 60
<b>Layers Analyzed:</b> Sample Homogenized	<b>Amosite:</b>	None Detected	<b>MMVF:</b> 40
<b>Colour:</b> Grey/White	<b>Crocidolite:</b>	None Detected	<b>Other Fibres:</b> None Detected
<b>Description:</b> Ceiling Tile - Rough	<b>Other Amphiboles:</b>	None Detected	<b>Non Fibrous:</b> None Detected
	<b>Comments:</b>	N/A	
<b>Client Sample:</b> 04-C	<b>Asbestos Detected?</b>	<b>No</b>	
<b>LEX Sample:</b> 016	<b>Chrysotile:</b>	None Detected	<b>Cellulose:</b> 60
<b>Layers Analyzed:</b> Sample Homogenized	<b>Amosite:</b>	None Detected	<b>MMVF:</b> 40
<b>Colour:</b> Grey/White	<b>Crocidolite:</b>	None Detected	<b>Other Fibres:</b> None Detected
<b>Description:</b> Ceiling Tile - Rough	<b>Other Amphiboles:</b>	None Detected	<b>Non Fibrous:</b> None Detected
	<b>Comments:</b>	N/A	
<b>Client Sample:</b> 05-A	<b>Asbestos Detected?</b>	<b>No</b>	
<b>LEX Sample:</b> 017	<b>Chrysotile:</b>	None Detected	<b>Cellulose:</b> None Detected
<b>Layers Analyzed:</b> Sample Homogenized	<b>Amosite:</b>	None Detected	<b>MMVF:</b> None Detected
<b>Colour:</b> Grey/White	<b>Crocidolite:</b>	None Detected	<b>Other Fibres:</b> None Detected
<b>Description:</b> Window Caulking - White	<b>Other Amphiboles:</b>	None Detected	<b>Non Fibrous:</b> 100
	<b>Comments:</b>	N/A	
<b>Client Sample:</b> 05-B	<b>Asbestos Detected?</b>	<b>No</b>	
<b>LEX Sample:</b> 018	<b>Chrysotile:</b>	None Detected	<b>Cellulose:</b> None Detected
<b>Layers Analyzed:</b> Sample Homogenized	<b>Amosite:</b>	None Detected	<b>MMVF:</b> None Detected
<b>Colour:</b> Grey/White	<b>Crocidolite:</b>	None Detected	<b>Other Fibres:</b> None Detected
<b>Description:</b> Window Caulking - White	<b>Other Amphiboles:</b>	None Detected	<b>Non Fibrous:</b> 100
	<b>Comments:</b>	N/A	

Other Amphiboles: ac=actinolite, a=anthophyllite, t-tremolite, u=unidentified  
MMVF: Man Made Vitreous Fibres: Fibreglass, Min. Wool, Rockwool, Glasswool  
PLM - method detection limit is 0.1%

Analyst



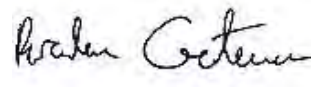
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		Fibrous Asbestos Content %	Other Materials Content %
<b>Client Sample:</b> 05-C	<b>Asbestos Detected?</b>	<b>No</b>	
<b>LEX Sample:</b> 019	<b>Chrysotile:</b>	None Detected	<b>Cellulose:</b> None Detected
<b>Layers Analyzed:</b> Sample Homogenized	<b>Amosite:</b>	None Detected	<b>MMVF:</b> None Detected
<b>Colour:</b> Grey/White	<b>Crocidolite:</b>	None Detected	<b>Other Fibres:</b> None Detected
<b>Description:</b> Window Caulking - White	<b>Other Amphiboles:</b>	None Detected	<b>Non Fibrous:</b> 100
	<b>Comments:</b>	N/A	
<b>Client Sample:</b> 06-A	<b>Asbestos Detected?</b>	<b>No</b>	
<b>LEX Sample:</b> 020	<b>Chrysotile:</b>	None Detected	<b>Cellulose:</b> None Detected
<b>Layers Analyzed:</b> Mastic	<b>Amosite:</b>	None Detected	<b>MMVF:</b> None Detected
<b>Colour:</b> Orange	<b>Crocidolite:</b>	None Detected	<b>Other Fibres:</b> None Detected
<b>Description:</b> Baseboard Mastic #1 (yellow)	<b>Other Amphiboles:</b>	None Detected	<b>Non Fibrous:</b> 100
	<b>Comments:</b>	N/A	
<b>Client Sample:</b> 06-B	<b>Asbestos Detected?</b>	<b>No</b>	
<b>LEX Sample:</b> 021	<b>Chrysotile:</b>	None Detected	<b>Cellulose:</b> None Detected
<b>Layers Analyzed:</b> Mastic	<b>Amosite:</b>	None Detected	<b>MMVF:</b> None Detected
<b>Colour:</b> Orange	<b>Crocidolite:</b>	None Detected	<b>Other Fibres:</b> None Detected
<b>Description:</b> Baseboard Mastic #1 (yellow)	<b>Other Amphiboles:</b>	None Detected	<b>Non Fibrous:</b> 100
	<b>Comments:</b>	N/A	
<b>Client Sample:</b> 06-C	<b>Asbestos Detected?</b>	<b>No</b>	
<b>LEX Sample:</b> 022	<b>Chrysotile:</b>	None Detected	<b>Cellulose:</b> None Detected
<b>Layers Analyzed:</b> Mastic	<b>Amosite:</b>	None Detected	<b>MMVF:</b> None Detected
<b>Colour:</b> Orange	<b>Crocidolite:</b>	None Detected	<b>Other Fibres:</b> None Detected
<b>Description:</b> Baseboard Mastic #1 (yellow)	<b>Other Amphiboles:</b>	None Detected	<b>Non Fibrous:</b> 100
	<b>Comments:</b>	N/A	
<b>Client Sample:</b> 07-A	<b>Asbestos Detected?</b>	<b>No</b>	
<b>LEX Sample:</b> 023.1	<b>Chrysotile:</b>	None Detected	<b>Cellulose:</b> None Detected
<b>Layers Analyzed:</b> Floor Tile	<b>Amosite:</b>	None Detected	<b>MMVF:</b> None Detected
<b>Colour:</b> Brown	<b>Crocidolite:</b>	None Detected	<b>Other Fibres:</b> None Detected
<b>Description:</b> Vinyl Flooring Tile - Brown with Grey + Mastic	<b>Other Amphiboles:</b>	None Detected	<b>Non Fibrous:</b> 100
	<b>Comments:</b>	N/A	

Other Amphiboles: ac=actinolite, a=anthophyllite, t=tremolite, u=unidentified  
 MMVF: Man Made Vitreous Fibres: Fibreglass, Min. Wool, Rockwool, Glasswool  
 PLM - method detection limit is 0.1%

Analyst



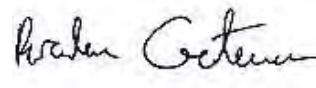
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Fibrous Asbestos Content %		Other Materials Content %	
<b>Client Sample:</b> 07-A	<b>Asbestos Detected?</b>	<b>No</b>	
<b>LEX Sample:</b> 023.2	<b>Chrysotile:</b>	None Detected	<b>Cellulose:</b> None Detected
<b>Layers Analyzed:</b> Mastic	<b>Amosite:</b>	None Detected	<b>MMVF:</b> None Detected
<b>Colour:</b> Orange	<b>Crocidolite:</b>	None Detected	<b>Other Fibres:</b> None Detected
<b>Description:</b> Vinyl Flooring Tile - Brown with Grey + Mastic	<b>Other Amphiboles:</b>	None Detected	<b>Non Fibrous:</b> 100
	<b>Comments:</b>	N/A	
<b>Client Sample:</b> 07-B	<b>Asbestos Detected?</b>	<b>No</b>	
<b>LEX Sample:</b> 024.1	<b>Chrysotile:</b>	None Detected	<b>Cellulose:</b> None Detected
<b>Layers Analyzed:</b> Floor Tile	<b>Amosite:</b>	None Detected	<b>MMVF:</b> None Detected
<b>Colour:</b> Brown	<b>Crocidolite:</b>	None Detected	<b>Other Fibres:</b> None Detected
<b>Description:</b> Vinyl Flooring Tile - Brown with Grey + Mastic	<b>Other Amphiboles:</b>	None Detected	<b>Non Fibrous:</b> 100
	<b>Comments:</b>	N/A	
<b>Client Sample:</b> 07-B	<b>Asbestos Detected?</b>	<b>No</b>	
<b>LEX Sample:</b> 024.2	<b>Chrysotile:</b>	None Detected	<b>Cellulose:</b> None Detected
<b>Layers Analyzed:</b> Mastic	<b>Amosite:</b>	None Detected	<b>MMVF:</b> None Detected
<b>Colour:</b> Orange	<b>Crocidolite:</b>	None Detected	<b>Other Fibres:</b> None Detected
<b>Description:</b> Vinyl Flooring Tile - Brown with Grey + Mastic	<b>Other Amphiboles:</b>	None Detected	<b>Non Fibrous:</b> 100
	<b>Comments:</b>	N/A	
<b>Client Sample:</b> 07-C	<b>Asbestos Detected?</b>	<b>No</b>	
<b>LEX Sample:</b> 025.1	<b>Chrysotile:</b>	None Detected	<b>Cellulose:</b> None Detected
<b>Layers Analyzed:</b> Floor Tile	<b>Amosite:</b>	None Detected	<b>MMVF:</b> None Detected
<b>Colour:</b> Brown	<b>Crocidolite:</b>	None Detected	<b>Other Fibres:</b> None Detected
<b>Description:</b> Vinyl Flooring Tile - Brown with Grey + Mastic	<b>Other Amphiboles:</b>	None Detected	<b>Non Fibrous:</b> 100
	<b>Comments:</b>	N/A	
<b>Client Sample:</b> 07-C	<b>Asbestos Detected?</b>	<b>No</b>	
<b>LEX Sample:</b> 025.2	<b>Chrysotile:</b>	None Detected	<b>Cellulose:</b> None Detected
<b>Layers Analyzed:</b> Mastic	<b>Amosite:</b>	None Detected	<b>MMVF:</b> None Detected
<b>Colour:</b> Orange	<b>Crocidolite:</b>	None Detected	<b>Other Fibres:</b> None Detected
<b>Description:</b> Vinyl Flooring Tile - Brown with Grey + Mastic	<b>Other Amphiboles:</b>	None Detected	<b>Non Fibrous:</b> 100
	<b>Comments:</b>	N/A	

Other Amphiboles: ac=actinolite, a=anthophyllite, t=tremolite, u=unidentified  
 MMVF: Man Made Vitreous Fibres: Fibreglass, Min. Wool, Rockwool, Glasswool  
 PLM - method detection limit is 0.1%

Analyst



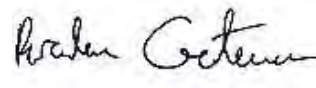
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		Fibrous Asbestos Content %	Other Materials Content %
<b>Client Sample:</b> 08-A	<b>Asbestos Detected?</b>	<b>Yes</b>	
<b>LEX Sample:</b> 026	<b>Chrysotile:</b>	50	<b>Cellulose:</b> None Detected
<b>Layers Analyzed:</b> Sample Homogenized	<b>Amosite:</b>	None Detected	<b>MMVF:</b> None Detected
<b>Colour:</b> Grey	<b>Crocidolite:</b>	None Detected	<b>Other Fibres:</b> None Detected
<b>Description:</b> Parged Pipe Fitting	<b>Other Amphiboles:</b>	None Detected	<b>Non Fibrous:</b> 50
	<b>Comments:</b>	This sample meets the definition of "asbestos containing material" according to Ontario Regulation 278/05.	
<b>Client Sample:</b> 09-A	<b>Asbestos Detected?</b>	<b>Yes</b>	
<b>LEX Sample:</b> 027	<b>Chrysotile:</b>	< 0.5	<b>Cellulose:</b> 100
<b>Layers Analyzed:</b> Sample Homogenized	<b>Amosite:</b>	None Detected	<b>MMVF:</b> None Detected
<b>Colour:</b> Black	<b>Crocidolite:</b>	None Detected	<b>Other Fibres:</b> None Detected
<b>Description:</b> Tar Duct Insulation	<b>Other Amphiboles:</b>	None Detected	<b>Non Fibrous:</b> None Detected
	<b>Comments:</b>	Not asbestos containing material under Ontario Regulation 278/05.	
<b>Client Sample:</b> 09-B	<b>Asbestos Detected?</b>	<b>Yes</b>	
<b>LEX Sample:</b> 028	<b>Chrysotile:</b>	< 0.5	<b>Cellulose:</b> 100
<b>Layers Analyzed:</b> Sample Homogenized	<b>Amosite:</b>	None Detected	<b>MMVF:</b> None Detected
<b>Colour:</b> Black	<b>Crocidolite:</b>	None Detected	<b>Other Fibres:</b> None Detected
<b>Description:</b> Tar Duct Insulation	<b>Other Amphiboles:</b>	None Detected	<b>Non Fibrous:</b> None Detected
	<b>Comments:</b>	Not asbestos containing material under Ontario Regulation 278/05.	
<b>Client Sample:</b> 09-C	<b>Asbestos Detected?</b>	<b>Yes</b>	
<b>LEX Sample:</b> 029	<b>Chrysotile:</b>	< 0.5	<b>Cellulose:</b> 100
<b>Layers Analyzed:</b> Sample Homogenized	<b>Amosite:</b>	None Detected	<b>MMVF:</b> None Detected
<b>Colour:</b> Black	<b>Crocidolite:</b>	None Detected	<b>Other Fibres:</b> None Detected
<b>Description:</b> Tar Duct Insulation	<b>Other Amphiboles:</b>	None Detected	<b>Non Fibrous:</b> None Detected
	<b>Comments:</b>	Not asbestos containing material under Ontario Regulation 278/05.	
<b>Client Sample:</b> 10-A	<b>Asbestos Detected?</b>	<b>No</b>	
<b>LEX Sample:</b> 030	<b>Chrysotile:</b>	None Detected	<b>Cellulose:</b> 5
<b>Layers Analyzed:</b> Sample Homogenized	<b>Amosite:</b>	None Detected	<b>MMVF:</b> None Detected
<b>Colour:</b> Blue/Grey	<b>Crocidolite:</b>	None Detected	<b>Other Fibres:</b> None Detected
<b>Description:</b> Sink Undercoat	<b>Other Amphiboles:</b>	None Detected	<b>Non Fibrous:</b> 95
	<b>Comments:</b>	N/A	

Other Amphiboles: ac=actinolite, a=anthophyllite, t-tremolite, u=unidentified  
MMVF: Man Made Vitreous Fibres: Fibreglass, Min. Wool, Rockwool, Glasswool  
PLM - method detection limit is 0.1%

Analyst



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		Fibrous Asbestos Content %	Other Materials Content %
<b>Client Sample:</b> 10-B	<b>Asbestos Detected?</b>	<b>No</b>	
<b>LEX Sample:</b> 031	<b>Chrysotile:</b>	None Detected	<b>Cellulose:</b> 5
<b>Layers Analyzed:</b> Sample Homogenized	<b>Amosite:</b>	None Detected	<b>MMVF:</b> None Detected
<b>Colour:</b> Blue/Grey	<b>Crocidolite:</b>	None Detected	<b>Other Fibres:</b> None Detected
<b>Description:</b> Sink Undercoat	<b>Other Amphiboles:</b>	None Detected	<b>Non Fibrous:</b> 95
	<b>Comments:</b>	N/A	
<b>Client Sample:</b> 10-C	<b>Asbestos Detected?</b>	<b>No</b>	
<b>LEX Sample:</b> 032	<b>Chrysotile:</b>	None Detected	<b>Cellulose:</b> 5
<b>Layers Analyzed:</b> Sample Homogenized	<b>Amosite:</b>	None Detected	<b>MMVF:</b> None Detected
<b>Colour:</b> Blue/Grey	<b>Crocidolite:</b>	None Detected	<b>Other Fibres:</b> None Detected
<b>Description:</b> Sink Undercoat	<b>Other Amphiboles:</b>	None Detected	<b>Non Fibrous:</b> 95
	<b>Comments:</b>	N/A	
<b>Client Sample:</b> 11-A	<b>Asbestos Detected?</b>	<b>No</b>	
<b>LEX Sample:</b> 033	<b>Chrysotile:</b>	None Detected	<b>Cellulose:</b> None Detected
<b>Layers Analyzed:</b> Mastic	<b>Amosite:</b>	None Detected	<b>MMVF:</b> None Detected
<b>Colour:</b> Orange	<b>Crocidolite:</b>	None Detected	<b>Other Fibres:</b> None Detected
<b>Description:</b> Baseboard Mastic #2	<b>Other Amphiboles:</b>	None Detected	<b>Non Fibrous:</b> 100
	<b>Comments:</b>	N/A	
<b>Client Sample:</b> 11-B	<b>Asbestos Detected?</b>	<b>No</b>	
<b>LEX Sample:</b> 034	<b>Chrysotile:</b>	None Detected	<b>Cellulose:</b> None Detected
<b>Layers Analyzed:</b> Mastic	<b>Amosite:</b>	None Detected	<b>MMVF:</b> None Detected
<b>Colour:</b> Orange	<b>Crocidolite:</b>	None Detected	<b>Other Fibres:</b> None Detected
<b>Description:</b> Baseboard Mastic #2	<b>Other Amphiboles:</b>	None Detected	<b>Non Fibrous:</b> 100
	<b>Comments:</b>	N/A	
<b>Client Sample:</b> 11-C	<b>Asbestos Detected?</b>	<b>No</b>	
<b>LEX Sample:</b> 035	<b>Chrysotile:</b>	None Detected	<b>Cellulose:</b> None Detected
<b>Layers Analyzed:</b> Mastic	<b>Amosite:</b>	None Detected	<b>MMVF:</b> None Detected
<b>Colour:</b> Orange	<b>Crocidolite:</b>	None Detected	<b>Other Fibres:</b> None Detected
<b>Description:</b> Baseboard Mastic #2	<b>Other Amphiboles:</b>	None Detected	<b>Non Fibrous:</b> 100
	<b>Comments:</b>	N/A	

Other Amphiboles: ac=actinolite, a=anthophyllite, t-tremolite, u=unidentified  
 MMVF: Man Made Vitreous Fibres: Fibreglass, Min. Wool, Rockwool, Glasswool  
 PLM - method detection limit is 0.1%

Analyst



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		Fibrous Asbestos Content %	Other Materials Content %
<b>Client Sample:</b> 12-A	<b>Asbestos Detected?</b>	<b>No</b>	
<b>LEX Sample:</b> 036.1	<b>Chrysotile:</b>	None Detected	<b>Cellulose:</b> None Detected
<b>Layers Analyzed:</b> Floor Tile	<b>Amosite:</b>	None Detected	<b>MMVF:</b> None Detected
<b>Colour:</b> White	<b>Crocidolite:</b>	None Detected	<b>Other Fibres:</b> None Detected
<b>Description:</b> Vinyl Flooring Tile - White and Black and Mastic (Black)	<b>Other Amphiboles:</b>	None Detected	<b>Non Fibrous:</b> 100
	<b>Comments:</b>	N/A	
<b>Client Sample:</b> 12-A	<b>Asbestos Detected?</b>	<b>Yes</b>	
<b>LEX Sample:</b> 036.2	<b>Chrysotile:</b>	1	<b>Cellulose:</b> None Detected
<b>Layers Analyzed:</b> Mastic	<b>Amosite:</b>	None Detected	<b>MMVF:</b> None Detected
<b>Colour:</b> Black	<b>Crocidolite:</b>	None Detected	<b>Other Fibres:</b> None Detected
<b>Description:</b> Vinyl Flooring Tile - White and Black and Mastic (Black)	<b>Other Amphiboles:</b>	None Detected	<b>Non Fibrous:</b> 99
	<b>Comments:</b>	This sample meets the definition of "asbestos containing material" according to Ontario Regulation 278/05.	
<b>Client Sample:</b> 12-B	<b>Asbestos Detected?</b>	<b>No</b>	
<b>LEX Sample:</b> 037.1	<b>Chrysotile:</b>	None Detected	<b>Cellulose:</b> None Detected
<b>Layers Analyzed:</b> Floor Tile	<b>Amosite:</b>	None Detected	<b>MMVF:</b> None Detected
<b>Colour:</b> White	<b>Crocidolite:</b>	None Detected	<b>Other Fibres:</b> None Detected
<b>Description:</b> Vinyl Flooring Tile - White and Black and Mastic (Black)	<b>Other Amphiboles:</b>	None Detected	<b>Non Fibrous:</b> 100
	<b>Comments:</b>	N/A	
<b>Client Sample:</b> 12-C	<b>Asbestos Detected?</b>	<b>No</b>	
<b>LEX Sample:</b> 038.1	<b>Chrysotile:</b>	None Detected	<b>Cellulose:</b> None Detected
<b>Layers Analyzed:</b> Floor Tile	<b>Amosite:</b>	None Detected	<b>MMVF:</b> None Detected
<b>Colour:</b> White	<b>Crocidolite:</b>	None Detected	<b>Other Fibres:</b> None Detected
<b>Description:</b> Vinyl Flooring Tile - White and Black and Mastic (Black)	<b>Other Amphiboles:</b>	None Detected	<b>Non Fibrous:</b> 100
	<b>Comments:</b>	N/A	
<b>Client Sample:</b> 13-A	<b>Asbestos Detected?</b>	<b>Yes</b>	
<b>LEX Sample:</b> 039	<b>Chrysotile:</b>	0.5	<b>Cellulose:</b> None Detected
<b>Layers Analyzed:</b> Sample Homogenized	<b>Amosite:</b>	None Detected	<b>MMVF:</b> None Detected
<b>Colour:</b> Green/Black	<b>Crocidolite:</b>	None Detected	<b>Other Fibres:</b> None Detected
<b>Description:</b> Vinyl Flooring Tile - Olive with White Streaks 9x9	<b>Other Amphiboles:</b>	None Detected	<b>Non Fibrous:</b> 99.5
	<b>Comments:</b>	This sample meets the definition of "asbestos containing material" according to Ontario Regulation 278/05.	

Other Amphiboles: ac=actinolite, a=anthophyllite, t-tremolite, u=unidentified  
 MMVF: Man Made Vitreous Fibres: Fibreglass, Min. Wool, Rockwool, Glasswool  
 PLM - method detection limit is 0.1%

Analyst



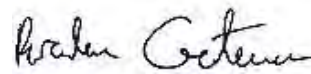
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		Fibrous Asbestos Content %	Other Materials Content %
<b>Client Sample:</b> 14-A	<b>Asbestos Detected?</b>	<b>No</b>	
<b>LEX Sample:</b> 042	<b>Chrysotile:</b>	None Detected	<b>Cellulose:</b> None Detected
<b>Layers Analyzed:</b> Sample Homogenized	<b>Amosite:</b>	None Detected	<b>MMVF:</b> None Detected
<b>Colour:</b> White/Orange	<b>Crocidolite:</b>	None Detected	<b>Other Fibres:</b> None Detected
<b>Description:</b> Vinyl Flooring Tile - White with Grey	<b>Other Amphiboles:</b>	None Detected	<b>Non Fibrous:</b> 100
	<b>Comments:</b>	N/A	
<b>Client Sample:</b> 14-B	<b>Asbestos Detected?</b>	<b>No</b>	
<b>LEX Sample:</b> 043	<b>Chrysotile:</b>	None Detected	<b>Cellulose:</b> None Detected
<b>Layers Analyzed:</b> Sample Homogenized	<b>Amosite:</b>	None Detected	<b>MMVF:</b> None Detected
<b>Colour:</b> White/Orange	<b>Crocidolite:</b>	None Detected	<b>Other Fibres:</b> None Detected
<b>Description:</b> Vinyl Flooring Tile - White with Grey	<b>Other Amphiboles:</b>	None Detected	<b>Non Fibrous:</b> 100
	<b>Comments:</b>	N/A	
<b>Client Sample:</b> 14-C	<b>Asbestos Detected?</b>	<b>No</b>	
<b>LEX Sample:</b> 044	<b>Chrysotile:</b>	None Detected	<b>Cellulose:</b> None Detected
<b>Layers Analyzed:</b> Sample Homogenized	<b>Amosite:</b>	None Detected	<b>MMVF:</b> None Detected
<b>Colour:</b> White/Orange	<b>Crocidolite:</b>	None Detected	<b>Other Fibres:</b> None Detected
<b>Description:</b> Vinyl Flooring Tile - White with Grey	<b>Other Amphiboles:</b>	None Detected	<b>Non Fibrous:</b> 100
	<b>Comments:</b>	N/A	
<b>Client Sample:</b> 15-A	<b>Asbestos Detected?</b>	<b>No</b>	
<b>LEX Sample:</b> 045	<b>Chrysotile:</b>	None Detected	<b>Cellulose:</b> None Detected
<b>Layers Analyzed:</b> Sample Homogenized	<b>Amosite:</b>	None Detected	<b>MMVF:</b> None Detected
<b>Colour:</b> White	<b>Crocidolite:</b>	None Detected	<b>Other Fibres:</b> None Detected
<b>Description:</b> Drywall Joint Filling Compound	<b>Other Amphiboles:</b>	None Detected	<b>Non Fibrous:</b> 100
	<b>Comments:</b>	N/A	
<b>Client Sample:</b> 15-B	<b>Asbestos Detected?</b>	<b>No</b>	
<b>LEX Sample:</b> 046	<b>Chrysotile:</b>	None Detected	<b>Cellulose:</b> None Detected
<b>Layers Analyzed:</b> Sample Homogenized	<b>Amosite:</b>	None Detected	<b>MMVF:</b> None Detected
<b>Colour:</b> White	<b>Crocidolite:</b>	None Detected	<b>Other Fibres:</b> None Detected
<b>Description:</b> Drywall Joint Filling Compound	<b>Other Amphiboles:</b>	None Detected	<b>Non Fibrous:</b> 100
	<b>Comments:</b>	N/A	
<b>Client Sample:</b> 15-C	<b>Asbestos Detected?</b>	<b>No</b>	
<b>LEX Sample:</b> 047	<b>Chrysotile:</b>	None Detected	<b>Cellulose:</b> None Detected
<b>Layers Analyzed:</b> Sample Homogenized	<b>Amosite:</b>	None Detected	<b>MMVF:</b> None Detected
<b>Colour:</b> White	<b>Crocidolite:</b>	None Detected	<b>Other Fibres:</b> None Detected
<b>Description:</b> Drywall Joint Filling Compound	<b>Other Amphiboles:</b>	None Detected	<b>Non Fibrous:</b> 100
	<b>Comments:</b>	N/A	

Other Amphiboles: ac=actinolite, a=anthophyllite, t-tremolite, u=unidentified  
MMVF: Man Made Vitreous Fibres: Fibreglass, Min. Wool, Rockwool, Glasswool  
PLM - method detection limit is 0.1%

Analyst



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		Fibrous Asbestos Content %	Other Materials Content %
<b>Client Sample:</b> 15-D	<b>Asbestos Detected?</b>	<b>No</b>	
<b>LEX Sample:</b> 048	<b>Chrysotile:</b>	None Detected	<b>Cellulose:</b> None Detected
<b>Layers Analyzed:</b> Sample Homogenized	<b>Amosite:</b>	None Detected	<b>MMVF:</b> None Detected
<b>Colour:</b> White	<b>Crocidolite:</b>	None Detected	<b>Other Fibres:</b> None Detected
<b>Description:</b> Drywall Joint Filling Compound	<b>Other Amphiboles:</b>	None Detected	<b>Non Fibrous:</b> 100
	<b>Comments:</b>	N/A	
<b>Client Sample:</b> 15-E	<b>Asbestos Detected?</b>	<b>No</b>	
<b>LEX Sample:</b> 049	<b>Chrysotile:</b>	None Detected	<b>Cellulose:</b> None Detected
<b>Layers Analyzed:</b> Sample Homogenized	<b>Amosite:</b>	None Detected	<b>MMVF:</b> None Detected
<b>Colour:</b> White	<b>Crocidolite:</b>	None Detected	<b>Other Fibres:</b> None Detected
<b>Description:</b> Drywall Joint Filling Compound	<b>Other Amphiboles:</b>	None Detected	<b>Non Fibrous:</b> 100
	<b>Comments:</b>	N/A	
<b>Client Sample:</b> 16-A	<b>Asbestos Detected?</b>	<b>No</b>	
<b>LEX Sample:</b> 050	<b>Chrysotile:</b>	None Detected	<b>Cellulose:</b> None Detected
<b>Layers Analyzed:</b> Sample Homogenized	<b>Amosite:</b>	None Detected	<b>MMVF:</b> None Detected
<b>Colour:</b> Orange	<b>Crocidolite:</b>	None Detected	<b>Other Fibres:</b> None Detected
<b>Description:</b> Carpet Tile Mastic (Yellow)	<b>Other Amphiboles:</b>	None Detected	<b>Non Fibrous:</b> 100
	<b>Comments:</b>	N/A	
<b>Client Sample:</b> 16-B	<b>Asbestos Detected?</b>	<b>No</b>	
<b>LEX Sample:</b> 051	<b>Chrysotile:</b>	None Detected	<b>Cellulose:</b> None Detected
<b>Layers Analyzed:</b> Sample Homogenized	<b>Amosite:</b>	None Detected	<b>MMVF:</b> None Detected
<b>Colour:</b> Orange	<b>Crocidolite:</b>	None Detected	<b>Other Fibres:</b> None Detected
<b>Description:</b> Carpet Tile Mastic (Yellow)	<b>Other Amphiboles:</b>	None Detected	<b>Non Fibrous:</b> 100
	<b>Comments:</b>	N/A	
<b>Client Sample:</b> 16-C	<b>Asbestos Detected?</b>	<b>No</b>	
<b>LEX Sample:</b> 052	<b>Chrysotile:</b>	None Detected	<b>Cellulose:</b> None Detected
<b>Layers Analyzed:</b> Sample Homogenized	<b>Amosite:</b>	None Detected	<b>MMVF:</b> None Detected
<b>Colour:</b> Orange	<b>Crocidolite:</b>	None Detected	<b>Other Fibres:</b> None Detected
<b>Description:</b> Carpet Tile Mastic (Yellow)	<b>Other Amphiboles:</b>	None Detected	<b>Non Fibrous:</b> 100
	<b>Comments:</b>	N/A	

Other Amphiboles: ac=actinolite, a=anthophyllite, t-tremolite, u=unidentified  
 MMVF: Man Made Vitreous Fibres: Fibreglass, Min. Wool, Rockwool, Glasswool  
 PLM - method detection limit is 0.1%

Analyst



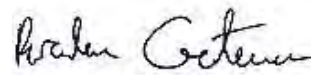
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		Fibrous Asbestos Content %	Other Materials Content %
<b>Client Sample:</b> 17-A	<b>Asbestos Detected?</b>	<b>Yes</b>	
<b>LEX Sample:</b> 053	<b>Chrysotile:</b>	0.5	<b>Cellulose:</b> None Detected
<b>Layers Analyzed:</b> Sample Homogenized	<b>Amosite:</b>	None Detected	<b>MMVF:</b> None Detected
<b>Colour:</b> Brown	<b>Crocidolite:</b>	None Detected	<b>Other Fibres:</b> None Detected
<b>Description:</b> Vinyl Flooring Tile - Brown with White Streaks 9x9	<b>Other Amphiboles:</b>	None Detected	<b>Non Fibrous:</b> 99.5
	<b>Comments:</b>	This sample meets the definition of "asbestos containing material" according to Ontario Regulation 278/05.	
<b>Client Sample:</b> 18-A	<b>Asbestos Detected?</b>	<b>Yes</b>	
<b>LEX Sample:</b> 056	<b>Chrysotile:</b>	0.5	<b>Cellulose:</b> None Detected
<b>Layers Analyzed:</b> Sample Homogenized	<b>Amosite:</b>	None Detected	<b>MMVF:</b> None Detected
<b>Colour:</b> Grey/Black/Orange	<b>Crocidolite:</b>	None Detected	<b>Other Fibres:</b> None Detected
<b>Description:</b> Vinyl Flooring Tile Grey with White Streaks 9x9	<b>Other Amphiboles:</b>	None Detected	<b>Non Fibrous:</b> 99.5
	<b>Comments:</b>	This sample meets the definition of "asbestos containing material" according to Ontario Regulation 278/05.	
<b>Client Sample:</b> 19-A	<b>Asbestos Detected?</b>	<b>Yes</b>	
<b>LEX Sample:</b> 059	<b>Chrysotile:</b>	0.5	<b>Cellulose:</b> None Detected
<b>Layers Analyzed:</b> Sample Homogenized	<b>Amosite:</b>	None Detected	<b>MMVF:</b> None Detected
<b>Colour:</b> Blue/Black	<b>Crocidolite:</b>	None Detected	<b>Other Fibres:</b> None Detected
<b>Description:</b> Vinyl Flooring Tile - Green/Blue	<b>Other Amphiboles:</b>	None Detected	<b>Non Fibrous:</b> 99.5
	<b>Comments:</b>	This sample meets the definition of "asbestos containing material" according to Ontario Regulation 278/05.	
<b>Client Sample:</b> 20-A	<b>Asbestos Detected?</b>	<b>Yes</b>	
<b>LEX Sample:</b> 062	<b>Chrysotile:</b>	2	<b>Cellulose:</b> None Detected
<b>Layers Analyzed:</b> Sample Homogenized	<b>Amosite:</b>	None Detected	<b>MMVF:</b> None Detected
<b>Colour:</b> White/Brown	<b>Crocidolite:</b>	None Detected	<b>Other Fibres:</b> None Detected
<b>Description:</b> Vinyl Flooring Tile - White with Green Streaks	<b>Other Amphiboles:</b>	None Detected	<b>Non Fibrous:</b> 98
	<b>Comments:</b>	This sample meets the definition of "asbestos containing material" according to Ontario Regulation 278/05.	
<b>Client Sample:</b> 21-A	<b>Asbestos Detected?</b>	<b>No</b>	
<b>LEX Sample:</b> 065	<b>Chrysotile:</b>	None Detected	<b>Cellulose:</b> 10
<b>Layers Analyzed:</b> Sample Homogenized	<b>Amosite:</b>	None Detected	<b>MMVF:</b> None Detected
<b>Colour:</b> Grey	<b>Crocidolite:</b>	None Detected	<b>Other Fibres:</b> None Detected
<b>Description:</b> Leveling Compound - Grey	<b>Other Amphiboles:</b>	None Detected	<b>Non Fibrous:</b> 90
	<b>Comments:</b>	N/A	

Other Amphiboles: ac=actinolite, a=anthophyllite, t-tremolite, u=unidentified  
MMVF: Man Made Vitreous Fibres: Fibreglass, Min. Wool, Rockwool, Glasswool  
PLM - method detection limit is 0.1%

Analyst



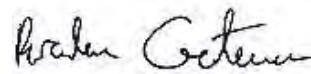
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		Fibrous Asbestos Content %	Other Materials Content %
<b>Client Sample:</b> 21-B	<b>Asbestos Detected?</b>	<b>No</b>	
<b>LEX Sample:</b> 066	<b>Chrysotile:</b>	None Detected	<b>Cellulose:</b> 10
<b>Layers Analyzed:</b> Sample Homogenized	<b>Amosite:</b>	None Detected	<b>MMVF:</b> None Detected
<b>Colour:</b> Grey	<b>Crocidolite:</b>	None Detected	<b>Other Fibres:</b> None Detected
<b>Description:</b> Leveling Compound - Grey	<b>Other Amphiboles:</b>	None Detected	<b>Non Fibrous:</b> 90
	<b>Comments:</b>	N/A	
<b>Client Sample:</b> 21-C	<b>Asbestos Detected?</b>	<b>No</b>	
<b>LEX Sample:</b> 067	<b>Chrysotile:</b>	None Detected	<b>Cellulose:</b> 10
<b>Layers Analyzed:</b> Sample Homogenized	<b>Amosite:</b>	None Detected	<b>MMVF:</b> None Detected
<b>Colour:</b> Grey	<b>Crocidolite:</b>	None Detected	<b>Other Fibres:</b> None Detected
<b>Description:</b> Leveling Compound - Grey	<b>Other Amphiboles:</b>	None Detected	<b>Non Fibrous:</b> 90
	<b>Comments:</b>	N/A	
<b>Client Sample:</b> 22-A	<b>Asbestos Detected?</b>	<b>No</b>	
<b>LEX Sample:</b> 068	<b>Chrysotile:</b>	None Detected	<b>Cellulose:</b> None Detected
<b>Layers Analyzed:</b> Sample Homogenized	<b>Amosite:</b>	None Detected	<b>MMVF:</b> None Detected
<b>Colour:</b> White/Orange	<b>Crocidolite:</b>	None Detected	<b>Other Fibres:</b> None Detected
<b>Description:</b> Flexible Pipe Insulation	<b>Other Amphiboles:</b>	None Detected	<b>Non Fibrous:</b> 100
	<b>Comments:</b>	N/A	
<b>Client Sample:</b> 22-B	<b>Asbestos Detected?</b>	<b>No</b>	
<b>LEX Sample:</b> 069	<b>Chrysotile:</b>	None Detected	<b>Cellulose:</b> None Detected
<b>Layers Analyzed:</b> Sample Homogenized	<b>Amosite:</b>	None Detected	<b>MMVF:</b> None Detected
<b>Colour:</b> White/Orange	<b>Crocidolite:</b>	None Detected	<b>Other Fibres:</b> None Detected
<b>Description:</b> Flexible Pipe Insulation	<b>Other Amphiboles:</b>	None Detected	<b>Non Fibrous:</b> 100
	<b>Comments:</b>	N/A	
<b>Client Sample:</b> 22-C	<b>Asbestos Detected?</b>	<b>No</b>	
<b>LEX Sample:</b> 070	<b>Chrysotile:</b>	None Detected	<b>Cellulose:</b> None Detected
<b>Layers Analyzed:</b> Sample Homogenized	<b>Amosite:</b>	None Detected	<b>MMVF:</b> None Detected
<b>Colour:</b> White/Orange	<b>Crocidolite:</b>	None Detected	<b>Other Fibres:</b> None Detected
<b>Description:</b> Flexible Pipe Insulation	<b>Other Amphiboles:</b>	None Detected	<b>Non Fibrous:</b> 100
	<b>Comments:</b>	N/A	

Other Amphiboles: ac=actinolite, a=anthophyllite, t-tremolite, u=unidentified  
 MMVF: Man Made Vitreous Fibres: Fibreglass, Min. Wool, Rockwool, Glasswool  
 PLM - method detection limit is 0.1%

Analyst



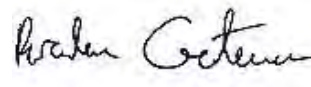
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		Fibrous Asbestos Content %	Other Materials Content %
<b>Client Sample:</b> 23-A	<b>Asbestos Detected?</b>	<b>Yes</b>	
<b>LEX Sample:</b> 071	<b>Chrysotile:</b>	1	<b>Cellulose:</b> None Detected
<b>Layers Analyzed:</b> Sample Homogenized	<b>Amosite:</b>	None Detected	<b>MMVF:</b> None Detected
<b>Colour:</b> Blue/Black	<b>Crocidolite:</b>	None Detected	<b>Other Fibres:</b> None Detected
<b>Description:</b> Vinyl Flooring Tile - red with White 9x9	<b>Other Amphiboles:</b>	None Detected	<b>Non Fibrous:</b> 99
	<b>Comments:</b>	This sample meets the definition of "asbestos containing material" according to Ontario Regulation 278/05.	
<b>Client Sample:</b> 24-A	<b>Asbestos Detected?</b>	<b>No</b>	
<b>LEX Sample:</b> 074	<b>Chrysotile:</b>	None Detected	<b>Cellulose:</b> None Detected
<b>Layers Analyzed:</b> Sample Homogenized	<b>Amosite:</b>	None Detected	<b>MMVF:</b> None Detected
<b>Colour:</b> Beige/Brown	<b>Crocidolite:</b>	None Detected	<b>Other Fibres:</b> None Detected
<b>Description:</b> Vinyl Flooring Tile Beige with Brown	<b>Other Amphiboles:</b>	None Detected	<b>Non Fibrous:</b> 100
	<b>Comments:</b>	N/A	
<b>Client Sample:</b> 24-B	<b>Asbestos Detected?</b>	<b>No</b>	
<b>LEX Sample:</b> 075	<b>Chrysotile:</b>	None Detected	<b>Cellulose:</b> None Detected
<b>Layers Analyzed:</b> Sample Homogenized	<b>Amosite:</b>	None Detected	<b>MMVF:</b> None Detected
<b>Colour:</b> Beige/Brown	<b>Crocidolite:</b>	None Detected	<b>Other Fibres:</b> None Detected
<b>Description:</b> Vinyl Flooring Tile Beige with Brown	<b>Other Amphiboles:</b>	None Detected	<b>Non Fibrous:</b> 100
	<b>Comments:</b>	N/A	
<b>Client Sample:</b> 24-C	<b>Asbestos Detected?</b>	<b>No</b>	
<b>LEX Sample:</b> 076	<b>Chrysotile:</b>	None Detected	<b>Cellulose:</b> None Detected
<b>Layers Analyzed:</b> Sample Homogenized	<b>Amosite:</b>	None Detected	<b>MMVF:</b> None Detected
<b>Colour:</b> Beige/Brown	<b>Crocidolite:</b>	None Detected	<b>Other Fibres:</b> None Detected
<b>Description:</b> Vinyl Flooring Tile Beige with Brown	<b>Other Amphiboles:</b>	None Detected	<b>Non Fibrous:</b> 100
	<b>Comments:</b>	N/A	
<b>Client Sample:</b> 25-A	<b>Asbestos Detected?</b>	<b>Yes</b>	
<b>LEX Sample:</b> 077	<b>Chrysotile:</b>	1	<b>Cellulose:</b> None Detected
<b>Layers Analyzed:</b> Sample Homogenized	<b>Amosite:</b>	None Detected	<b>MMVF:</b> None Detected
<b>Colour:</b> Grey/Black	<b>Crocidolite:</b>	None Detected	<b>Other Fibres:</b> None Detected
<b>Description:</b> Vinyl Flooring Tile - Grey with Black 9x9	<b>Other Amphiboles:</b>	None Detected	<b>Non Fibrous:</b> 99
	<b>Comments:</b>	This sample meets the definition of "asbestos containing material" according to Ontario Regulation 278/05.	

Other Amphiboles: ac=actinolite, a=anthophyllite, t-tremolite, u=unidentified  
 MMVF: Man Made Vitreous Fibres: Fibreglass, Min. Wool, Rockwool, Glasswool  
 PLM - method detection limit is 0.1%

Analyst



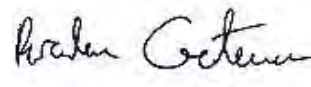
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		Fibrous Asbestos Content %	Other Materials Content %
<b>Client Sample:</b> 26-A	<b>Asbestos Detected?</b>	<b>No</b>	
<b>LEX Sample:</b> 080	<b>Chrysotile:</b>	None Detected	<b>Cellulose:</b> None Detected
<b>Layers Analyzed:</b> Sample Homogenized	<b>Amosite:</b>	None Detected	<b>MMVF:</b> None Detected
<b>Colour:</b> Beige/Black	<b>Crocidolite:</b>	None Detected	<b>Other Fibres:</b> None Detected
<b>Description:</b> Vinyl Flooring Tile - Oatmeal Pattern	<b>Other Amphiboles:</b>	None Detected	<b>Non Fibrous:</b> 100
	<b>Comments:</b>	N/A	
<b>Client Sample:</b> 26-B	<b>Asbestos Detected?</b>	<b>No</b>	
<b>LEX Sample:</b> 081	<b>Chrysotile:</b>	None Detected	<b>Cellulose:</b> None Detected
<b>Layers Analyzed:</b> Sample Homogenized	<b>Amosite:</b>	None Detected	<b>MMVF:</b> None Detected
<b>Colour:</b> Beige/Black	<b>Crocidolite:</b>	None Detected	<b>Other Fibres:</b> None Detected
<b>Description:</b> Vinyl Flooring Tile - Oatmeal Pattern	<b>Other Amphiboles:</b>	None Detected	<b>Non Fibrous:</b> 100
	<b>Comments:</b>	N/A	
<b>Client Sample:</b> 26-C	<b>Asbestos Detected?</b>	<b>No</b>	
<b>LEX Sample:</b> 082	<b>Chrysotile:</b>	None Detected	<b>Cellulose:</b> None Detected
<b>Layers Analyzed:</b> Sample Homogenized	<b>Amosite:</b>	None Detected	<b>MMVF:</b> None Detected
<b>Colour:</b> Beige/Black	<b>Crocidolite:</b>	None Detected	<b>Other Fibres:</b> None Detected
<b>Description:</b> Vinyl Flooring Tile - Oatmeal Pattern	<b>Other Amphiboles:</b>	None Detected	<b>Non Fibrous:</b> 100
	<b>Comments:</b>	N/A	
<b>Client Sample:</b> 27-A	<b>Asbestos Detected?</b>	<b>No</b>	
<b>LEX Sample:</b> 083	<b>Chrysotile:</b>	None Detected	<b>Cellulose:</b> None Detected
<b>Layers Analyzed:</b> Sample Homogenized	<b>Amosite:</b>	None Detected	<b>MMVF:</b> None Detected
<b>Colour:</b> Purple	<b>Crocidolite:</b>	None Detected	<b>Other Fibres:</b> None Detected
<b>Description:</b> Vinyl Flooring Tile - Purple with White speckles	<b>Other Amphiboles:</b>	None Detected	<b>Non Fibrous:</b> 100
	<b>Comments:</b>	N/A	
<b>Client Sample:</b> 27-B	<b>Asbestos Detected?</b>	<b>No</b>	
<b>LEX Sample:</b> 084	<b>Chrysotile:</b>	None Detected	<b>Cellulose:</b> None Detected
<b>Layers Analyzed:</b> Sample Homogenized	<b>Amosite:</b>	None Detected	<b>MMVF:</b> None Detected
<b>Colour:</b> Purple	<b>Crocidolite:</b>	None Detected	<b>Other Fibres:</b> None Detected
<b>Description:</b> Vinyl Flooring Tile - Purple with White speckles	<b>Other Amphiboles:</b>	None Detected	<b>Non Fibrous:</b> 100
	<b>Comments:</b>	N/A	

Other Amphiboles: ac=actinolite, a=anthophyllite, t-tremolite, u=unidentified  
MMVF: Man Made Vitreous Fibres: Fibreglass, Min. Wool, Rockwool, Glasswool  
PLM - method detection limit is 0.1%

Analyst



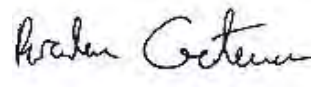
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		Fibrous Asbestos Content %	Other Materials Content %
<b>Client Sample:</b> 27-C	<b>Asbestos Detected?</b>	<b>No</b>	
<b>LEX Sample:</b> 085	<b>Chrysotile:</b>	None Detected	<b>Cellulose:</b> None Detected
<b>Layers Analyzed:</b> Sample Homogenized	<b>Amosite:</b>	None Detected	<b>MMVF:</b> None Detected
<b>Colour:</b> Purple	<b>Crocidolite:</b>	None Detected	<b>Other Fibres:</b> None Detected
<b>Description:</b> Vinyl Flooring Tile - Purple with White speckles	<b>Other Amphiboles:</b>	None Detected	<b>Non Fibrous:</b> 100
	<b>Comments:</b>	N/A	
<b>Client Sample:</b> 28-A	<b>Asbestos Detected?</b>	<b>No</b>	
<b>LEX Sample:</b> 086	<b>Chrysotile:</b>	None Detected	<b>Cellulose:</b> None Detected
<b>Layers Analyzed:</b> Sample Homogenized	<b>Amosite:</b>	None Detected	<b>MMVF:</b> None Detected
<b>Colour:</b> Beige	<b>Crocidolite:</b>	None Detected	<b>Other Fibres:</b> None Detected
<b>Description:</b> Undersink Coating - White	<b>Other Amphiboles:</b>	None Detected	<b>Non Fibrous:</b> 100
	<b>Comments:</b>	N/A	
<b>Client Sample:</b> 28-B	<b>Asbestos Detected?</b>	<b>No</b>	
<b>LEX Sample:</b> 087	<b>Chrysotile:</b>	None Detected	<b>Cellulose:</b> None Detected
<b>Layers Analyzed:</b> Sample Homogenized	<b>Amosite:</b>	None Detected	<b>MMVF:</b> None Detected
<b>Colour:</b> Beige	<b>Crocidolite:</b>	None Detected	<b>Other Fibres:</b> None Detected
<b>Description:</b> Undersink Coating - White	<b>Other Amphiboles:</b>	None Detected	<b>Non Fibrous:</b> 100
	<b>Comments:</b>	N/A	
<b>Client Sample:</b> 28-C	<b>Asbestos Detected?</b>	<b>No</b>	
<b>LEX Sample:</b> 088	<b>Chrysotile:</b>	None Detected	<b>Cellulose:</b> None Detected
<b>Layers Analyzed:</b> Sample Homogenized	<b>Amosite:</b>	None Detected	<b>MMVF:</b> None Detected
<b>Colour:</b> Beige	<b>Crocidolite:</b>	None Detected	<b>Other Fibres:</b> None Detected
<b>Description:</b> Undersink Coating - White	<b>Other Amphiboles:</b>	None Detected	<b>Non Fibrous:</b> 100
	<b>Comments:</b>	N/A	
<b>Client Sample:</b> 29-A	<b>Asbestos Detected?</b>	<b>No</b>	
<b>LEX Sample:</b> 089	<b>Chrysotile:</b>	None Detected	<b>Cellulose:</b> None Detected
<b>Layers Analyzed:</b> Sample Homogenized	<b>Amosite:</b>	None Detected	<b>MMVF:</b> None Detected
<b>Colour:</b> Beige	<b>Crocidolite:</b>	None Detected	<b>Other Fibres:</b> None Detected
<b>Description:</b> Vinyl Flooring Tile - Cream	<b>Other Amphiboles:</b>	None Detected	<b>Non Fibrous:</b> 100
	<b>Comments:</b>	N/A	

Other Amphiboles: ac=actinolite, a=anthophyllite, t-tremolite, u=unidentified  
 MMVF: Man Made Vitreous Fibres: Fibreglass, Min. Wool, Rockwool, Glasswool  
 PLM - method detection limit is 0.1%

Analyst



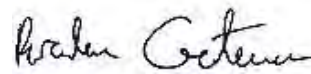
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<b>Client Sample:</b> 29-B	<b>Asbestos Detected?</b>	<b>No</b>	
<b>LEX Sample:</b> 090	<b>Chrysotile:</b>	None Detected	<b>Cellulose:</b> None Detected
<b>Layers Analyzed:</b> Sample Homogenized	<b>Amosite:</b>	None Detected	<b>MMVF:</b> None Detected
<b>Colour:</b> Beige	<b>Crocidolite:</b>	None Detected	<b>Other Fibres:</b> None Detected
<b>Description:</b> Vinyl Flooring Tile - Cream	<b>Other Amphiboles:</b>	None Detected	<b>Non Fibrous:</b> 100
	<b>Comments:</b>	N/A	
<b>Client Sample:</b> 29-C	<b>Asbestos Detected?</b>	<b>No</b>	
<b>LEX Sample:</b> 091	<b>Chrysotile:</b>	None Detected	<b>Cellulose:</b> None Detected
<b>Layers Analyzed:</b> Sample Homogenized	<b>Amosite:</b>	None Detected	<b>MMVF:</b> None Detected
<b>Colour:</b> Beige	<b>Crocidolite:</b>	None Detected	<b>Other Fibres:</b> None Detected
<b>Description:</b> Vinyl Flooring Tile - Cream	<b>Other Amphiboles:</b>	None Detected	<b>Non Fibrous:</b> 100
	<b>Comments:</b>	N/A	
<b>Client Sample:</b> 30-A	<b>Asbestos Detected?</b>	<b>Yes</b>	
<b>LEX Sample:</b> 092	<b>Chrysotile:</b>	0.5	<b>Cellulose:</b> None Detected
<b>Layers Analyzed:</b> Sample Homogenized	<b>Amosite:</b>	None Detected	<b>MMVF:</b> None Detected
<b>Colour:</b> Brown	<b>Crocidolite:</b>	None Detected	<b>Other Fibres:</b> None Detected
<b>Description:</b> Vinyl Flooring Tile - Brown with Multicolour Streaks 9x9	<b>Other Amphiboles:</b>	None Detected	<b>Non Fibrous:</b> 99.5
	<b>Comments:</b>	This sample meets the definition of "asbestos containing material" according to Ontario Regulation 278/05.	
<b>Client Sample:</b> 31-A	<b>Asbestos Detected?</b>	<b>Yes</b>	
<b>LEX Sample:</b> 095	<b>Chrysotile:</b>	1	<b>Cellulose:</b> None Detected
<b>Layers Analyzed:</b> Sample Homogenized	<b>Amosite:</b>	None Detected	<b>MMVF:</b> None Detected
<b>Colour:</b> Grey	<b>Crocidolite:</b>	None Detected	<b>Other Fibres:</b> None Detected
<b>Description:</b> Vinyl Flooring Tile - White with Brown Streaks 9x9	<b>Other Amphiboles:</b>	None Detected	<b>Non Fibrous:</b> 99
	<b>Comments:</b>	This sample meets the definition of "asbestos containing material" according to Ontario Regulation 278/05.	
<b>Client Sample:</b> 32-A	<b>Asbestos Detected?</b>	<b>Yes</b>	
<b>LEX Sample:</b> 098	<b>Chrysotile:</b>	0.5	<b>Cellulose:</b> None Detected
<b>Layers Analyzed:</b> Sample Homogenized	<b>Amosite:</b>	None Detected	<b>MMVF:</b> None Detected
<b>Colour:</b> Blue/White	<b>Crocidolite:</b>	None Detected	<b>Other Fibres:</b> None Detected
<b>Description:</b> Vinyl Flooring Tile - Blue with White Streaks 9x9	<b>Other Amphiboles:</b>	None Detected	<b>Non Fibrous:</b> 99.5
	<b>Comments:</b>	This sample meets the definition of "asbestos containing material" according to Ontario Regulation 278/05.	

Other Amphiboles: ac=actinolite, a=anthophyllite, t=tremolite, u=unidentified  
MMVF: Man Made Vitreous Fibres: Fibreglass, Min. Wool, Rockwool, Glasswool  
PLM - method detection limit is 0.1%

Analyst



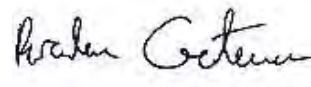
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		Fibrous Asbestos Content %	Other Materials Content %
<b>Client Sample:</b> 33-A	<b>Asbestos Detected?</b>	<b>Yes</b>	
<b>LEX Sample:</b> 101	<b>Chrysotile:</b>	6	<b>Cellulose:</b> None Detected
<b>Layers Analyzed:</b> Sample Homogenized	<b>Amosite:</b>	None Detected	<b>MMVF:</b> None Detected
<b>Colour:</b> Black	<b>Crocidolite:</b>	None Detected	<b>Other Fibres:</b> None Detected
<b>Description:</b> Vinyl Flooring Tile - Black with Black Streaks 9x9	<b>Other Amphiboles:</b>	None Detected	<b>Non Fibrous:</b> 94
	<b>Comments:</b>	This sample meets the definition of "asbestos containing material" according to Ontario Regulation 278/05.	
<b>Client Sample:</b> 34-A	<b>Asbestos Detected?</b>	<b>No</b>	
<b>LEX Sample:</b> 104	<b>Chrysotile:</b>	None Detected	<b>Cellulose:</b> None Detected
<b>Layers Analyzed:</b> Sample Homogenized	<b>Amosite:</b>	None Detected	<b>MMVF:</b> None Detected
<b>Colour:</b> Grey/Black	<b>Crocidolite:</b>	None Detected	<b>Other Fibres:</b> None Detected
<b>Description:</b> Vinyl Flooring Tile - Grey with Black Streaks	<b>Other Amphiboles:</b>	None Detected	<b>Non Fibrous:</b> 100
	<b>Comments:</b>	N/A	
<b>Client Sample:</b> 34-B	<b>Asbestos Detected?</b>	<b>No</b>	
<b>LEX Sample:</b> 105	<b>Chrysotile:</b>	None Detected	<b>Cellulose:</b> None Detected
<b>Layers Analyzed:</b> Sample Homogenized	<b>Amosite:</b>	None Detected	<b>MMVF:</b> None Detected
<b>Colour:</b> Grey/Black	<b>Crocidolite:</b>	None Detected	<b>Other Fibres:</b> None Detected
<b>Description:</b> Vinyl Flooring Tile - Grey with Black Streaks	<b>Other Amphiboles:</b>	None Detected	<b>Non Fibrous:</b> 100
	<b>Comments:</b>	N/A	
<b>Client Sample:</b> 34-C	<b>Asbestos Detected?</b>	<b>No</b>	
<b>LEX Sample:</b> 106	<b>Chrysotile:</b>	None Detected	<b>Cellulose:</b> None Detected
<b>Layers Analyzed:</b> Sample Homogenized	<b>Amosite:</b>	None Detected	<b>MMVF:</b> None Detected
<b>Colour:</b> Grey/Black	<b>Crocidolite:</b>	None Detected	<b>Other Fibres:</b> None Detected
<b>Description:</b> Vinyl Flooring Tile - Grey with Black Streaks	<b>Other Amphiboles:</b>	None Detected	<b>Non Fibrous:</b> 100
	<b>Comments:</b>	N/A	
<b>Client Sample:</b> 35-A	<b>Asbestos Detected?</b>	<b>No</b>	
<b>LEX Sample:</b> 107	<b>Chrysotile:</b>	None Detected	<b>Cellulose:</b> 60
<b>Layers Analyzed:</b> Sample Homogenized	<b>Amosite:</b>	None Detected	<b>MMVF:</b> 40
<b>Colour:</b> Grey	<b>Crocidolite:</b>	None Detected	<b>Other Fibres:</b> None Detected
<b>Description:</b> Ceiling Tile - Bumps with Pinholes 2x4	<b>Other Amphiboles:</b>	None Detected	<b>Non Fibrous:</b> None Detected
	<b>Comments:</b>	N/A	

Other Amphiboles: ac=actinolite, a=anthophyllite, t-tremolite, u=unidentified  
 MMVF: Man Made Vitreous Fibres: Fibreglass, Min. Wool, Rockwool, Glasswool  
 PLM - method detection limit is 0.1%

Analyst



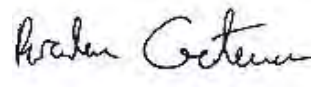
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Fibrous Asbestos Content %		Other Materials Content %	
<b>Client Sample:</b> 35-B	<b>Asbestos Detected?</b>	<b>No</b>	
<b>LEX Sample:</b> 108	<b>Chrysotile:</b>	None Detected	<b>Cellulose:</b> 60
<b>Layers Analyzed:</b> Sample Homogenized	<b>Amosite:</b>	None Detected	<b>MMVF:</b> 40
<b>Colour:</b> Grey	<b>Crocidolite:</b>	None Detected	<b>Other Fibres:</b> None Detected
<b>Description:</b> Ceiling Tile - Bumps with Pinholes 2x4	<b>Other Amphiboles:</b>	None Detected	<b>Non Fibrous:</b> None Detected
	<b>Comments:</b>	N/A	
<b>Client Sample:</b> 35-C	<b>Asbestos Detected?</b>	<b>No</b>	
<b>LEX Sample:</b> 109	<b>Chrysotile:</b>	None Detected	<b>Cellulose:</b> 60
<b>Layers Analyzed:</b> Sample Homogenized	<b>Amosite:</b>	None Detected	<b>MMVF:</b> 40
<b>Colour:</b> Grey	<b>Crocidolite:</b>	None Detected	<b>Other Fibres:</b> None Detected
<b>Description:</b> Ceiling Tile - Bumps with Pinholes 2x4	<b>Other Amphiboles:</b>	None Detected	<b>Non Fibrous:</b> None Detected
	<b>Comments:</b>	N/A	
<b>Client Sample:</b> 36-A	<b>Asbestos Detected?</b>	<b>Yes</b>	
<b>LEX Sample:</b> 110	<b>Chrysotile:</b>	1	<b>Cellulose:</b> None Detected
<b>Layers Analyzed:</b> Sample Homogenized	<b>Amosite:</b>	None Detected	<b>MMVF:</b> None Detected
<b>Colour:</b> Red/Black	<b>Crocidolite:</b>	None Detected	<b>Other Fibres:</b> None Detected
<b>Description:</b> Vinyl Flooring Tile - Red with White Streaks 9x9	<b>Other Amphiboles:</b>	None Detected	<b>Non Fibrous:</b> 99
	<b>Comments:</b>	This sample meets the definition of "asbestos containing material" according to Ontario Regulation 278/05.	
<b>Client Sample:</b> 37-A	<b>Asbestos Detected?</b>	<b>No</b>	
<b>LEX Sample:</b> 113	<b>Chrysotile:</b>	None Detected	<b>Cellulose:</b> None Detected
<b>Layers Analyzed:</b> Sample Homogenized	<b>Amosite:</b>	None Detected	<b>MMVF:</b> None Detected
<b>Colour:</b> Red/Black	<b>Crocidolite:</b>	None Detected	<b>Other Fibres:</b> None Detected
<b>Description:</b> Vinyl Flooring Tile - Orange/Red	<b>Other Amphiboles:</b>	None Detected	<b>Non Fibrous:</b> 100
	<b>Comments:</b>	N/A	
<b>Client Sample:</b> 37-B	<b>Asbestos Detected?</b>	<b>No</b>	
<b>LEX Sample:</b> 114	<b>Chrysotile:</b>	None Detected	<b>Cellulose:</b> None Detected
<b>Layers Analyzed:</b> Sample Homogenized	<b>Amosite:</b>	None Detected	<b>MMVF:</b> None Detected
<b>Colour:</b> Red/Black	<b>Crocidolite:</b>	None Detected	<b>Other Fibres:</b> None Detected
<b>Description:</b> Vinyl Flooring Tile - Orange/Red	<b>Other Amphiboles:</b>	None Detected	<b>Non Fibrous:</b> 100
	<b>Comments:</b>	N/A	

Other Amphiboles: ac=actinolite, a=anthophyllite, t-tremolite, u=unidentified  
 MMVF: Man Made Vitreous Fibres: Fibreglass, Min. Wool, Rockwool, Glasswool  
 PLM - method detection limit is 0.1%

Analyst



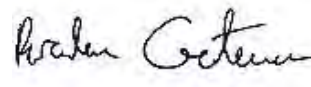
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		Fibrous Asbestos Content %	Other Materials Content %
<b>Client Sample:</b> 37-C	<b>Asbestos Detected?</b>	<b>No</b>	
<b>LEX Sample:</b> 115	<b>Chrysotile:</b>	None Detected	<b>Cellulose:</b> None Detected
<b>Layers Analyzed:</b> Sample Homogenized	<b>Amosite:</b>	None Detected	<b>MMVF:</b> None Detected
<b>Colour:</b> Red/Black	<b>Crocidolite:</b>	None Detected	<b>Other Fibres:</b> None Detected
<b>Description:</b> Vinyl Flooring Tile - Orange/Red	<b>Other Amphiboles:</b>	None Detected	<b>Non Fibrous:</b> 100
	<b>Comments:</b>	N/A	
<b>Client Sample:</b> 38-A	<b>Asbestos Detected?</b>	<b>No</b>	
<b>LEX Sample:</b> 116	<b>Chrysotile:</b>	None Detected	<b>Cellulose:</b> None Detected
<b>Layers Analyzed:</b> Sample Homogenized	<b>Amosite:</b>	None Detected	<b>MMVF:</b> None Detected
<b>Colour:</b> Red/Grey	<b>Crocidolite:</b>	None Detected	<b>Other Fibres:</b> None Detected
<b>Description:</b> Vinyl Flooring Tile - Dark Multicolour Red	<b>Other Amphiboles:</b>	None Detected	<b>Non Fibrous:</b> 100
	<b>Comments:</b>	N/A	
<b>Client Sample:</b> 38-B	<b>Asbestos Detected?</b>	<b>No</b>	
<b>LEX Sample:</b> 117	<b>Chrysotile:</b>	None Detected	<b>Cellulose:</b> None Detected
<b>Layers Analyzed:</b> Sample Homogenized	<b>Amosite:</b>	None Detected	<b>MMVF:</b> None Detected
<b>Colour:</b> Red/Grey	<b>Crocidolite:</b>	None Detected	<b>Other Fibres:</b> None Detected
<b>Description:</b> Vinyl Flooring Tile - Dark Multicolour Red	<b>Other Amphiboles:</b>	None Detected	<b>Non Fibrous:</b> 100
	<b>Comments:</b>	N/A	
<b>Client Sample:</b> 38-C	<b>Asbestos Detected?</b>	<b>No</b>	
<b>LEX Sample:</b> 118	<b>Chrysotile:</b>	None Detected	<b>Cellulose:</b> None Detected
<b>Layers Analyzed:</b> Sample Homogenized	<b>Amosite:</b>	None Detected	<b>MMVF:</b> None Detected
<b>Colour:</b> Red/Grey	<b>Crocidolite:</b>	None Detected	<b>Other Fibres:</b> None Detected
<b>Description:</b> Vinyl Flooring Tile - Dark Multicolour Red	<b>Other Amphiboles:</b>	None Detected	<b>Non Fibrous:</b> 100
	<b>Comments:</b>	N/A	
<b>Client Sample:</b> 39-A	<b>Asbestos Detected?</b>	<b>Yes</b>	
<b>LEX Sample:</b> 119	<b>Chrysotile:</b>	1	<b>Cellulose:</b> None Detected
<b>Layers Analyzed:</b> Sample Homogenized	<b>Amosite:</b>	None Detected	<b>MMVF:</b> None Detected
<b>Colour:</b> Green/Black	<b>Crocidolite:</b>	None Detected	<b>Other Fibres:</b> None Detected
<b>Description:</b> Vinyl Flooring Tile - Army Green with White	<b>Other Amphiboles:</b>	None Detected	<b>Non Fibrous:</b> 99
	<b>Comments:</b>	This sample meets the definition of "asbestos containing material" according to Ontario Regulation 278/05.	

Other Amphiboles: ac=actinolite, a=anthophyllite, t=tremolite, u=unidentified  
 MMVF: Man Made Vitreous Fibres: Fibreglass, Min. Wool, Rockwool, Glasswool  
 PLM - method detection limit is 0.1%

Analyst



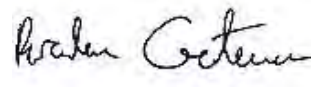
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		Fibrous Asbestos Content %	Other Materials Content %
<b>Client Sample:</b> 40-A	<b>Asbestos Detected?</b>	<b>No</b>	
<b>LEX Sample:</b> 122	<b>Chrysotile:</b>	None Detected	<b>Cellulose:</b> 60
<b>Layers Analyzed:</b> Sample Homogenized	<b>Amosite:</b>	None Detected	<b>MMVF:</b> 40
<b>Colour:</b> Grey	<b>Crocidolite:</b>	None Detected	<b>Other Fibres:</b> None Detected
<b>Description:</b> Ceiling Tile - Texture with pinholes + fissures 2x2	<b>Other Amphiboles:</b>	None Detected	<b>Non Fibrous:</b> None Detected
	<b>Comments:</b>	N/A	
<b>Client Sample:</b> 40-B	<b>Asbestos Detected?</b>	<b>No</b>	
<b>LEX Sample:</b> 123	<b>Chrysotile:</b>	None Detected	<b>Cellulose:</b> 60
<b>Layers Analyzed:</b> Sample Homogenized	<b>Amosite:</b>	None Detected	<b>MMVF:</b> 40
<b>Colour:</b> Grey	<b>Crocidolite:</b>	None Detected	<b>Other Fibres:</b> None Detected
<b>Description:</b> Ceiling Tile - Texture with pinholes + fissures 2x2	<b>Other Amphiboles:</b>	None Detected	<b>Non Fibrous:</b> None Detected
	<b>Comments:</b>	N/A	
<b>Client Sample:</b> 40-C	<b>Asbestos Detected?</b>	<b>No</b>	
<b>LEX Sample:</b> 124	<b>Chrysotile:</b>	None Detected	<b>Cellulose:</b> 60
<b>Layers Analyzed:</b> Sample Homogenized	<b>Amosite:</b>	None Detected	<b>MMVF:</b> 40
<b>Colour:</b> Grey	<b>Crocidolite:</b>	None Detected	<b>Other Fibres:</b> None Detected
<b>Description:</b> Ceiling Tile - Texture with pinholes + fissures 2x2	<b>Other Amphiboles:</b>	None Detected	<b>Non Fibrous:</b> None Detected
	<b>Comments:</b>	N/A	
<b>Client Sample:</b> 41-A	<b>Asbestos Detected?</b>	<b>No</b>	
<b>LEX Sample:</b> 125	<b>Chrysotile:</b>	None Detected	<b>Cellulose:</b> None Detected
<b>Layers Analyzed:</b> Sample Homogenized	<b>Amosite:</b>	None Detected	<b>MMVF:</b> None Detected
<b>Colour:</b> Black	<b>Crocidolite:</b>	None Detected	<b>Other Fibres:</b> None Detected
<b>Description:</b> Black Pipe Insulation	<b>Other Amphiboles:</b>	None Detected	<b>Non Fibrous:</b> 100
	<b>Comments:</b>	N/A	
<b>Client Sample:</b> 41-B	<b>Asbestos Detected?</b>	<b>No</b>	
<b>LEX Sample:</b> 126	<b>Chrysotile:</b>	None Detected	<b>Cellulose:</b> None Detected
<b>Layers Analyzed:</b> Sample Homogenized	<b>Amosite:</b>	None Detected	<b>MMVF:</b> None Detected
<b>Colour:</b> Black	<b>Crocidolite:</b>	None Detected	<b>Other Fibres:</b> None Detected
<b>Description:</b> Black Pipe Insulation	<b>Other Amphiboles:</b>	None Detected	<b>Non Fibrous:</b> 100
	<b>Comments:</b>	N/A	

Other Amphiboles: ac=actinolite, a=anthophyllite, t-tremolite, u=unidentified  
 MMVF: Man Made Vitreous Fibres: Fibreglass, Min. Wool, Rockwool, Glasswool  
 PLM - method detection limit is 0.1%

Analyst




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		Fibrous Asbestos Content %	Other Materials Content %
<b>Client Sample:</b> 41-C	<b>Asbestos Detected?</b>	<b>No</b>	
<b>LEX Sample:</b> 127	<b>Chrysotile:</b>	None Detected	<b>Cellulose:</b> None Detected
<b>Layers Analyzed:</b> Sample Homogenized	<b>Amosite:</b>	None Detected	<b>MMVF:</b> None Detected
<b>Colour:</b> Black	<b>Crocidolite:</b>	None Detected	<b>Other Fibres:</b> None Detected
<b>Description:</b> Black Pipe Insulation	<b>Other Amphiboles:</b>	None Detected	<b>Non Fibrous:</b> 100
	<b>Comments:</b>	N/A	
<b>Client Sample:</b> 42-A	<b>Asbestos Detected?</b>	<b>No</b>	
<b>LEX Sample:</b> 128	<b>Chrysotile:</b>	None Detected	<b>Cellulose:</b> None Detected
<b>Layers Analyzed:</b> Sample Homogenized	<b>Amosite:</b>	None Detected	<b>MMVF:</b> None Detected
<b>Colour:</b> Grey	<b>Crocidolite:</b>	None Detected	<b>Other Fibres:</b> None Detected
<b>Description:</b> Vinyl Flooring Tile - Multi-Grey	<b>Other Amphiboles:</b>	None Detected	<b>Non Fibrous:</b> 100
	<b>Comments:</b>	N/A	
<b>Client Sample:</b> 42-B	<b>Asbestos Detected?</b>	<b>No</b>	
<b>LEX Sample:</b> 129	<b>Chrysotile:</b>	None Detected	<b>Cellulose:</b> None Detected
<b>Layers Analyzed:</b> Sample Homogenized	<b>Amosite:</b>	None Detected	<b>MMVF:</b> None Detected
<b>Colour:</b> Grey	<b>Crocidolite:</b>	None Detected	<b>Other Fibres:</b> None Detected
<b>Description:</b> Vinyl Flooring Tile - Multi-Grey	<b>Other Amphiboles:</b>	None Detected	<b>Non Fibrous:</b> 100
	<b>Comments:</b>	N/A	
<b>Client Sample:</b> 42-C	<b>Asbestos Detected?</b>	<b>No</b>	
<b>LEX Sample:</b> 130	<b>Chrysotile:</b>	None Detected	<b>Cellulose:</b> None Detected
<b>Layers Analyzed:</b> Sample Homogenized	<b>Amosite:</b>	None Detected	<b>MMVF:</b> None Detected
<b>Colour:</b> Grey	<b>Crocidolite:</b>	None Detected	<b>Other Fibres:</b> None Detected
<b>Description:</b> Vinyl Flooring Tile - Multi-Grey	<b>Other Amphiboles:</b>	None Detected	<b>Non Fibrous:</b> 100
	<b>Comments:</b>	N/A	
<b>Client Sample:</b> 43-A	<b>Asbestos Detected?</b>	<b>No</b>	
<b>LEX Sample:</b> 131	<b>Chrysotile:</b>	None Detected	<b>Cellulose:</b> None Detected
<b>Layers Analyzed:</b> Sample Homogenized	<b>Amosite:</b>	None Detected	<b>MMVF:</b> None Detected
<b>Colour:</b> Grey/Orange	<b>Crocidolite:</b>	None Detected	<b>Other Fibres:</b> None Detected
<b>Description:</b> Vinyl Flooring Sheet - Dark Grey	<b>Other Amphiboles:</b>	None Detected	<b>Non Fibrous:</b> 100
	<b>Comments:</b>	N/A	
<b>Client Sample:</b> 43-B	<b>Asbestos Detected?</b>	<b>No</b>	
<b>LEX Sample:</b> 132	<b>Chrysotile:</b>	None Detected	<b>Cellulose:</b> None Detected
<b>Layers Analyzed:</b> Sample Homogenized	<b>Amosite:</b>	None Detected	<b>MMVF:</b> None Detected
<b>Colour:</b> Grey/Orange	<b>Crocidolite:</b>	None Detected	<b>Other Fibres:</b> None Detected
<b>Description:</b> Vinyl Flooring Sheet - Dark Grey	<b>Other Amphiboles:</b>	None Detected	<b>Non Fibrous:</b> 100
	<b>Comments:</b>	N/A	

Other Amphiboles: ac=actinolite, a=anthophyllite, t-tremolite, u=unidentified  
 MMVF: Man Made Vitreous Fibres: Fibreglass, Min. Wool, Rockwool, Glasswool  
 PLM - method detection limit is 0.1%

Analyst



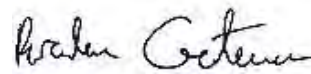
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		Fibrous Asbestos Content %	Other Materials Content %
<b>Client Sample:</b> 43-C	<b>Asbestos Detected?</b>	<b>No</b>	
<b>LEX Sample:</b> 133	<b>Chrysotile:</b>	None Detected	<b>Cellulose:</b> None Detected
<b>Layers Analyzed:</b> Sample Homogenized	<b>Amosite:</b>	None Detected	<b>MMVF:</b> None Detected
<b>Colour:</b> Grey/Orange	<b>Crocidolite:</b>	None Detected	<b>Other Fibres:</b> None Detected
<b>Description:</b> Vinyl Flooring Sheet - Dark Grey	<b>Other Amphiboles:</b>	None Detected	<b>Non Fibrous:</b> 100
	<b>Comments:</b>	N/A	
<b>Client Sample:</b> 44-A	<b>Asbestos Detected?</b>	<b>No</b>	
<b>LEX Sample:</b> 134	<b>Chrysotile:</b>	None Detected	<b>Cellulose:</b> None Detected
<b>Layers Analyzed:</b> Sample Homogenized	<b>Amosite:</b>	None Detected	<b>MMVF:</b> None Detected
<b>Colour:</b> Brown	<b>Crocidolite:</b>	None Detected	<b>Other Fibres:</b> None Detected
<b>Description:</b> Vinyl Flooring Tile - Tan + Brown	<b>Other Amphiboles:</b>	None Detected	<b>Non Fibrous:</b> 100
	<b>Comments:</b>	N/A	
<b>Client Sample:</b> 44-B	<b>Asbestos Detected?</b>	<b>No</b>	
<b>LEX Sample:</b> 135	<b>Chrysotile:</b>	None Detected	<b>Cellulose:</b> None Detected
<b>Layers Analyzed:</b> Sample Homogenized	<b>Amosite:</b>	None Detected	<b>MMVF:</b> None Detected
<b>Colour:</b> Brown	<b>Crocidolite:</b>	None Detected	<b>Other Fibres:</b> None Detected
<b>Description:</b> Vinyl Flooring Tile - Tan + Brown	<b>Other Amphiboles:</b>	None Detected	<b>Non Fibrous:</b> 100
	<b>Comments:</b>	N/A	
<b>Client Sample:</b> 44-C	<b>Asbestos Detected?</b>	<b>No</b>	
<b>LEX Sample:</b> 136	<b>Chrysotile:</b>	None Detected	<b>Cellulose:</b> None Detected
<b>Layers Analyzed:</b> Sample Homogenized	<b>Amosite:</b>	None Detected	<b>MMVF:</b> None Detected
<b>Colour:</b> Brown	<b>Crocidolite:</b>	None Detected	<b>Other Fibres:</b> None Detected
<b>Description:</b> Vinyl Flooring Tile - Tan + Brown	<b>Other Amphiboles:</b>	None Detected	<b>Non Fibrous:</b> 100
	<b>Comments:</b>	N/A	

Other Amphiboles: ac=actinolite, a=anthophyllite, t-tremolite, u=unidentified  
 MMVF: Man Made Vitreous Fibres: Fibreglass, Min. Wool, Rockwool, Glasswool  
 PLM - method detection limit is 0.1%

Analyst



This test report relates only to the items tested and must not be used to claim product endorsement by NVLAP or any agency of the United States government. This test report must not be reproduced, except in full, without the written consent of the laboratory. Please note that the Chain of Custody form received with the items tested is an integral part of this report and must be considered in the interpretation of these results.



---

## **Appendix C – Laboratory Certificate of Analysis – Lead in Paint Chip Samples**



Your P.O. #: 530472  
Your Project #: 01180066  
Your C.O.C. #: nz

**Attention: Dan Humphrey**

Lex Scientific Inc  
291 Woodlawn Rd W  
Unit B12  
Guelph, ON  
CANADA N1H 7L6

**Report Date: 2018/05/30**  
Report #: R5184076  
Version: 1 - Final

**CERTIFICATE OF ANALYSIS**

**MAXXAM JOB #: B8C2991**

**Received: 2018/05/24, 15:30**

Sample Matrix: Paint  
# Samples Received: 2

Analyses	Date		Date Analyzed	Laboratory Method	Reference
	Quantity	Extracted			
Metals in Paint	2	2018/05/25	2018/05/25	CAM SOP-00408	EPA 6010D m

**Remarks:**

Maxxam Analytics' laboratories are accredited to ISO/IEC 17025:2005 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by Maxxam are based upon recognized Provincial, Federal or US method compendia such as CCME, MDDELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in Maxxam's profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and Maxxam in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported; unless indicated otherwise, associated sample data are not blank corrected.

Maxxam Analytics' liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. Maxxam has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by Maxxam, unless otherwise agreed in writing.

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.

Results relate to samples tested.

This Certificate shall not be reproduced except in full, without the written approval of the laboratory.

Reference Method suffix "m" indicates test methods incorporate validated modifications from specific reference methods to improve performance.

\* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.



Your P.O. #: 530472  
Your Project #: 01180066  
Your C.O.C. #: nz

**Attention: Dan Humphrey**

Lex Scientific Inc  
291 Woodlawn Rd W  
Unit B12  
Guelph, ON  
CANADA N1H 7L6

**Report Date: 2018/05/30**  
Report #: R5184076  
Version: 1 - Final

**CERTIFICATE OF ANALYSIS**

**MAXXAM JOB #: B8C2991**  
**Received: 2018/05/24, 15:30**

Encryption Key



Maxxam  
30 May 2018 11:47:40

Please direct all questions regarding this Certificate of Analysis to your Project Manager.  
Nazeema Rahaman, Project Manager  
Email: NRahaman@maxxam.ca  
Phone# (905) 817-5700

=====

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Maxxam Job #: B8C2991  
Report Date: 2018/05/30

Lex Scientific Inc  
Client Project #: 01180066  
Your P.O. #: 530472  
Sampler Initials: LEX

### ELEMENTS BY ATOMIC SPECTROSCOPY (PAINT)

<b>Maxxam ID</b>		GTU598		GTU599		
<b>Sampling Date</b>		2018/05/18		2018/05/18		
<b>COC Number</b>		nz		nz		
	<b>UNITS</b>	<b>L-01 GREY PAINT</b>	<b>RDL</b>	<b>L-02 BEIGE PAINT</b>	<b>RDL</b>	<b>QC Batch</b>
<b>Metals</b>						
Lead (Pb)	mg/kg	2600	11	290	10	5547822
RDL = Reportable Detection Limit						
QC Batch = Quality Control Batch						



Maxxam Job #: B8C2991  
Report Date: 2018/05/30

Lex Scientific Inc  
Client Project #: 01180066  
Your P.O. #: 530472  
Sampler Initials: LEX

### TEST SUMMARY

**Maxxam ID:** GTU598  
**Sample ID:** L-01 GREY PAINT  
**Matrix:** Paint

**Collected:** 2018/05/18  
**Shipped:**  
**Received:** 2018/05/24

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Metals in Paint	ICP	5547822	2018/05/25	2018/05/25	Suban Kanapathipillai

**Maxxam ID:** GTU599  
**Sample ID:** L-02 BEIGE PAINT  
**Matrix:** Paint

**Collected:** 2018/05/18  
**Shipped:**  
**Received:** 2018/05/24

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Metals in Paint	ICP	5547822	2018/05/25	2018/05/25	Suban Kanapathipillai



Maxxam Job #: B8C2991  
Report Date: 2018/05/30

Lex Scientific Inc  
Client Project #: 01180066  
Your P.O. #: 530472  
Sampler Initials: LEX

#### GENERAL COMMENTS

Sample GTU598 [L-01 GREY PAINT] : Metals Analysis: Due to the sample matrix, sample required dilution. Detection limit was adjusted accordingly.

Sample GTU599 [L-02 BEIGE PAINT] : Metals Analysis: Due to the sample matrix, sample required dilution. Detection limit was adjusted accordingly.

**Results relate only to the items tested.**



Maxxam Job #: B8C2991  
Report Date: 2018/05/30

Lex Scientific Inc  
Client Project #: 01180066  
Your P.O. #: 530472  
Sampler Initials: LEX

### QUALITY ASSURANCE REPORT

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
5547822	SUK	Matrix Spike	Lead (Pb)	2018/05/25		NC	%	75 - 125
5547822	SUK	QC Standard	Lead (Pb)	2018/05/25		100	%	75 - 125
5547822	SUK	Method Blank	Lead (Pb)	2018/05/25	ND, RDL=1.0		mg/kg	
5547822	SUK	RPD	Lead (Pb)	2018/05/25	3.7		%	35

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

QC Standard: A sample of known concentration prepared by an external agency under stringent conditions. Used as an independent check of method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spike amount was too small to permit a reliable recovery calculation (matrix spike concentration was less than the native sample concentration)



Maxxam Job #: B8C2991  
Report Date: 2018/05/30

Lex Scientific Inc  
Client Project #: 01180066  
Your P.O. #: 530472  
Sampler Initials: LEX

#### VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

Brad Newman, Scientific Service Specialist

---

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.



6740 Campbell Rd, Mississauga, Ontario L5N 2L8  
Phone: 905-817-5700 Fax: 905-817-5779 Toll Free: 800-563-6266  
CAM FCD-01191/3

### CHAIN OF CUSTODY RECORD

Page 1 of 1

Invoice Information		Report Information (if differs from invoice)		Project Information (where applicable)		Turnaround Time (TAT) Required	
Company Name:	LEX Scientific Inc.	Company Name:	LEX	Quotation #:	530472	<input checked="" type="checkbox"/> Regular TAT (5-7 days) Most analyses	
Contact Name:	Berni Hoskima	Contact Name:	Don Humphrey	P.O. # / A/E:	C1180066	PLEASE PROVIDE ADVANCE NOTICE FOR RUSH PROJECTS	
Address:	291 Woodlawn Road West, Unit B-12 Guelph, ON N1H 7L6	Address:		Project #:		Rush TAT (Such charges will be applied)	
Phone:	519-824-7082	Phone:		Site Location:		<input type="checkbox"/> 1 Day	<input type="checkbox"/> 2 Days <input type="checkbox"/> 3-4 Days
Email:	lexscientific.com	Email:	dhumphrey@lexscientific.com	Site #:	LEX	Date Required:	
MCE REGULATED DRINKING WATER OR WATER INTENDED FOR HUMAN CONSUMPTION MUST BE SUBMITTED ON THE MAXXAM DRINKING WATER CHAIN OF CUSTODY							
Regulation 153		Other Regulations		Analysis Requested			
<input type="checkbox"/> Table 1	<input type="checkbox"/> Res/Park	<input type="checkbox"/> Med/ Fine	<input type="checkbox"/> CCME	<input type="checkbox"/> Sanitary Sewer Bylaw			
<input type="checkbox"/> Table 2	<input type="checkbox"/> Ind/Comm	<input type="checkbox"/> Coarse	<input type="checkbox"/> MISA	<input type="checkbox"/> Storm Sewer Bylaw			
<input type="checkbox"/> Table 3	<input type="checkbox"/> Agri/ Other		<input type="checkbox"/> PWGO	Region:			
<input type="checkbox"/> Table			<input type="checkbox"/> Other (Specify):				
FOR RSC (PLEASE CIRCLE) Y / N		REG 558 (MIN 3 DAY TAT REQUIRED)					
Include Criteria on Certificate of Analysis: Y / N							
SAMPLES MUST BE KEPT COOL (< 10°C) FROM TIME OF SAMPLING UNTIL DELIVERY TO MAXXAM							
SAMPLE IDENTIFICATION		DATE SAMPLED (YYYY/MM/DD)	TIME SAMPLED (HH:MM)	MAXXAM			
1	L-01 Grey Paint	2018/05/18		Paint			
2	L-02 Beige Paint	2018/05/18		Paint			
3							
4							
5							
6							
7							
8							
9							
10							
RELINQUISHED BY: (Signature/Print)		DATE: (YYYY/MM/DD)	TIME: (HH:MM)	RECEIVED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)	MAXXAM JOB #
D. HUMPHREY		2018/05/22		2018/05/24	2018/05/24	15:30	

24-May-18 15:30  
Nazeema Rahaman  
B8C2991  
GK1 ENV-602

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## **Appendix D – Asbestos Quantification and Management Form**

Appendix D: Asbestos Quantification and Management Form

Floor	Room Name	Room #	Structure	Designated Substance	Material	Sample ID	Quantity	Units	Condition	Friability	Comments
1		128	Insulation	Asbestos	Parged pipe fitting	08	3	units	Good	Yes	Limited view. Likely more above ceiling
1		129	Insulation	Asbestos	Parged pipe fitting	08		units		Yes	Unable to view above ceiling
1		130	Insulation	Asbestos	Parged pipe fitting	08	2	units	Good	Yes	Limited view. Likely more above ceiling
1	132	132	Insulation	Asbestos	Parged pipe fitting	08	6	units	Good	Yes	Limited view. Likely more above ceiling
1	132A	132	Insulation	Asbestos	Parged pipe fitting	08		units	Good	Yes	Unable to view above ceiling
1	132B	132	Insulation	Asbestos	Parged pipe fitting	08		units		Yes	Unable to view above ceiling
1	132C	132	Insulation	Asbestos	Parged pipe fitting	08		units		Yes	Unable to view above ceiling
1		133	Insulation	Asbestos	Parged pipe fitting	08	23	units	Good	Yes	Limited view. Likely more above ceiling
1		135	Insulation	Asbestos	Parged pipe fitting	08	10	units	Good	No	Limited view. Likely more above ceiling
1		138	Insulation	Asbestos	Parged pipe fitting	08	2	units	Good	Yes	Limited view. Likely more above ceiling
1	138A	138	Insulation	Asbestos	Parged pipe fitting	08	6	units	Good	Yes	Limited view. Likely more above ceiling
1	138B	138	Insulation	Asbestos	Parged pipe fitting	08	7	units	Good	Yes	Limited view. Likely more above ceiling
1		139	Insulation	Asbestos	Parged pipe fitting	08	2	units	Good	Yes	Limited view. Likely more above ceiling
1	139A	139	Insulation	Asbestos	Parged pipe fitting	08	7	units	Good	Yes	
1	140A	140	Insulation	Asbestos	Parged pipe fitting	08	22	units	Good	Yes	
1	Washroom		Insulation	Asbestos	Parged pipe fitting	08	6	units	Good	Yes	
1	Washroom	116	Insulation	Asbestos	Parged pipe fitting	08	22	units	Good	Yes	Above room and inside wall cavity
1	Washroom	117	Insulation	Asbestos	Parged pipe fitting	08	9	units	Good	Yes	Limited view. Likely more above ceiling
1	117A, 117B	117	Insulation	Asbestos	Parged pipe fitting	08		units		Yes	Limited view. Likely more above ceiling
1		119	Insulation	Asbestos	Parged pipe fitting	08	2	units	Good	Yes	Unable to view above ceiling.



Note: Green cells indicate ACM VFT and black mastic/ Orange cells indicate non-ACM VFT but ACM containing black mastic

Appendix D: Asbestos Quantification and Management Form

Floor	Room Name	Room #	Structure	Designated Substance	Material	Sample ID	Quantity	Units	Condition	Friability	Comments
1	120A	120	Insulation	Asbestos	Parged pipe fitting	08	80	units	Good	Yes	Some remediation observed
1	120A	120	Insulation	Asbestos	Parged pipe fitting	08	10	units	Fair	Yes	
1	120A	120	Insulation	Asbestos	Parged boiler tanks	08	3	units	Fair	Yes	Some remediation observed
1		121	Insulation	Asbestos	Parged pipe fitting	08		units		Yes	Unable to view above ceiling
1		123	Insulation	Asbestos	Parged pipe fitting	08	11	units	Good	Yes	Limited view. Likely more above ceiling
1	125B	125	Insulation	Asbestos	Parged pipe fitting	08	2	units	Good	Yes	Behind sink (room 125A)
1	125A	125	Insulation	Asbestos	Parged pipe fitting	08	2	units	Good	Yes	
1		126	Insulation	Asbestos	Parged pipe fitting	08	15	units	Good	Yes	Limited view. Likely more above ceiling
1	126D	126	Insulation	Asbestos	Parged pipe fitting	08		units		Yes	Limited view. Likely more above ceiling
1	126E	126	Insulation	Asbestos	Parged pipe fitting	08	9	units	Good	No	
1	126A	126	Insulation	Asbestos	Parged pipe fitting	08	5	units	Good	Yes	
1		127	Insulation	Asbestos	Parged pipe fitting	08	10	units	Good	Yes	Limited view. Likely more above ceiling
1	MW116		Insulation	Asbestos	Parged pipe fitting	08	7	units	Good	Yes	Limited view. Likely more above ceiling
1	101	101	Insulation	Asbestos	Parged pipe fitting	08	10	units	Good	Yes	
1	109, 109A, 109B	109	Insulation	Asbestos	Parged pipe fitting	08	10	units	Good	Yes	Limited view. Likely more above ceiling
3	Penthouse mechanical room	222	Insulation	Asbestos	Parged pipe wrapping	08	1200	sq ft	Good	Yes	Found on circular ducting
3	Penthouse mechanical room	222	Insulation	Asbestos	Parged pipe fitting	08	20	units	Good	Yes	Part of ducting systems has not been remediated
3	Penthouse mechanical room	222	Insulation	Asbestos	Parged pipe wrapping	08	1100	sq ft	Good	Yes	Wrapped around rectangular ducting
3	Penthouse mechanical room	222	Insulation	Asbestos	Parged pipe wrapping	08	1300	sq ft	Good	Yes	Wrapped around air handling units
2		223	Insulation	Asbestos	Parged pipe fitting	08	7	units	Good	Yes	
1		102	Insulation	Asbestos	Parged pipe fitting	08	4	units	Good	Yes	Limited view behind sink area



Note: Green cells indicate ACM VFT and black mastic/ Orange cells indicate non-ACM VFT but ACM containing black mastic

Appendix D: Asbestos Quantification and Management Form

Floor	Room Name	Room #	Structure	Designated Substance	Material	Sample ID	Quantity	Units	Condition	Friability	Comments
1	C102	102	Insulation	Asbestos	Parged pipe fitting	08	16	units	Good	Yes	Limited view. Count approx. Evidence of some elbows mitigated (approx. 10)
1	C103	103	Insulation	Asbestos	Parged pipe fitting	08	30	units	Good	No	Limited view. Likely more above ceiling
1	113A	113	Insulation	Asbestos	Parged pipe fitting	08	2	units	Good	Yes	Limited view behind sink area
1		128	Insulation	Asbestos	Parged pipe fitting	08	2	units	Good	Yes	Limited view behind sink area
1	124	124	Ceiling	Asbestos	Parged pipe fitting	08	9	units	Good	Yes	Limited view above ceiling and behind sink area
2	Men's washroom	202	Insulation	Asbestos	Parged pipe fitting	08		units		Yes	Unable to view above ceiling
2		201	Insulation	Asbestos	Parged pipe fitting	08		units		Yes	Unable to view above ceiling
2		203	Insulation	Asbestos	Parged pipe fitting	08	6	units	Good	Yes	
2	204B	204	Insulation	Asbestos	Parged pipe fitting	08	10	units	Good	Yes	
2	206B, 206C	206	Insulation	Asbestos	Parged pipe fitting	08	3	units	Good	Yes	Limited view. Likely more above ceiling
2	209, 209A	209	Insulation	Asbestos	Parged pipe fitting	08	8	units	Good	Yes	Limited view behind sink area
2	C201		Insulation	Asbestos	Parged pipe fitting	08	14	units	Good	Yes	Limited view. Likely more above ceiling
1		130	Floor	Asbestos	Mastic - black	12	150	sq ft	Good	No	Beneath carpet tiles
1		137	Floor	Asbestos	Mastic - black	12	35	sq ft	Fair	No	No tile present, same mastic
1		138	Floor	Asbestos	VFT - white with black + mastic - black	12	220	sq ft	Good	No	
1		127	Floor	Asbestos	VFT - white with black + mastic - black	12	540	sq ft	Good	No	Beneath carpet tiles
1	106, 106A, 106B	106	Floor	Asbestos	Mastic - black	12	300	sq ft	Good	No	No tile present, same mastic
1		107	Floor	Asbestos	Mastic - black	12	170	sq ft	Good	No	No tile present, same mastic
1		115	Floor	Asbestos	VFT - white with black + mastic - black	12	126	sq ft	Good	No	
2	204	204	Floor	Asbestos	Mastic - black	12	300	sq ft	Good	No	No tile present, same mastic



Note: Green cells indicate ACM VFT and black mastic/ Orange cells indicate non-ACM VFT but ACM containing black mastic

Appendix D: Asbestos Quantification and Management Form

Floor	Room Name	Room #	Structure	Designated Substance	Material	Sample ID	Quantity	Units	Condition	Friability	Comments
2	205A, 205B	205	Floor	Asbestos	Mastic - black	12	472	sq ft	Good	No	No tile present, same mastic
2	206B, 206C	206	Floor	Asbestos	Mastic - black	12	104	sq ft	Good	No	No tile present, same mastic
1	138-A	138	Floor	Asbestos	VFT - 9x9 olive with white streaks + mastic - black	13	30	sq ft	Good	No	
1	138-B	138	Floor	Asbestos	VFT - 9x9 olive with white streaks + mastic - black	13	32	sq ft	Good	No	
2	215,215A,215B	215	Floor	Asbestos	VFT - 9x9 olive with white streaks + mastic - black	13	192	sq ft	Good	No	Beneath carpet tiles
2	215D,215C,216	216	Floor	Asbestos	VFT - 9x9 olive with white streaks + mastic - black	13	230	sq ft	Good	No	Beneath carpet tiles
2	218, 218A, 218B, 218C	218	Floor	Asbestos	VFT - 9x9 olive with white streaks + mastic - black	13	256	sq ft	Good	No	
1		112	Floor	Asbestos	VFT - 9x9 olive with white streaks + mastic - black	13	36	sq ft	Good	No	
2	C201		Floor	Asbestos	VFT - 9x9 olive with white streaks + mastic - black	13	80	sq ft	Good	No	
1	138-B	138	Floor	Asbestos	VFT -white with grey + mastic - black	14	18	sq ft	Good	No	
1		126	Floor	Asbestos	VFT -white with grey + mastic - black	14	270	sq ft	Good	No	Beneath carpet tiles
1	126E	126	Floor	Asbestos	VFT -white with grey + mastic - black	14	121	sq ft	Good	No	Beneath carpet tiles
1	Staff washroom	109	Floor	Asbestos	VFT -white with grey + mastic - black	14	28	sq ft	Good	No	
1	113A	113	Floor	Asbestos	VFT -white with grey + mastic - black	14	30	sq ft	Good	No	
1		128	Floor	Asbestos	VFT -white with grey + mastic - black	14	10	sq ft	Good	No	Any other flooring not quantified due to large proportional differences
2	204B	204	Floor	Asbestos	VFT -white with grey + mastic - black	14	15	sq ft	Good	No	

Appendix D: Asbestos Quantification and Management Form

Floor	Room Name	Room #	Structure	Designated Substance	Material	Sample ID	Quantity	Units	Condition	Friability	Comments
2	207, 207B	207	Floor	Asbestos	VFT - white with grey + mastic - black	14	15	sq ft	Good	No	
1	132A	132	Floor	Asbestos	VFT - 9x9 brown with white streaks + mastic - black	17	144	sq ft	Good	No	Beneath carpet tiles
2		221	Floor	Asbestos	VFT - 9x9 brown with white streaks + mastic - black	17	276	sq ft	Good	No	Beneath carpet tiles
3	Penthouse mechanical room	222	Floor	Asbestos	VFT - 9x9 brown with white streaks + mastic - black	17	16	sq ft	Good	No	
2	209, 209A	209	Floor	Asbestos	VFT - 9x9 brown with white streaks + mastic - black	17	96	sq ft	Good	No	
2	210, 210A, 210B, 210C	210	Floor	Asbestos	VFT - 9x9 brown with white streaks + mastic - black	17	80	sq ft	Good	No	
1		128	Floor	Asbestos	VFT - 9x9 grey with white streaks + mastic - black	18	200	sq ft	Good	No	
1	117A	117	Floor	Asbestos	VFT - 9x9 grey with white streaks + mastic - black	18	143	sq ft	Good	No	Beneath carpet tiles
1	117B	117	Floor	Asbestos	VFT - 9x9 grey with white streaks + mastic - black	18	121	sq ft	Good	No	
1	125B	125	Floor	Asbestos	VFT - 9x9 grey with white streaks + mastic - black	18	60	sq ft	Good	No	Pooling water
1	125A	125	Floor	Asbestos	VFT - 9x9 grey with white streaks + mastic - black	18	216	sq ft	Fair	No	
1		125	Floor	Asbestos	VFT - 9x9 grey with white streaks + mastic - black	18	24	sq ft	Good	No	
1	126D	126	Floor	Asbestos	VFT - 9x9 grey with white streaks + mastic - black	18	60	sq ft	Good	No	Beneath carpet tiles
1	126B	126	Floor	Asbestos	VFT - 9x9 grey with white streaks + mastic - black	18	143	sq ft	Good	No	Beneath carpet tiles
2	214A,B	214	Floor	Asbestos	VFT - 9x9 grey with white streaks + mastic - black	18	242	sq ft	Good	No	Beneath carpet tiles
2	215, 215A, 215B	215	Floor	Asbestos	VFT - 9x9 grey with white streaks + mastic - black	18	121	sq ft	Good	No	Beneath carpet tiles



Note: Green cells indicate ACM VFT and black mastic/ Orange cells indicate non-ACM VFT but ACM containing black mastic

Appendix D: Asbestos Quantification and Management Form

Floor	Room Name	Room #	Structure	Designated Substance	Material	Sample ID	Quantity	Units	Condition	Friability	Comments
1		111	Floor	Asbestos	VFT - 9x9 grey with white streaks + mastic - black	18	300	sq ft	Good	No	
2		203	Floor	Asbestos	VFT - 9x9 grey with white streaks + mastic - black	18	215	sq ft	Good	No	Beneath carpet tiles.
2	203A	203	Floor	Asbestos	VFT - 9x9 grey with white streaks + mastic - black	18	88	sq ft	Good	No	Beneath carpet tiles
2	206B, 206C	206	Floor	Asbestos	VFT - 9x9 grey with white streaks + mastic - black	18	10	sq ft	Good	No	
2	206A	206	Floor	Asbestos	VFT - 9x9 grey with white streaks + mastic - black	18	280	sq ft	Good	No	
1		126	Floor	Asbestos	VFT - green/blue + mastic - black	19	270	sq ft	Good	No	Beneath carpet tiles
1	132B	132	Floor	Asbestos	VFT - 9x9 white with green + mastic - black	20	130	sq ft	Good	No	Beneath carpet tiles
1	126D	126	Floor	Asbestos	VFT - 9x9 white with green + mastic - black	20	60	sq ft	Good	No	Beneath carpet tiles
1		119	Floor	Asbestos	VFT - 9x9 teal with white + mastic - black	23	96	sq ft	Good	No	
1		123	Floor	Asbestos	VFT - beige with brown + mastic - black	24	300	sq ft	Good	No	
1		123	Floor	Asbestos	VFT - 9x9 grey with black + mastic - black	25	300	sq ft	Good	No	
1	124	124	Floor	Asbestos	VFT-9x9 grey with black + mastic - black	25	132	sq ft	Good	No	
1		123	Floor	Asbestos	VFT - oatmeal pattern + mastic - black	26	300	sq ft	Good	No	
2	215, 215A, 215B	215	Floor	Asbestos	VFT - oatmeal pattern + mastic - black	26	12	sq ft	Good	No	
1	124	124	Floor	Asbestos	VFT- oatmeal pattern + mastic - black	26	132	sq ft	Good	No	
2		203	Floor	Asbestos	VFT - 9x9 brown with multicolored streaks + mastic - black	30	400	sq ft	Good	No	Beneath carpet tiles. Limited access



Note: Green cells indicate ACM VFT and black mastic/ Orange cells indicate non-ACM VFT but ACM containing black mastic

Appendix D: Asbestos Quantification and Management Form

Floor	Room Name	Room #	Structure	Designated Substance	Material	Sample ID	Quantity	Units	Condition	Friability	Comments
2	208	208	Floor	Asbestos	VFT - 9x9 brown with multicolored streaks + mastic - black	30	64	sq ft	Good	No	
2	210, 210A, 210B, 210C	210	Floor	Asbestos	VFT - 9x9 brown with multicolored streaks + mastic - black	30	450	sq ft	Good	No	
2	215D, 215C, 216	216	Floor	Asbestos	VFT - 9x9 white with brown streaks + mastic - black	31	121	sq ft	Good	No	Beneath carpet tiles
2	219, 219A, 219B, 219C	219	Floor	Asbestos	VFT - 9x9 white with brown streaks + mastic - black	31	500	sq ft	Good	No	Beneath carpet tiles
2	Breaker room	220	Floor	Asbestos	VFT - white with brown streaks + mastic - black	31	72	sq ft	Fair	No	Tiles missing
1		102	Floor	Asbestos	VFT - 9x9 white with brown streaks + mastic - black	31	275	sq ft	Good	No	
2	203B	203	Floor	Asbestos	VFT - 9x9 white with brown streaks + mastic - black	31	176	sq ft	Good	No	Beneath carpet tiles
2	207, 207B	207	Floor	Asbestos	VFT - 9x9 blue with white streaks + mastic - black	31	345	sq ft	Good	No	
2	215, 215A, 215B	215	Floor	Asbestos	VFT - 9x9 blue with white streaks + mastic - black	32	70	sq ft	Good	No	
2	215D, 215C, 216	216	Floor	Asbestos	VFT - 9x9 blue with white streaks + mastic - black	32	77	sq ft	Good	No	Beneath carpet tiles
2		223	Floor	Asbestos	VFT - 9x9 blue with white + mastic - black	32	276	sq ft	Good	No	Beneath carpet tiles
2	204B	204	Floor	Asbestos	VFT - 9x9 blue with streaks + mastic - black	32	156	sq ft	Good	No	
2	213, 213A, 213B, 213C	213	Floor	Asbestos	VFT - 9x9 blue with white + mastic - black	32	260	sq ft	Good	No	
2	204B	204	Floor	Asbestos	VFT - black with white streaks + mastic - black	33	40	sq ft	Good	No	
1	C103	103	Floor	Asbestos	VFT - grey with black streaks + mastic - black	34	16	sq ft	Good	No	



Note: Green cells indicate ACM VFT and black mastic/ Orange cells indicate non-ACM VFT but ACM containing black mastic

Appendix D: Asbestos Quantification and Management Form

Floor	Room Name	Room #	Structure	Designated Substance	Material	Sample ID	Quantity	Units	Condition	Friability	Comments
1	113A	113	Floor	Asbestos	VFT - grey with black streaks + mastic - black	34	300	sq ft	Good	No	
2	204B	204	Floor	Asbestos	VFT - grey with black streaks + mastic - black	34	54	sq ft	Good	No	
2	213, 213A, 213B, 213C	213	Floor	Asbestos	VFT - grey with black streaks + mastic - black	34	260	sq ft	Good	No	
2	219, 219A, 219B, 219C	219	Floor	Asbestos	VFT- 9x9 red with white streaks + mastic - black	36	25	sq ft	Good	No	Beneath carpet tiles
1		128	Floor	Asbestos	VFT- 9x9 red with white streaks + mastic - black	36	450	sq ft	Good	No	
2	209, 209A	209	Floor	Asbestos	VFT- 9x9 red with white streaks + mastic - black	36	205	sq ft	Good	No	
2	C201		Floor	Asbestos	VFT- 9x9 red with white streaks + mastic - black	36	20	sq ft	Good	No	
2	209, 209A	209	Floor	Asbestos	VFT -orange/red + mastic - black	37	70	sq ft	Good	No	Some VFT seem more faded than others
2	209, 209A	209	Floor	Asbestos	VFT-dark multi red + mastic - black	38	18	sq ft	Good	No	
2	213, 213A, 213B, 213C	213	Floor	Asbestos	VFT - army green with white	39	170	sq ft	Good	No	
1		112	Floor	Asbestos	VFT - multigrey + mastic - black	42	16	sq ft	Good	No	
1					VFT - tan and brown + mastic -brown	44	65	sq ft	Good	No	Likely installed at same time as other 12x12 tiles. Other tiles sampled are Samples 26, 42
1		138	Other	Asbestos	Transite board	N/A	50	sq ft	Good	No	Presumed ACM
2	209, 209A	209	Other	Asbestos	Sink undercoating - gold	N/A	2	units	Good	No	Presumed ACM

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## **Appendix 'B'**

### **Letter Report: Spray-Applied Beam Insulation Inspection – Former VMI Building – Ontario Veterinary College**

Prepared by LEX Scientific Inc., June 2018 (LEX Project No. 01180066)



August 30, 2018  
LEX Project No. 01180066-B

Mr. Peter Ibrajev  
University of Guelph – Physical Resources Dept.  
J.C. Hersey Building, 117 College Avenue East  
Guelph, ON N1G 2W1

**Re: Spray-Applied Beam Insulation Inspection  
Former VMI Building – Ontario Veterinary College**

Dear Mr. Ibrajev:

LEX Scientific Inc. (LEX) was retained by the University of Guelph – Physical Resources Dept. (the University) to conduct a visual confirmation inspection of Spray-Applied Beam Insulation (spray insulation) at the Ontario Veterinary College – Former VMI Building located at 50 College Ave. West, Guelph, ON. The inspection was requested to confirm the presence of asbestos containing fireproofing. The inspection was conducted by LEX Environmental Technologist Jarrett Deneau, B.Sc., on August 23, 2018.

The spray fireproofing insulation was identified to have been historically present from an internal review of University of Guelph documents. In addition to this, the following signage was present adjacent to the ceiling tiles in two locations where the fireproofing was historically identified. The signage stated: *“Asbestos Containing Materials above Ceiling Tiles. Please use Type 2 Procedures when entering this space. For more information call ext 2030.”* As such, prior to LEX conducting a visual confirmation inspection, Fibrecon Insulation (Fibrecon) erected small enclosures in the corridor areas selected at the locations where fireproofing was potentially present. See **Attachment #1** for markup's of floor plans showing the locations of the enclosures.

LEX did not observe any materials of note in the ceiling space of inspection enclosure #1 located in corridor C102.

During the inspection, LEX observed the spray insulation along multiple beams in the ceiling space of corridor C201, outside room 217 in inspection enclosure #2. However, due to the extremely limited view above the ceiling tiles, the spray insulation was only be observable from the limited area exposed along the north side of the wall within the enclosure.

LEX observed what appeared to be spackling or dust along the decking beam located in inspection enclosure #3 in corridor C202. It does not appear to be spray insulation but could potentially be residue if fireproofing had been historically present and abated at some point.

Pictures of interest pertaining to the inspection can be viewed in **Attachment #2: Photolog of Notable Pictures**.

Between May 14 to 18, 2018, LEX conducted a Designated Substances Survey (DSS) of the building. During the survey, no spray insulation was observed by LEX staff. As part of the survey, LEX opened up multiple ceiling tiles to inspect the ceiling space along the corridors throughout the building. It was likely that the spray insulation was not observed due to extremely limited visibility in the ceiling space of the corridors. This was compounded by the limited amount of ceiling tiles that LEX staff thought could be removed and replaced without causing substantial damage to the tiles.

On behalf of LEX, we would like to thank you for the opportunity to serve you. If you have any questions regarding this report or any health and safety issue, please call us at (519).824.7082.

Yours truly,

**LEX Scientific Inc.**



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Jarrett Deneau, B.Sc.  
Environmental Technologist



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Eric Hoffbauer, P. Eng.  
Project Manager – Consulting Services

**Attachment #1: Floor Plans Showing Enclosure Locations**

**Attachment #2: Photolog of Notable Pictures**

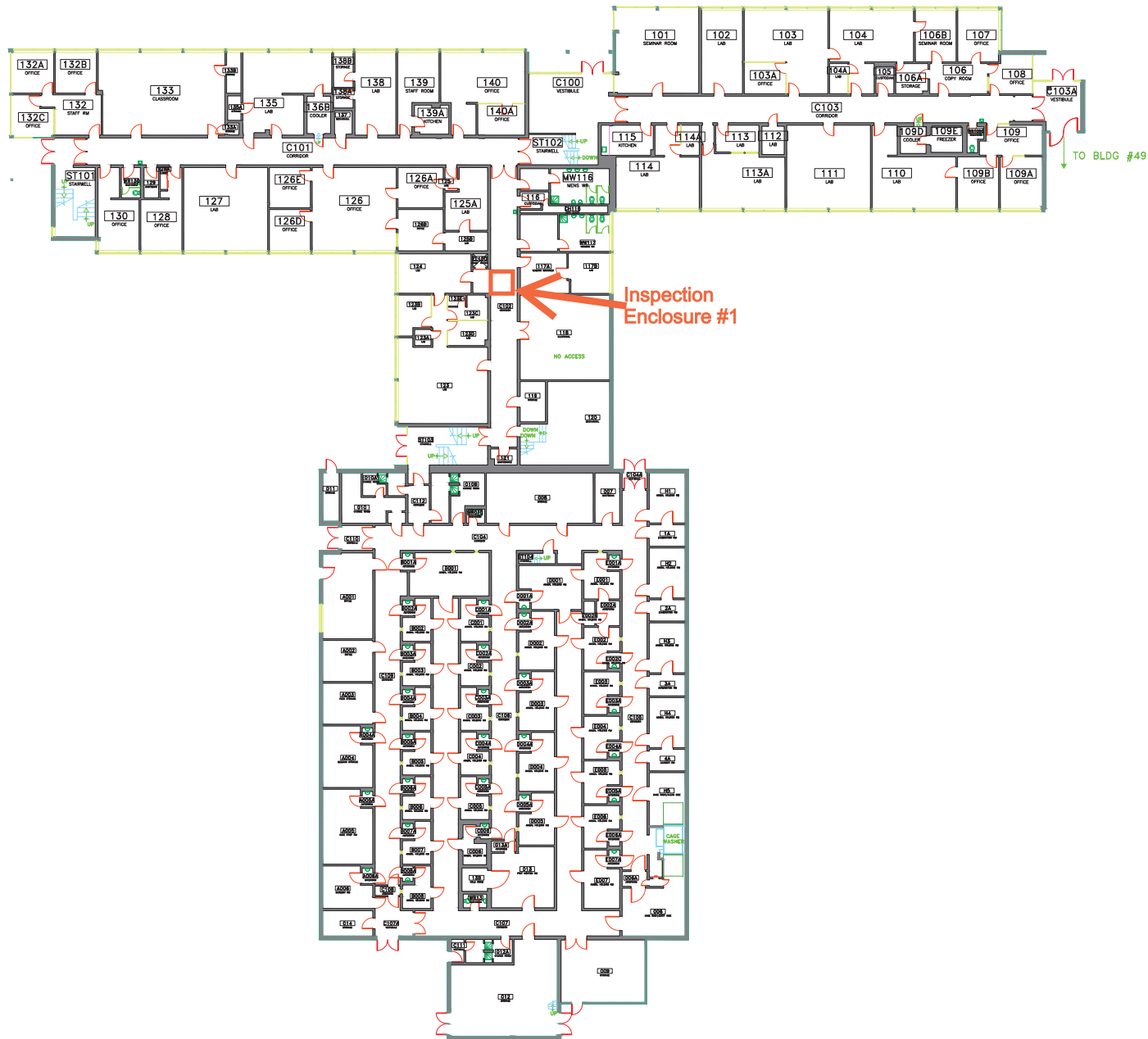
## Disclaimer

This report is prepared exclusively for the purposes, project and site location outlined in the report. The report is based on information provided to, or collected and/or obtained by LEX as indicated in the report, and applies solely to site conditions existing at the time of sampling. LEX's report represents a reasonable analysis and interpretation of available information within an agreed scope of work, schedule and budget.

LEX's liability to the Client and all claimants not party to this agreement shall be limited to injury or loss caused by negligence of LEX and/ or sub-consultants for which it is responsible. The total amount of LEX's liability for said negligence shall be limited to the lesser of the fees paid for or actual damages incurred by the Client and the Client hereby waives all claims in excess of this amount howsoever arising including any claim for contribution and indemnity which the Client may have against LEX. The Client irrevocably and unconditionally agrees to defend, indemnify and hold LEX harmless from all claims and expenses associated therewith resulting from claims brought by other parties in excess of the aforesaid limit.

LEX prepared this report for the sole benefit of University of Guelph – Physical Resources Dept.; it reflects LEX's best judgment in light of the information available at the time of preparation. Any use which a third party makes of this report, or any reliance on or decisions made based on it, are the responsibilities of such third parties. LEX accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions taken based on this report.

## **Attachment 1**



**DO NOT SCALE DRAWINGS.**

Contractors must check and verify all site conditions. Notify the Owner's Representative in writing before proceeding with the work if discrepancies are evident between the drawings and the site condition. No extras to the contract will be allowed if discrepancies were evident prior to start of work.

**ASBESTOS:**

Perform all work avoiding contact or disturbance of any asbestos materials. If asbestos or suspected asbestos containing materials are discovered during the work, all work must stop. At that point, the Contractor is to bring in an Asbestos Removal Contractor along with the Owner's Representative to review the extent of the work & provide a quotation to the University of Guelph's Construction Dept. for subsequent removal. Work shall resume after the Owner's Representative has approved such action.

Reference Documents

—  
—  
—

**A** = Detail number  
**B** = Sheet number where detailed

5			
4			
3			
2			
1			

NO. ISSUED BY DATE



**UNIVERSITY OF GUELPH**  
 Planning, Engineering & Construction  
 Physical Resources  
 Guelph, Ontario. N1G 2W1

Project  
**BASE PLAN**

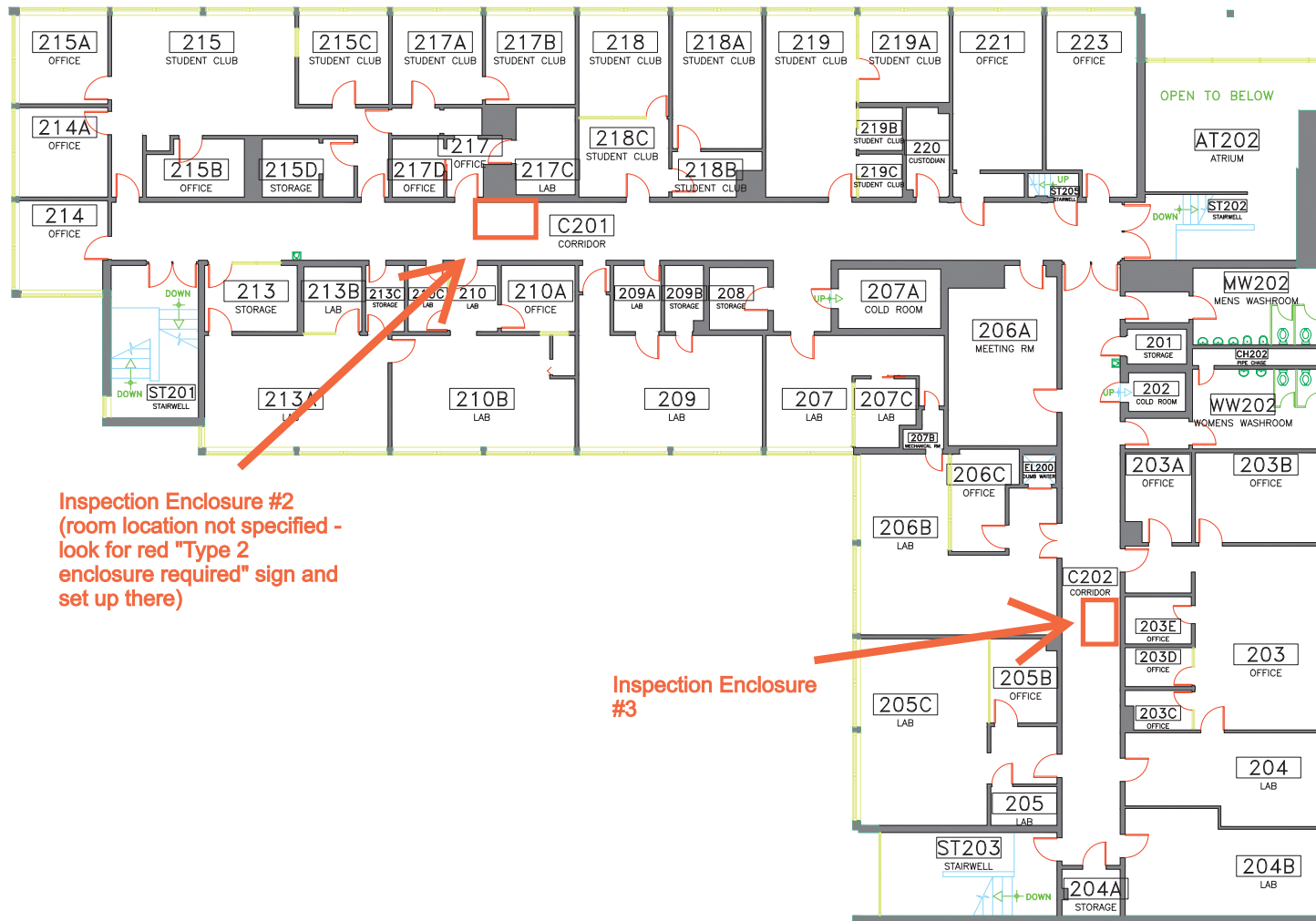
Drawing Title  
**FIRST FLOOR**

Project No.

Location  
 University of Guelph  
 FORMER VMI-Bldg.#046

Scale N.T.S.	Date MARCH, 2015
Drawn by B.M.T.	Drawing No. B-1
Client's Approval	
Approved by	of 1

Cad File No.



Inspection Enclosure #2  
(room location not specified -  
look for red "Type 2  
enclosure required" sign and  
set up there)

Inspection Enclosure  
#3

#### Reference Documents

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A = Detail number  
B = Sheet number where detailed

5			
4			
3			
2			
1			

NO. ISSUED BY DATE

#### Orientation

Project North



**UNIVERSITY  
of GUELPH**

Planning, Engineering & Construction  
Physical Resources  
Guelph, Ontario, N1G 2W1

#### Project

SPACE USE

#### Drawing Title

SECOND LEVEL

#### Project No.

#### Location

University of Guelph  
FORMER VMI-Bldg#046

Scale N.T.S. Date MARCH 2013

Drawn by B.M. Drawing No.





Client's Approval

Approved by J.V. B-2 of 1

Cad File No.

## Attachment 2

## Attachment #2: Photolog of Notable Pictures

	
<p>Photo 1: Spray insulation on beam above ceiling tiles from within enclosure located in corridor C201.</p>	<p>Photo 2: Approximate closest location where LEX inspected the ceiling space during the DSS. Located in corridor C201 outside room 213. Ceiling space easily accessible as hatch is equipped with a hinge. Fireproofing not visible from here.</p>
	
<p>Photo 3: No spray insulation visible on beam located in ceiling space in enclosure located in corridor C202. Specks visible on the beam.</p>	<p>Photo 4: Specks visible on beam above the ceiling of the vestibule C100. Similar to what was observed in corridor C202. Appeared to be dust or cement residue from application.</p>

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## **Appendix 'C'**

### **Footing and Subgrade Inspection and Recommendations**

Prepared by Chung & Vander Doelen Engineering Ltd., July 7, 2018



<b>SUBJECT:</b>	<b>Footing and Subgrade Inspection and Recommendations</b>		
<b>DATE:</b>	July 7, 2018	<b>FILE NO.:</b>	M181172
<b>TIME:</b>	9:00 AM	<b>WEATHER:</b>	Interior
<b>PROJECT:</b>	Building 046 Renovations		
<b>LOCATION:</b>	University of Guelph	<b>CLIENT:</b>	Physical Resources, Design, Engineering & Construction University of Guelph
<b>REPORTED TO:</b>	Peter Ibrajev	<b>INSPECTED BY:</b>	Adam Mamon
<b>AREA INSPECTED:</b>	Proposed Elevator and High Density Storage		

As requested, a representative of CHUNG & VANDER DOELEN ENGINEERING LTD. (CVD) attended the site to inspect the existing subgrade conditions below the proposed areas.

#### Elevator

1. The existing building footing extends 1.05m below the existing finished floor elevation. The foundation comprises of 3.5 courses of masonry block on a 6-7" thick concrete footing.
2. The exposed subgrade material at the footing elevation consists of dense native Silty Sand and Gravel and is suitable to support a maximum bearing resistance of 150 kPa at SLS and 250 kPa at ULS. Subgrade suitability should be confirmed by the Geotechnical Engineer prior to pouring footings.
3. It is understood that the design footing elevation for the proposed elevator footing is 1500mm below the existing finished floor, or approximately 450mm below the existing underside of footing elevation.
4. Conventional spread footings are acceptable for use as the elevator footing. The subgrade materials are stable with no groundwater observed, therefore the excavation can be cut vertically against the existing footing for the elevator footing construction. The excavation should not be left open for an extended period of time.
5. The existing building footing should not be undermined during construction. CVD can assess the stability of the exposed existing footing soils during the excavation and construction.
6. No additional frost protection is required.
7. The existing subgrade materials are suitable for reuse as subgrade backfill.

#### High Density Storage

##### **Existing Conditions:**

1. An area measuring approximately 0.6m by 0.9m was cut into the existing concrete floor slab along the north wall of the proposed high density storage room.
2. The existing concrete slab is approximately 4.5" thick and does not contain any reinforcement. No voids were observed below the floor slab.
3. The composition of the existing slab base and subbase was generally found to consist of 6" of compact crushed clear stone overlying dense Silty Sand and Gravel with loose to compact fill of the same composition along the foundation wall.



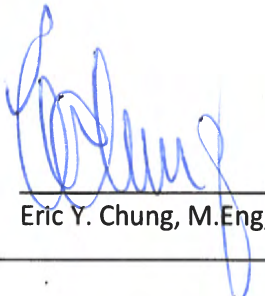
<b>SUBJECT:</b>	<b>Footing and Subgrade Inspection and Recommendations</b>		
<b>DATE:</b>	July 7, 2018	<b>FILE NO.:</b>	M181172
<b>TIME:</b>	9:00 AM	<b>WEATHER:</b>	Interior
<b>PROJECT:</b>	Building 046 Renovations		
<b>LOCATION:</b>	University of Guelph	<b>CLIENT:</b>	Physical Resources, Design, Engineering & Construction University of Guelph
<b>REPORTED TO:</b>	Peter Ibrajev	<b>INSPECTED BY:</b>	Adam Mamon
<b>AREA INSPECTED:</b>	Proposed Elevator and High Density Storage		

4. The existing underside of the foundation along north wall is 1.05m below the existing finished floor elevation with a 5" to 6" thick concrete footing and masonry block foundation wall.

**Recommendations:**

1. The imposed load on the concrete floor slab was provided by J.L. Richards and Associates Ltd. as 7.2 kPa for the desired type of storage racking used.
2. The existing floor slab, base and native subbase is considered suitable to support the specified load however it is recommended to consider the following conditions:
  - A. Due to the loose to compact backfill along the north foundation wall encountered in the test pit, the racking storage system should be placed a minimum of 1.2m away from the wall to avoid differential settlement caused by the unsuitable foundation wall backfill material. This condition is also likely to exist against the east wall and the racking should also be kept away 1.2m.
  - B. To optimize the amount of area suitable to support the specified racking storage load, CVD recommends removing the concrete slab below the proposed area. The loose subgrade material should be removed and re-compacted as engineered fill. The existing fill is suitable for reuse as the subbase and should be compacted to 98% SPMDD. The crushed clear stone base should be replaced to match the existing base and the concrete slab should have a minimum 28 day strength of 25 MPa.

Reviewed By:

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


## **Appendix 'D'**

### **University of Guelph Standard Operating Procedures (SOP):**

IU.324 – Procedures for Getting Supplies In and Out of the Facility

IU.326 – Donning and Doffing of Personal Protective Equipment (PPE)

IU.329 – Personal Items in the Containment Zone

Standard Operating Procedures	
 <b>Isolation Unit</b>	Title: <b>Procedures for Getting Supplies In and Out of the Facility</b>
	SOP Number: <b>IU.324</b> Approval Date: February 2017 Revision Date:

**PURPOSE:** To provide instructions for getting supplies and equipment in and out of the Isolation facility to implement bio- security and containment

**POLICY:** To meet or exceed the standards as set out in the CCAC Guide to the Care and Use of Experimental Animals and CCAC guidelines and the Canadian Biosafety Standards and Guidelines

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**PROCEDURES:**

**\*Cardboard boxes or Styrofoam containers are not to be used as storage. Cardboard is not to be brought into the facility. Only when samples are to be put on ice, can Styrofoam be brought in.**

**A. Movement of single use cardboard boxes for oocyst collection from outside storage room**

- researcher must make sure that boxes are free from any debris that may have accumulated on the boxes while in the outside storage room
- boxes must be double bagged and bags must be securely tied
- researcher must enter the building using main entrance going through the disinfectant mats
- it is recommended that personnel change into facility specific scrubs
- proceed directly to the designated room, put on the boots and disposable gown, mask, gloves and bonnet and bring the boxes right into the room
- when all of the doors are closed in the room, they may remove the boxes from the bags and leave the bags in the room
- an Isolation staff member will remove and dispose of the bags through the dirty corridor

**B. Bringing in small to medium supplies to be used in an animal room**

- any item that will be required within the animal containment area, must be double bagged

- bags are located in the main entrance foyer
- if more bags, or bigger bags are required, get assistance from a staff member before entering the facility with supplies
- remember that supplies **cannot** be brought from one room to another
- if you are dealing with multiple rooms, multiple packages should be made up and have one designated for each room
- do not share sharps containers between rooms, bring one small container for each room
- when you have your supplies double bagged, make your way to the assigned animal room
- open the door to the ante room and before donning personal protective equipment(PPE)remove the first bag and place it on the designated clean shelf in the ante room
- step into the ante room, stepping into the boots and set bagged supplies on a stable surface
- put on PPE (if PPE is not in the ante-room, it will be located in a rolling storage bin in the hall way and will need to be gathered before entering the ante-room)close hallway door , enter housing room and perform what procedures are needed
- exit room and enter ante room, remove dirty items from the dirty bag and place them in the clean bag on the clean shelf. Dispose of dirty bag in garbage.
- remove one pair of gloves and seal clean bag
- remove PPE and exit ante room into the clean hallway
- upon request research teams can be provided with disinfectant that is effective against the agent in use

### **C. Bringing in large or bulky supplies to be used in an animal room**

- any item that will be required within the animal containment area, must be double bagged
- bags are located in the main entrance foyer
- if more bags, or bigger bags are required, get assistance from a staff member before entering the facility with supplies
- remember that supplies **cannot** be brought from one room to another
- if you are dealing with multiple rooms, multiple containers should be made up and have one designated for each room
- when you have your supplies double bagged, make your way to the assigned animal room
- step into the ante room, stepping into the boots and set bagged supplies on a stable surface
- put on PPE (if PPE is not in the ante-room, it will be located in a rolling

storage bin in the hall way and will need to be gathered before entering the ante-room) , close hallway door, enter housing room, remove both bags and perform what procedures are needed

- leave large and bulky items in the room and an Isolation staff member will dispose of the bags and ensure large and bulky items are washed and returned to the clean corridor.
- remove PPE and exit ante room into the clean hallway

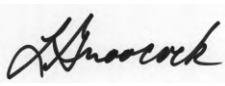



#### **D. Bringing in Supplies to be used in the post mortem (PM) room**


- if tissue collection or necropsies are to be done several times throughout the stay, a labelled plastic container with supplies may be left in the PM. This will help prevent the likelihood of cross contamination since supplies will not be going back and forth
- place equipment inside a durable, puncture resistant container and place in double garbage bags supplied at the entry way to Isolation Facility
- transport this equipment through clean halls in closed bags that are placed on lab carts to the PM room
- open the door to the ante room and before placing on personal protective equipment(PPE), remove the first bag and place it on the designated clean side of the shelf in the ante room
- step into the ante room, stepping into the boots and set bagged supplies on the dirty side of the shelf in the ante room
- put on PPE, close hallway door , enter PM room and perform what procedures are needed
- after you are done in the PM room, wipe down equipment with disinfect and place supplies in remaining bag
- exit PM room and enter ante room, remove dirty items from the dirty bag and place them in the clean bag on the clean side of the shelf. Dispose of dirty bag in garbage.
- remove one pair of gloves and seal clean bag
- remove PPE and exit ante room into the clean hallway
- if large quantities need to be removed from the building, arrangements can be made with the Isolation staff to pass it out the back door to a waiting member of the research team

#### E. Removing a cage of mice from the facility

- bring two bags from the main entrance
- open the door to the ante room and before placing on personal protective equipment(PPE), place one bag on the designated clean shelf in the ante room
- step into the ante room, stepping into the boots and set second bag on a stable surface
- put on PPE, close hallway door, enter housing room and locate the cage for removal
- within the animal containment area, place the cage in one bag and tie a knot in the bag providing an air bubble
- exit room and enter ante room and place the bagged cage into the clean bag on the clean shelf.
- remove one pair of gloves and seal the second clean bag
- remove PPE and exit ante room into the clean hallway
- alternatively, if exiting via the dirty corridor please coordinate with the lead hand or RAT x54428
- the transport container must protect animals from cold, heat, noise and wind; maintain bio-containment; and prevent animal escape. To that end, a cooler that may be disinfected between uses is recommended for transportation out of the facility.

#### Signatures

Author	Author	Author	Facility Manager	Facility Veterinarian
Name (please print):	Name (please print):	Name (please print):	Name (please print):	Name (please print):
Linda Groocock	Vicky Carson	Tony Cengija	Mary Fowler	
Signature:	Signature:	Signature:	Signature:	Signature:
				

Standard Operating Procedures	
 <b>Isolation Unit</b>	Title: <b>Donning and Doffing of Personal Protective Equipment (PPE)</b>
	SOP Number: <b>IU.326</b> Approval Date: February 2017 Revision Date:

**PURPOSE:** To outline the step-by-step process of donning and doffing of PPE

**POLICY:** To meet or exceed the Canadian Biosafety Standards and Guidelines

**NOTE:**

**Donning and doffing of PPE is the process in which a person will put on and remove all PPE to decrease the possibility of exposing themselves to a contaminant.**

When working with zoonotic pathogens and/or an airborne pathogen, precautions indicate that an N95 respirator must be worn. With regards to exposure to lab allergens or unknown health status of farm animals an N95 respirator is recommended.

Risk assessments for appropriate PPE are conducted both departmentally and through the Biosafety Committee.

**PROCEDURES:**

**A – PPE for Entering the Animal Containment Rooms**

**DONNING**

**- PPE for all rooms (other than long-term mouse rooms) is located in rolling storage bins in the hallway**

- Disposable gown must be worn in most animal rooms. Make sure both sets of strings are tied (one set behind neck and the other around the waist).

- For rooms with cattle or swine, coveralls must be worn instead of disposable gowns.

- Put on surgical mask (ear loop straps are placed around ears), N95 mask or respirator (fit test required)

- Put on a bonnet, making sure all hair is tucked inside.

- Put on the first pair of gloves, then a second pair of gloves is pulled over the cuff of the gown or coveralls

- Remove shoes in the clean corridor, step on sill and step into room-specific boots, without touching them

- Unsoiled coveralls can be reused during the course of the day to re-enter the animal rooms. To use coveralls hanging in the anteroom, remove shoes in hallway and balance on the anteroom sill. Place one leg into leg of coveralls and set foot into boot, tucking coveralls in, then repeat this step for the other leg.
- Eye protection (if warranted through a risk assessment) is stored in a container with a lid within the anteroom. Put on eye protection as you enter the anteroom.
- Enter and service room

## **DOFFING**

- When exiting room, step boots into the footbath in the ante room
- Remove and dispose of outside/dirty layer of gloves
- Remove mask with gloved hands (inside/clean gloves), along with the bonnet and eye protection
- Eye protection is wiped with an alcohol wipe and placed back into the container with a lid
- Remove disposable gown and throw in garbage
- If wearing coveralls, open the door to the hallway with gloved hands. Unbutton and unzip the coveralls. Remove boots as you step on the sill, and remove coveralls one leg at a time while balancing on the sill. Hang coveralls on the hook.
- Remove inner pair of gloves. Discard gloves in garbage
- Wash hands, refer to SOP IU.325 “ Hand Hygiene”
- Exit ante room while gently removing boots, leaving them upright in the anteroom

## **B – Use of the PM room**

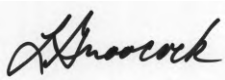



### **DONNING**


- If there is a risk of contamination through the disposable gown or coveralls, please wear facility specific scrubs under prescribed PPE (gown or coverall)
- Put on appropriate PPE as outlined in Section A, PPE is located in a rolling storage in located outside of the PM Room door
- Remove shoes in clean hall, and step into the boots dedicated for the PM room

### **DOFFING**

- Remove PPE following the procedure outlined in “A” and dispose in designated waste
- If coveralls were worn, they are to be placed in the “Dirty laundry” bin
- Exit PM room via anteroom, slip off designated boots in the anteroom one at a time returning to your shoes in the clean hall
- Wash hands at the hands-free sink, refer to SOP IU.325 “ Hand Hygiene”.
- In the change room, remove facility specific scrubs. A shower is available and highly encouraged after work in the post mortem room. Change into street clothes and exit the facility

## Signatures

Author	Author	Author	Facility Manager	Facility Veterinarian
Name (please print):	Name (please print):	Name (please print):	Name (please print):	Name (please print):
Linda Groocock	Vicky Carson	Tony Cengija	Mary Fowler	
Signature:	Signature:	Signature:	Signature:	Signature:
				

Standard Operating Procedures	
 <b>Isolation Facility</b>	Title: Personal Items in the Containment Zone
	SOP Number: IU.329 Approval Date: February 2017 Revision Date:





**PURPOSE:** Personal items should not be brought into the animal containment zone unless it is critical to the experiment or animal monitoring. This SOP will outline a step by step procedure to prevent personal items from becoming contaminated while working in the containment zone.

**POLICY:** To meet the Canadian Biosafety Standards and Guidelines

**PROCEDURES:**

- Before entering the containment zone, remove all personal items (e.g. cell phones, music devices, cameras etc) and leave them in the locker room. A combination lock may be placed on the locker for the duration of time you are working in the unit
- If you are required to bring a device into the containment zone, the device must be placed in a resealable plastic bag prior to entry. These bags are available in the front entrance of the Isolation unit or from any of the full time technicians in the unit
- Most cell phones and cameras can be used when placed in a zip lock bags, as this level of film does not interfere with touchscreens, but testing the device before going into the containment zone is recommended
- When preparing to exit the containment zone, the resealable bag with the device still contained within it must be disinfected in the anteroom. The technicians will supply disinfectant wipes when they supply the bags. Apply disinfectant to the outer surfaces before doffing your PPE, (refer to SOP IU.326 – “Donning and Doffing of PPE”)
- Immediately after exiting the containment zone anteroom remove the resealable bag and dispose it in the garbage in the anteroom. Wash hands thoroughly.

## Signatures

Author	Author	Author	Facility Manager	Facility Veterinarian
Name (please print):	Name (please print):	Name (please print):	Name (please print):	Name (please print):
Linda Groocock	Vicky Carson	Tony Cengija	Mary Fowler	
Signature:	Signature:	Signature:	Signature:	Signature:
				

## **Appendix 'E'**

### **EACO Mould Abatement Guidelines Edition 3 (2015)**

# **EACO Mould Abatement Guidelines**

## **Edition 3 (2015)**



### **Foreword**

This guideline has been prepared to assist building owners, constructors, contractors, subcontractors and workers who have duties under the Occupational Health and Safety Act and its Regulations to safely perform work activities involving Mould (Microbial) Abatement and remediation. The guideline is intended to promote safe work practices, the use of personal protective equipment, worker awareness and training and is based in a thorough review of the available guidance materials available to December 2014 and professional experience of the abatement industry in Ontario.

We believe that this guideline will not only help employers fulfill their responsibilities and due diligence under the Occupational Health and Safety Act but will also assist them to better address the challenges involved with proper assessment and remediation of Mould (Microbial) contamination in buildings.

### **Disclaimer**

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

# **EACO Mould Abatement Guidelines**

## **Edition 3 (2015)**

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## **EACO Mould Abatement Guidelines**

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#### **SECTION A: GENERAL POINTS AND LIMITATIONS**

1. Three levels of work practice are given for removal of Small, Medium and Large-scale Mould growth, depending on the extent of material supporting Mould growth present. The thresholds between Small and Medium project areas (10 ft<sup>2</sup>) and between Medium and Large project areas (100 ft<sup>2</sup>) are a guideline only and are subject to professional judgment. EACO recommends that the enumeration of Mould growth be based on an approximation of the extent of visible growth (total affected area of building material), including the estimated extent of any hidden Mould.
2. These procedures do not address the identification or control of the cause(s) of the Mould growth being abated by these procedures. This would include such factors as past flooding, moisture intrusion and elevated levels of relative humidity. The project authority is cautioned to ensure that the underlying cause(s) of the Mould growth is investigated and remedied prior to completing the Abatement process to reduce the potential for Mould re-growth.
3. These procedures do not address the potential for fungal infections that may be acquired by Susceptible Occupants in hospitals or other health care settings if Mouldy materials are disturbed without appropriate precautions. Refer to “Construction-related Nosocomial Infections in Patients in Health Care Facilities – Decreasing the Risk of Aspergillus, Legionella and Other Infections”, July 2001, Canada Communicable Disease Report, Health Canada and CSA Standard Z317.13-12, Infection Control During Construction or Renovation of Health Care Facilities.
4. These procedures do not address the potential presence of Designated Substances (asbestos, lead, etc.) or other hazardous materials in a mould remediation work area. The project authority is cautioned that designated substances are regulated in Ontario under the Occupational Health & Safety Act. In addition, Ontario Regulation 278/05, *Regulation Respecting Asbestos on Construction Projects and in Buildings and Repair Operations* (O. Reg. 278/05) outlines specific procedures for the handling and disturbance of asbestos-containing materials (ACM). Typical ACMs that may be disturbed as part of a mould remediation project include drywall joint filling compound, ceiling tiles, pipe and duct insulation and vinyl flooring.
5. These procedures are not directly intended to address Biohazards, other than Mould, potentially present in a project area as a result of contamination with sewage waste, river floods or other water with high levels of Microbial contamination. Appendix D does provide additional procedures for unsanitary remediation. The reader is referred to the guidance of the Institute of Inspection, Cleaning and Restoration Certification S500 Standard, “Standard and Reference Guide for Professional Water Damage Restoration.” Additional precautions might apply.
6. These guidelines are not meant to respond to the development of minor areas of superficial mould growth in households due to water absorption or condensation on the occupied side of finishes, often referred to as lifestyle mould growth. Examples include spotty mould growth on grout in bathrooms or on cold window frames under winter conditions. Such areas of minor surface mould growth are generally limited in area and can usually be addressed with improved ventilation and/or moisture control, and standard house cleaning methods. However, if there are large areas of surface condensation or indications of sub-surface moisture sources, the area should be inspected for the possibility of hidden water damage or mould growth.

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### **SECTION B: GENERAL PRECAUTIONS APPLICABLE TO ALL LEVELS OF MOULD ABATEMENT WORK**

#### **1. Protection of Occupants**

- 1.1 The project authority should consider whether occupants should be removed from areas adjacent to the work area. The removal of occupants from spaces adjacent to the work area is not necessary in all cases but should be considered in the presence of Susceptible Occupants including but not limited to infants less than 12 months old, persons having undergone recent surgery, the elderly, immune suppressed people, or people with chronic inflammatory lung diseases.

#### **2. Worker Training and Medical Pre-screening**

- 2.1 Mould abatement workers shall be trained in the hazards of Mould Abatement and in the procedures to be followed. Training at a minimum shall include classroom and site instruction. Minimum training topics shall include: hazards of mould abatement; use and limitations of personal protective equipment such as respirators and gloves; proper abatement practices including site isolation, removal techniques, proper clean-up and decontamination procedures. General health and safety training should also be provided to workers, as required by the Occupational Health & Safety Act and regulations for construction sites, and waste handling and disposal regulations.
- 2.2 Workers must be fit to work with potential Mould or microbial exposure. Workers with a history of significant allergic disease (asthma, hay fever, hives, etc.) or with a potential immuno-compromised status (persons with an immune system disease, taking immune system suppression medication, etc.) should consult with an experienced physician to determine whether Mould removal activities, and the associated potential for exposure to pathogenic materials, would present an unacceptable health risk.
- 2.3 Mould Abatement workers who may encounter a risk of infectious disease from unsanitary water sources (sewage, river floods, etc.) should consult with an experienced physician regarding vaccinations to reduce the risk of infectious disease through available immunizations, particularly Hepatitis A and B, tetanus and polio.

#### **3. Respiratory Protection**

- 3.1 The respiratory protection in these procedures has been established for protection against fungal particulate material, for which a Respirator with a NIOSH-approved particulate filter will be adequate. Another type of Respirator may be required if the Mould Abatement will employ a Disinfectant with a volatile hazardous ingredient (e.g., household chlorine bleach). Consult MSDS data for specific respiratory protection in relation to specific cleaning products.
- 3.2 Respirators shall be NIOSH approved.
- 3.3 Workers should complete Respirator pre-screening as detailed in CSA Standard Z94.4-11, Selection, Care and Use of Respirators (Appendix E Figure E1) and, if required, consult with an experienced physician to determine if a Respirator can be used without serious difficulty.
- 3.4 Respirator wearers shall be Fit-tested for each type of Respirator, prior to use, following CSA Standard Z94.4-11, Selection, Care and Use of Respirators.

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- 3.5 Follow CSA Standard Z180.1-13 as amended, for testing of breathing air quality for supplied air respiratory protection required for dry ice abrasive blasting (see Appendix C).
- 3.6 Clean and maintain the Respirator and battery pack (where applicable) in accordance with manufacturer's recommendations.
- 3.7 No facial hair or spectacle side arms, which affect the seal of the Respirator to the skin, are allowed.
- 3.8 Dispose of filters daily due to the potential growth of Mould spores on damp filter media.
- 3.9 Due to the nature and working conditions of Mould Abatement, Filtering Facepiece Respirators shall not be utilized for Level 2 or Level 3 Abatement projects.

#### **4. Personal Protection and Hygiene**

- 4.1 Refer to the EACO Guideline Construction Worker Hygiene Practices 2014. Workers shall wear appropriate eye protection including safety glasses or goggles that provide protection from external debris (not required with full face negative pressure respirator), chemical splashes, impact or dusty environments, dust-impermeable gloves appropriate for the work underway and water-impermeable gloves for application of detergent and/or Disinfectant. Refer to the MSDS for the detergent and/or Disinfectant for glove selection.
- 4.2 Wash face and hands after work at the Abatement project each time after exiting the Abatement work area.
- 4.3 For all levels of work, eating, drinking or smoking is prohibited in the work area.

#### **5. Cleaning**

- 5.1 Pre-clean any items that will be retained, whether removed from the work area or covered and left in the work area. Use appropriate and effective cleaning methods.
- 5.2 After bulk removal, clean the surrounding areas with a HEPA vacuum. No other type of vacuum can be used. If a HEPA vacuum is not available, wet wiping may be adequate for Level 1 work.
- 5.3 Do not dry sweep or dry whisk. Use power tools only if fitted with effective HEPA-filtered dust collection.
- 5.4 Wipe all non-Porous surfaces within the removal area with a detergent solution. Rinse with clear water as required.
- 5.5 As an option, a Disinfectant solution can be used in place of, or in addition to a detergent. Apply the Disinfectant as specified by the manufacturer, maintaining the surfaces wet for the prescribed period. Generally, surfaces to be disinfected must be cleaned of all dust and loose organic material prior to application of the Disinfectant. A Disinfectant is required where the work area has been contaminated with a significant pathogenic hazard (i.e., sewage floods).
- 5.6 The project authority should consider the use of a Disinfectant in hospital or health care settings, or in other settings where the project authority believes occupants to be significantly immunocompromised. Refer to the Health Canada and CSA guidelines for prevention of fungal infections in health care settings, given above.

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- 5.7 Use only disinfectants with current Health Canada DIN registration. Apply the disinfectant according to the DIN label, observing requirements for mixing, storage time, worker safety, pre-cleaning, contact time, and any requirements for rinsing.
- 5.8 These cleaning requirements apply to all exposed surfaces within the work area. The project authority will determine if soft goods and Porous materials can be adequately cleaned or must be disposed of.
- 5.9 Clean all equipment used in the Abatement work area by HEPA vacuuming or wet wiping. Equipment that cannot be readily cleaned shall be HEPA vacuumed and sealed in 6 mil polyethylene bags before removal from the work area.

#### **6. Post Abatement Cleanup**

- 6.1 Remove Polyethylene sheeting used during abatement by carefully rolling towards the centre of the work area. Clean any visible dust and debris using a HEPA vacuum.
- 6.2 Clean all tools, supplies and equipment in the work area using a HEPA vacuum and by wet wiping. Equipment that cannot be readily cleaned (e.g. vacuum hose, wire brushes, etc.) shall be HEPA vacuumed and sealed in 6 mil polyethylene bags or suitable sealed containers before removal from the work area.
- 6.3 Seal the intake and exhaust of HEPA Filtered Exhaust Fans (negative air machines) and clean the cabinet by wet wiping, before removal from the work area.
- 6.4 Leave the work area and surrounding areas dry and visibly free of dust and debris.

#### **7. Waste Disposal**

- 7.1 Remove all waste as contaminated material, including but not limited to building debris, disposable coveralls, Respirator filters and/or cartridges, and plastic sheeting. All waste should be immediately double-bagged into two 6-mil polyethylene bags, each individually sealed. If the material cannot be bagged, wrap in 2 layers of 6 mil Polyethylene Sheeting and seal with tape.
- 7.2 Transport and dispose of the waste material in compliance with local, provincial and federal regulations, including the Ontario Environmental Protection Act and any other regulations, which may apply to the Mould or the substrate on which the Mould was located.

#### **8. Post-Abatement Drying**

- 8.1 By the completion of the mould abatement, ensure the cause of the mould growth has been identified and an action plan initiated to prevent further mould growth. This action would include mitigation of the original cause of the mould contamination. This would include such factors as past flooding, moisture intrusion or elevated levels of relative humidity. Also, at completion of mould abatement check that the remaining finishes (e.g., concrete, wood framing, sub-floors) have been adequately dried so that mould growth will not re-occur when new finishes are installed. The work area may require further drying efforts before re-construction can commence.

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#### **SECTION C: PRECAUTIONS FOR LEVELS 1, 2 AND 3 MOULD ABATEMENT**

- 9. Level 1: Small Isolated Areas, Less than 10 ft<sup>2</sup> (1 m<sup>2</sup>) of Building Materials or Clean-up of Less than 10 ft<sup>2</sup> (1 m<sup>2</sup>) of Mould Growth in HVAC Systems in Non-occupied Areas.**
- 9.1 This section gives instructions for performing Mould Abatement specifically for small-scale projects. This work practice is suitable for the abatement of under about 10 square feet of mould growth on building materials or finishes or the abatement of the same extent of mould growth within HVAC equipment in non-occupied areas such as mechanical rooms. Abatement of HVAC equipment in occupied locations shall be performed following a minimum of Level 2 procedures (contained mould abatement). Comply with all of the items of Section B, General Precautions (protection of occupants, worker training and medical pre-screening, respiratory protection, personal protection and hygiene, cleaning, and waste disposal) while performing this work.
- 9.2 The worker shall wear a half face piece air-purifying Respirator fitted with replaceable filters (N95 minimum) or a Filtering Facepiece Respirator (N95 minimum) plus appropriate gloves.
- 9.3 Workers shall wear full-body dust-impervious coveralls with attached hoods. Secure the coveralls tight at the ankles and wrists.
- 9.4 Turn off HVAC systems where possible and seal over any diffusers immediately adjacent to the work area.
- 9.5 Where possible, place a drop sheet below the Mouldy materials.
- 9.6 Dust Suppression methods should be used where possible, prior to disturbance of the Mouldy materials. Tape a section of plastic sheeting or duct tape over the Mouldy material, or if this is not feasible, lightly mist the Mouldy material with water.
- 9.7 Remove any Porous substrate materials (ceiling tiles, drywall, etc.) to a point beyond the immediate areas of visible contamination, for a minimum distance of 30 cm in all directions.
- 9.8 Clean the work area and dispose of the waste.
- 10. Level 2: Medium areas, 10-100 ft<sup>2</sup> (1-10 m<sup>2</sup>) or less than 10 ft<sup>2</sup> (1 m<sup>2</sup>) in HVAC Systems in Occupied Areas**
- 10.1 This section gives instructions for performing Mould Abatement specifically for medium scale projects, or the abatement of less than 10 square feet of mould growth in HVAC equipment in occupied areas. Comply with all of the items of Section B, General Precautions (protection of occupants, worker training and medical pre-screening, Respiratory protection, personal protection and hygiene, cleaning, and waste disposal) while performing this work.
- 10.2 Consult with a qualified Health and Safety Professional prior to remediation work to provide Quality Assurance for the project and monitoring of compliance with these guidelines.
- 10.3 A competent supervisor must be present during all Contaminated Work.
- 10.4 The worker shall wear gloves appropriate for the work being done and full-body dust-impervious coveralls with attached hood. Secure the coveralls tight at the ankles and wrists.

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- 10.5 The worker shall wear an elastomeric half face piece air-purifying Respirator fitted with 100 Series Filter cartridges.
- 10.6 Workers shall wear disposable boot covers or separate work boots that can be effectively HEPA vacuumed or wiped clean prior to removal from the work area.
- 10.7 Turn-off HVAC systems where possible and seal over any supply and return openings immediately adjacent to the work area. Objective of this engineering control is to maintain negative pressure and prevent the distribution of mould spores and dust from the work area.
- 10.8 The Abatement area must be secured and access restricted. Isolate the work area with an enclosure constructed of fibre-reinforced Polyethylene Sheeting or 6 mil Polyethylene Sheeting, taped and supported as required. Provide a temporary roof where an existing ceiling does not complete the temporary enclosure. The Project authority may require a single chamber decontamination/change room.
- 10.9 A Competent Supervisor or project authority must inspect the work area for defects in the enclosure, barriers and change room, at the beginning of every shift and at the end of every shift. Records of the inspections should be generated and maintained.
- 10.10 Install signs warning of the exposure hazard. Suggested wording: CAUTION, MOULD EXPOSURE, WEAR ASSIGNED PROTECTIVE EQUIPMENT, AUTHORIZED PERSONNEL ONLY.
- 10.11 Provide continuous Negative Pressure within the enclosure by drawing air from the work area and exhausting it out of the enclosure, either by use of a HEPA vacuum or a portable HEPA-filtered exhaust fan. Provide a minimum Negative Pressure of 5 Pascals (0.02 inches of water column) and at least 4 air changes per hour. Discharge the filtered air outside the building and away from persons wherever possible, and if this is not possible, consider on-site leak testing of the HEPA filtered equipment. Refer to the EACO DOP/PAO Testing Procedure Guideline 2013. Negative Pressure must be maintained until the completion of all Contaminated Work.
- 10.12 Remove any Porous substrate materials (ceiling tiles, drywall, etc.) to a point beyond the immediate areas of visible contamination, for a minimum distance of 30 cm in all directions.
- 10.13 Clean the work area and dispose of the waste.
- 10.14 Before exiting the work area, workers shall fully wipe or vacuum clean all footwear, coveralls and other personal protective equipment and remove and dispose of protective equipment not for re-use. Workers shall then complete personal cleaning as in Section B, General Precautions.
- 11. Level 3: Large Areas, More than 100 ft<sup>2</sup> (10 m<sup>2</sup>), or more than 10 ft<sup>2</sup> (1 m<sup>2</sup>) in HVAC Systems**
  - 11.1 The following work procedures describe the general set-up, conduct and safety measures for Level 3 Mould Abatement. Each project should be conducted following a site-specific work plan or specification developed by a Health and Safety Professional.
  - 11.2 This section gives instructions for performing Mould Abatement specifically for large-scale projects. Comply with all of the items of Section B, General Precautions (protection of occupants, worker training and medical pre-screening, Respiratory protection, personal protection and hygiene, cleaning, and waste disposal) while performing this work.

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#### Quality Assurance

- 11.3 Consult with a qualified Health and Safety Professional (qualified by knowledge, training and experience) with experience performing Microbial investigations and remediation, prior to remediation work, to develop a site specific work plan or specification and Quality Assurance services for the project and monitoring of compliance with these guidelines.

Quality assurance will include a combination of site inspections prior to abatement, during abatement, after abatement and clearance sampling including air sampling prior to dismantling of the abatement work area. Clearance sampling requirements to be defined by the appointed Health and Safety Professional. Refer to Section 11.22

#### Worker Protection

- 11.4 The worker shall wear a tight-fitting full face piece Powered Air Purifying Respirator with high efficiency particulate filters or a non-powered full face piece air purifying Respirator fitted with 100 Series Filters. Refer to Appendix C for respiratory protection for dry ice abrasive blasting.
- 11.5 The worker shall wear gloves appropriate for the work being done and full-body dust-impervious coveralls with attached hood. Secure the coveralls tight at the ankles and wrists.
- 11.6 Workers shall wear disposable boot covers or separate work boots that can be effectively HEPA vacuumed or wiped clean prior to removal from the work area.
- 11.7 A Competent Supervisor must be present during all Contaminated Work.

#### Site Isolation

- 11.8 Turn-off HVAC systems where possible and seal over any supply and return openings immediately adjacent to the work area.
- 11.9 Isolate the work area from adjacent spaces using temporary hoarding, tape and Polyethylene Sheeting, etc.
- 11.10 Install signs warning of the exposure hazard. Suggested wording: CAUTION, MOULD EXPOSURE, WEAR ASSIGNED PROTECTIVE EQUIPMENT, AUTHORIZED PERSONNEL ONLY.
- 11.11 Provide continuous Negative Pressure within the enclosure, through use of portable HEPA-Filtered Exhaust Fans. Provide a minimum Negative Pressure of 5 Pascals (0.02 inches of water column) and at least 4 air changes per hour. Note that higher levels of negative air pressure may be required to maintain site isolation. Discharge the filtered air outside the building and away from persons wherever possible, and if this is not possible, perform on-site leak testing of the HEPA filtered fan. Negative Pressure must be maintained until the completion of all Contaminated Work.
- 11.12 Negative Pressure within the enclosure shall be continuously measured and recorded with a portable monitor located at the entrance to the work area.

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- 11.13 A Competent Supervisor and/or the Health and Safety Professional must inspect the work area for defects in the enclosure, barriers and change room, at the beginning of every shift, at the end of every shift where there is no shift beginning immediately following the shift that is ending, and at least once per day on days where there are no shifts. Records of the inspections should be generated and maintained.

#### Worker and Waste Decontamination Facilities

- 11.14 Provide a Worker Decontamination Facility, to include a clean change room and a dirty change room. Install flap doors at each opening into and within the decontamination facility. Provide a wash station consisting of at least a basin, fresh water, soap and toweling, in the clean change room. A shower for worker comfort may be provided, but is optional. Refer to Appendix A for a diagram of a typical Decontamination Facility.
- 11.15 When going into the Contaminated Work area the worker will don clean coveralls and a Respirator in the clean change room.
- 11.16 Prior to exiting the Contaminated Work Area, the worker will use a HEPA vacuum in the work area to remove gross contamination from coveralls and boot covers (or separate dirty work boots).
- 11.17 The worker will then enter the dirty change room where the dirty coveralls and boot covers are removed (to be used only once). Work boots used without boot covers will also be removed and stored in the dirty change room.
- 11.18 The worker then proceeds to the clean change room to complete clean up. The wash station is to be used by each worker on leaving the work area to clean face and hands.
- 11.19 A separate Waste Decontamination Facility, consisting of a double bagging room and a waste transfer room should be provided where large volumes of waste will be removed. Seal the waste into bags (or Polyethylene Sheeting sealed with tape) in the Contaminated Work area, and wipe the exterior of the bags or other containers. Transfer the waste to the double bagging room and place a second bag around bagged waste. Seal the second bag. Transfer the double-bagged waste into the waste transfer room for removal by workers entering from the outside of the decontamination facilities.

#### Removal, Salvage and Cleaning

- 11.20 Remove any Porous substrate materials (ceiling tiles, drywall, etc.) to a point beyond the immediate areas of visible contamination, for a minimum distance of 30 cm in all directions.
- 11.21 Clean the work area and dispose of the waste. Clean tools and equipment such as vacuums, negative air units or any other items that were exposed during abatement.

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#### Clearance Inspection and Monitoring

- 11.22 The Health and Safety Professional or representative should inspect the Level 3 work area for acceptable completion, by a combination of careful inspection and testing. A site will be considered acceptable and clean when a thorough inspection shows an acceptable state of cleanliness. In addition, Clearance air samples to be taken to indicate the work area is no longer impacted by the Mould contamination abatement process.

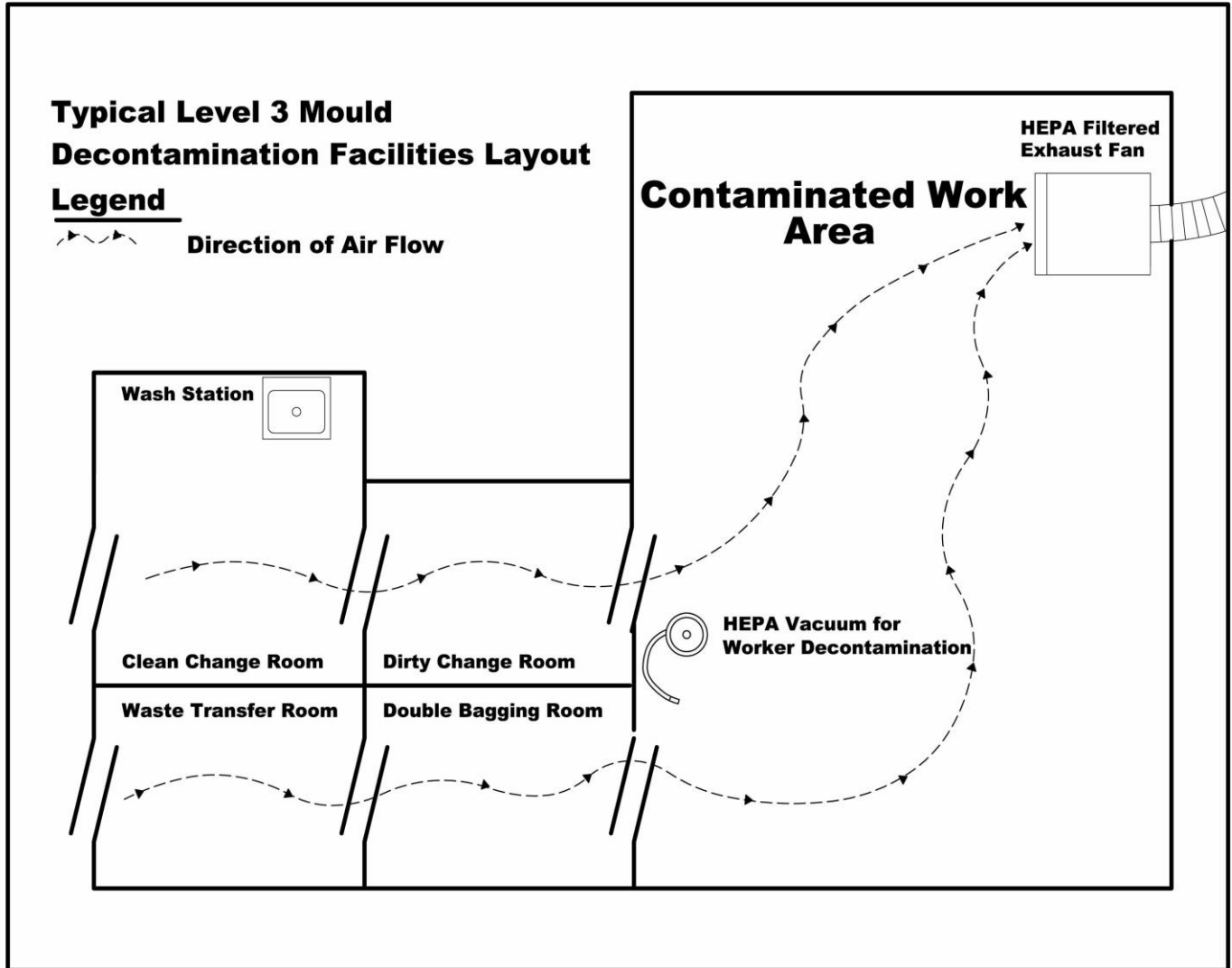
Generally, clearance air samples collected within the work area will be compared to samples taken in adjacent areas from where the work area make-up air is being drawn, another suitable location, or to outdoor air samples. An acceptable condition is indicated when:

1. Concentrations of airborne fungal particles in the work area are not significantly elevated when compared to concentrations in the reference area; and
2. The types of fungal particulate present in the work area do not significantly differ from those present in the reference area.

Surface samples should show minimal or no Mould growth remaining at completion. Interpretations of sample results are subject to the professional judgment of the Health and Safety professional with experience performing microbial investigation and remediation.

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**Appendix A: Typical Level 3 Mould Decontamination Facility Lay-Out**



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### **Appendix B: Procedures for Clean-up of Bird and Bat Droppings**

*Workers removing accumulations of bird or bat droppings are at risk of exposure to airborne fungal spores (and other microbial hazards) likely to be released when this material is disturbed. Bird and bat droppings should be presumed to be contaminated with the fungi Histoplasma capsulatum, Cryptococcus neoformans, and other infectious hazards. The spores of some of these organisms can remain infectious for decades after their growth in the guano has ceased. Many of these microorganisms are known to cause respiratory infections in workers exposed during construction or maintenance disturbance.*

*NOTE: Although a disinfectant will be applied during this work, the treated excrement may still contain viable organisms and use of personal protective equipment should continue until the site is cleaned.*

#### General Precautions during Abatement Work

1. Health and safety measures and procedures required during the abatement of bird or bat droppings shall be based on the findings of a project-specific risk assessment completed by a health and safety professional.
2. The project-specific risk assessment must consider conservation and/or habitat preservation.
3. The project-specific risk assessment should consider post abatement corrective measures that may be necessary to prevent the return of birds or bats (e.g. block openings into buildings or structure ledges, screen off ventilation intakes or other void openings, install netting/mesh or anti-roosting control systems, etc.).
4. Requirements of Section B (of this document) shall also apply, as applicable, for the clean-up of bird or bat droppings. Section B provides general guidance related to; protection of occupants, worker training and medical pre-screening, respiratory protection, personal protection and hygiene practices.

#### Personal Protection

All work will require the following personal protective equipment, as a minimum:

- Rubber boots (CSA approved for construction work).
- Either disposable gloves taped to coveralls and worn under work gloves, or heavy rubber or nitrile work gloves, taped to coveralls.
- Water-resistant disposable coveralls, complete with elasticized hood, taped to gloves and boots.
- Minimum of a full-face piece respirator fitted with appropriate cartridge filters. As a minimum, P100 filters are required for protection against airborne particles. Depending on the disinfectant used, the cartridge may require protection against vapours or gases. A powered air purifying respirator (PAPR) fitted with an appropriate cartridge filter may also be used, and will provide more comfort for the worker.

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### **Appendix B: Procedures for Clean-up of Bird and Bat Droppings**

#### Disinfectant

Use only disinfectants with current Health Canada drug identification number (DIN) registration. Apply the disinfectant according to the DIN label, observing requirements for mixing, storage time, worker safety, pre-cleaning, contact time, and any requirements for rinsing.

#### Hazard Sign

Install signs warning of exposure hazard during all abatement operations.

#### Site Isolation Considerations

The site isolation procedures implemented shall be based on the findings of a project-specific risk assessment. The following site isolation procedures, as a minimum, should be considered for all bird or bat dropping abatement operations.

1. Turn-off HVAC systems where possible and seal over any openings immediately adjacent to the work area.
2. Isolate the work area from adjacent spaces using temporary hoarding, tape and polyethylene sheeting, etc.
3. If the work area is enclosed, establish continuous negative pressure using portable HEPA-filtered exhaust fans. Provide a minimum negative pressure of 5 Pascals (0.02 inches of water column) and at least 4 air changes per hour. Refer to EACO document “*DOP / PAO Testing Guideline, 2013*”, for guidance on negative air system testing and reporting requirements.
  - a. Negative pressure within the enclosure shall be continuously measured and recorded with a portable monitor.
4. Provide a worker decontamination facility, to include a clean change room and a dirty change room. Install flap doors at each opening into and within the decontamination facility. Provide a wash station consisting of at least a basin, fresh water, soap and toweling, in the clean change room. Refer to Appendix A for a diagram of a typical decontamination facility.
  - a. For large work areas, long term projects or areas with excessive amounts of bird or bat droppings, including a shower in the worker decontamination facility should be considered.
5. Additional considerations for outdoor operations:
  - a. Install signs warning of exposure hazard, and ropes or barriers, around the perimeter of the work area, to the extent that is practicable, to prevent unauthorized personnel from entering the work area. All workers and personnel within the perimeter of the work zone must be adequately protected.
  - b. Provide a worker decontamination facility as close to the work area as practical.
  - c. Assess the prevailing wind patterns affecting the work area. Arrange the location of the worker decontamination facility, and sequencing of abatement operations, in a manner to minimize exposure to workers and surrounding areas.
  - d. Complete an assessment to identify the location of fresh air intakes for building heating, ventilation and air conditioning (HVAC) systems. Fresh air intakes and/or HVAC

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### **Appendix B: Procedures for Clean-up of Bird and Bat Droppings**

systems located within the perimeter of the work area shall be turned-off where possible and openings shall be sealed.

- i. Clean HVAC system sheet metal that may have been contaminated.
- ii. Replace HVAC air filters that may have been contaminated.
- e. Isolate other routes of potential air transfer (into a building) located within the perimeter of the work area, such as windows, doors, void spaces, vents, etc.
- f. If soil removal is required, soil pretreatment or decontamination may be required.

#### Work Practices

1. Dampen dry and dusty droppings with water to reduce the amount of airborne dust that may be created during abatement activities. Adding a surfactant to water (i.e. a wetting agent) may further reduce the amount of dust that becomes airborne.
  - a. Wetting should be completed only by a low-pressure system or hose.
    - i. Never wet bird or bat droppings using a high pressure power-washer system or using a high pressure garden hose setting (e.g. do not use direct or jet spray settings).
  - b. Where bird or bat droppings are excessive, a prolonged wetting period and/or, repeated wetting during abatement work may be required.
    - i. Never dry shovel or dry sweep bird or bat droppings.
  - c. Avoid walking over areas with bird or bat droppings unnecessarily.
2. Perform an initial shoveling and HEPA vacuum removal of as much of the residue as possible.
3. Following a HEPA vacuuming, apply a disinfectant solution to all areas with visible residue. Apply with a garden sprayer set for droplet as opposed to mist spraying. Lightly brush to ensure uniform wetting and contact through to the underlying surface. Apply additional disinfectant as necessary to maintain the area wet for the contact time specified by the disinfectant manufacturer. Leave the material wet overnight where practical to do so.
4. Clean the area of residue with suitable tools and HEPA vacuuming. Lightly mist with water to reduce dust formation.
5. After surfaces have been cleaned of residue to the extent possible, apply a second application of the disinfectant and maintain wet contact time for the period recommended by the manufacturer. If the surface cannot be left with a residue, rinse and wipe with clear water.

#### Waste Collection and Disposal

Collect all waste into 6 mil disposal bags and immediately seal. Wipe the bag with the disinfectant solution and place into a second bag. Ensure proper notification and compliance with all applicable local, provincial and federal regulations including the Ontario Environmental Protection Act.

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### **Appendix B: Procedures for Clean-up of Bird and Bat Droppings**

#### Clearance Inspection

The project authority or representative should complete a detailed visual inspection of the work area to confirm that an acceptable level of cleanliness has been achieved.

NOTE: Currently there are no accredited analytical procedures able to measure the presence of viable organisms of *Histoplasma capsulatum*.

#### Post Abatement Corrective Measures

1. Review the findings and recommendations of the project-specific risk assessment. The project-specific risk assessment must consider conservation and/or habitat preservation.
2. The project-specific risk assessment should consider post abatement corrective measures that may be necessary to prevent the return of birds or bats (e.g. block openings into buildings or structure ledges, screen off ventilation intakes or other void openings, install netting/mesh or anti-roosting control systems, etc.).

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### **Appendix C: Additional Hazards with Abrasive Blasting in Mould Abatement**

General guidance related to; protection of occupants, worker training and medical pre-screening respiratory protection, personal protection and hygiene procedures are found in Section of B of this document and shall apply, as applicable, for mould abatement using abrasive blasting,

Abrasive blasting techniques, using media such as soda, dry-ice or sand, are effective methods for the removal of mould growth from contaminated building materials. However, it must be recognized that additional hazards to workers and building occupants might exist when utilizing such methods. The primary hazards and additional precautions recommended for abrasive blasting of mould growth are summarized below:

- The aggressive disturbance of mould growth through blasting will result in much higher airborne mould concentrations than manual removal methods.
- Dry-ice blasting will release significant amounts of carbon dioxide (CO<sub>2</sub>) into the work area which may result in an overexposure to carbon dioxide in enclosed work areas.
- The compressed air used to deliver the blasting media will reduce the negative pressure in the containment. Even smaller blasting equipment delivers 2000 cfm or more of additional air into the containment. This air supply will offset the negative pressure created by ventilation equipment.
- The pressure applied by the blasting equipment can transport or drive mould debris through various substrates, building elements, and assemblies (such as floor board seams, roof and wall sheathing seams, service penetrations, expansion joints) to an uncontained or occupied area where it may impact air quality or expose other workers, building occupants or the public.

Based on these hazards, the following precautions, in addition to the measures prescribed in Section B (of this document), should be followed when conducting abrasive blasting operations.

#### Containment

1. Level 3 precautions should be used for all blasting activities.
2. Ensure the substrate being blasted will not permit the penetration of blast media, dust or mould. If the substrate is likely to permit the transport of blast media, dust or mould then erect appropriate containment.
3. Provide adequate negative pressure ventilation during abrasive blasting. The ventilation must take into consideration the supply of air into the work area by the compressed air delivery of the abrasive media.
4. Continually monitor the workplace atmosphere for oxygen content and carbon dioxide when using dry-ice blasting methods.

# **EACO Mould Abatement Guidelines**

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### **Appendix C: Additional Hazards with Abrasive Blasting in Mould Abatement**

#### **Blast Media and Substrate Dust**

5. Silica containing blast media should not be used wherever possible due to the high toxicity of fine silica dust. This is of particular importance in occupied buildings.
6. Ensure that adequate precautions are taken to control the hazards of the dust generated from the surfaces being impacted, which may include lead based and lead containing paints, silica containing substrate or asbestos containing materials.

#### **Personal Protection**

7. The minimum respiratory protection for all abrasive blasting activities shall be a full face piece air purifying respirator with P100 filters.
8. Wear supplied air respiratory protection for abrasive blasting with dry ice. Monitor carbon dioxide concentrations on an ongoing basis to determine the requirement for and adequacy of supplied air respiratory protection.
9. The addition of a worker decontamination shower should be considered, but is optional.

# **EACO Mould Abatement Guidelines**

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### **Appendix D: Additional Procedures for Unsanitary Remediation**

#### **1. Introduction and Scope**

- Buildings can be flooded with Unsanitary Water sources that contain micro-organisms that pose a risk of infection to occupants and abatement workers. Examples of Unsanitary Water include water originating from a sanitary sewer system, and flooding from over-land water or waterways. This appendix presents the precautions necessary for the cleaning of Unsanitary Water contamination.
- Further precautions will be required where there other hazards in addition to Unsanitary Water, such as mould growth, chemicals or asbestos.
- For further information on water damage restoration, refer to Standard and Reference Guide for Professional Water Damage Restoration, IICRC S500, Institute of Inspection Cleaning and Restoration Certification, 3<sup>rd</sup> Edition, 2006.
- Requirements of Section B (of this document) shall also apply, as applicable, for the remediation of unsanitary water. Section B provides general guidance related to protection of occupants, worker training and medical pre-screening, respiratory protection, personal protection and hygiene practices.

#### **2. Personal Protection**

All work with Unsanitary Water restoration requires the following personal protective equipment:

- CSA-approved construction-rated rubber boots.
- Water-resistant disposable coveralls, complete with elasticized hood, taped to gloves and boots.
- Rubber or nitrile work gloves, tape-sealed to the coveralls at the wrists and cuffs. Inspect before re-use. Wear puncture-resistant work gloves on top of the liquid-resistant gloves, where there is a risk of cuts or tears.
- Minimum of a half-face piece Respirator, fitted with a P100 cartridge filter. Odour protection can be provided with combination organic vapour and P100 cartridges.
- Chemical splash goggles, or a full-facepiece respirator fitted with P100 filters, or a Powered Air Purifying Respirator (PAPR) fitted with Type H filters.

#### **3. Isolation**

- Turn off HVAC systems where possible and seal over any openings immediately adjacent to the work area.
- Seal off the contaminated areas to prevent access by unauthorized persons. Consider polyethylene sheeting isolation to ceiling height if there a strong odour present or there will be significant demolition work. Negative pressure ventilation as specified for Level 2 Mould Abatement elsewhere in this guideline may be a useful additional precaution.

# **EACO Mould Abatement Guidelines**

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### **Appendix D: Additional Procedures for Unsanitary Remediation**

- Install signs warning of a Biological Hazard and restricting access to personnel with suitable protection.

#### **4. Cleaning and Disinfection**

- Generally, all porous materials impacted by Unsanitary Water cannot be de-contaminated and must be discarded. Dispose of all drywall, carpets, carpet tiles, soft furniture, etc.
- It might be possible to restore some porous contents impacted by Unsanitary Water (e.g., high-value carpets, clothing, documents) using specialized restoration services. Any decision to restore contaminated porous articles should be approved by the Competent Person. Post-disinfection testing with bacteria swab testing is recommended for these items.
- Package all waste contaminated with Unsanitary Water into sealed water-tight containers, typically a 6 mil polyethylene bag. Wipe the containers with the disinfectant solution. Alternately, wrap items with 6 mil polyethylene sheeting, seal with tape and wipe the exterior of the packaged waste with disinfectant.
- After removal of items and finishes to be discarded, clean all surfaces with a general-purpose cleanser prior to application of a disinfectant. All soiling must be removed before disinfection.
- Apply a Health Canada approved disinfectant to all surfaces impacted with Unsanitary Water. If the product is sold as a concentrate, mix according to the manufacturer's recommendations and use within the time given by the manufacturer. Observe the wet contact time specified in the Health Canada approval (typically 5 – 10 minutes), re-applying as necessary.
- If indicated by the manufacturer, rinse the disinfected surfaces with clean potable water.
- Ensure all mould-susceptible surfaces are dry within 24 hours. Ensure all other surfaces are adequately dry before the installation of mould-susceptible surfaces that could be impacted by excess trapped moisture.

#### **5. Post-Disinfection Testing**

- Collect surface samples to test for residual viable bacteria, by swabbing 100 square centimetre areas of typical disinfected surfaces or articles.
- Analyse the swab samples for *E. coli* and possibly other Unsanitary Water indicator bacteria.
- The standard of acceptance for *E. coli* on disinfected surfaces, is no detectable Colony Forming Units per 100 square centimetre area.

# EACO Mould Abatement Guidelines

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### Appendix E: Definitions

Term	Definition
Abatement	The process of returning a building or part thereof, from a condition of Biohazard, to background concentrations of biological agents and products, typical of buildings not affected by Mould contamination.
Biohazard	The presence of (a) biologically derived aerosols, gases, or vapours of a kind and concentration likely to cause disease or predispose persons to adverse health effects, or (b) indoor biological growth and remnants of growth that may become airborne and to which people may be exposed.
Canister or Cartridge	A container with a filter, sorbent, or catalyst, or combination of these items, which removes specific contaminants from the air passed through the container.
Clearance Tests	Environmental tests (e.g., air samples, tape lifts, swabs) taken after Mould Abatement has been completed as a Quality Assurance measure.
Competent Person or Supervisor	A person who is qualified because of knowledge, training and experience to organize the performance of Mould Abatement, is familiar with Mould Abatement procedures, and has knowledge of the hazards of Mould and other dangers in the Abatement work area.
Contaminated Work	The portion of the Abatement project during which active disturbance, handling or cleanup of contaminated materials is occurring.
<i>Cryptococcus neoformans</i>	A pathogenic yeast growing in accumulated bird (usually pigeon) or bat Guano and posing a risk of cryptococcosis infections in heavily exposed or immuno-compromised individuals.
Disinfectant	Substance used to reduce the number of micro-organisms such as Moulds, bacteria or viruses to below the level necessary to cause infection. Some common Disinfectants, include sodium hypochlorite, quaternary ammonium compounds, and hydrogen peroxide.
DIN	Drug Identification Number. Registration number given by Health Canada for approval of disinfectants. Specifies the organisms against which the disinfectant is effective, and requirements for mixing, storage, application, and rinsing, if required.
Designated Substance	Hazardous materials (asbestos, lead, silica, mercury and others) designated by the Ontario Ministry of Labour for specific regulation under the Occupational Health and Safety Act. Property owners must notify contractors bidding on projects of the presence of Designated Substances. In addition to a regulation on asbestos, the Ontario Ministry of Labour has issued guidelines for the potential exposure from silica, lead, mercury and isocyanates on construction projects.
Dust Suppression	Measures taken to reduce the release of spores and other Mould-derived particulate matter during Mould Abatement.
Filtering Facepiece	Particulate-filtering Respirator where the facepiece is also the filter.
Fit-test	A qualitative or quantitative method to evaluate the fit of a specific make, model and size of Respirator on an individual.
Guano	Bird or bat dung, considered a risk for infection by Moulds or other micro-organisms.
HEPA Filtered Exhaust Fan	Portable exhaust fan in sealed cabinet equipped with HEPA filtration used to exhaust filtered air out of an enclosed Mould Abatement work area for the purpose of establishing and maintaining a Negative Pressure in the Mould Abatement work area with respect to surrounding areas, and also to provide general ventilation of the Abatement area.

# EACO Mould Abatement Guidelines

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### Appendix E: Definitions

Health and Safety Professional	An individual qualified by knowledge, skills, education, training and experience to perform assessments of Mould contamination, collect and interpret environmental tests, develop recommendations for Abatement work and provide inspection and Quality Assurance services.
HEPA	High Efficiency Particulate Air filter capable of trapping and retaining particles greater than or equal to 0.3 micrometers in diameter, at a minimum efficiency of 99.97%
<i>Histoplasma capsulatum</i>	A fungus frequently found growing in deposits of bird and bat Guano, and a risk for human infections during remediation work, renovation and demolition.
HVAC	Heating, ventilating and air conditioning (equipment).
Mould	Normally refers to fungi with filamentous growth form, often giving rise to “fuzzy”, cottony, wooly or powdery textured colonies. Moulds produce spores that are poorly visible or not visible at all to the naked eye and that in many species are specialized to become airborne.
Microbial	Referring to any of Mould, bacteria, viruses or other micro-organisms.
MSDS	Material Safety Data Sheet, required by Workplace Hazardous Materials Information System (WHMIS) legislation, and giving information on hazardous materials, including properties, hazards, first-aid, emergency response, and personal protection.
N95	A Respirator particulate filter, 95% efficient at stopping a 0.3 micrometer aerosol, and not resistant to oil, a classification of particulate filters set by NIOSH.
Negative Pressure	A reduced pressure established within a Mould Abatement enclosure by extracting air directly from Abatement area, and discharging this air outside the work area. The discharged air must be HEPA filtered, the exhaust unit should be leak-checked and preferably the air is discharged outside the building.
NIOSH	National Institute for Occupational Safety and Health, part of the U.S. Centers for Disease Control and Prevention.
100 Series Filter	Any Respirator particulate filter, 99.97% efficient at stopping a 0.3 micrometer aerosol. A classification of particulate filters set by NIOSH.
Polyethylene Sheeting	Polyethylene Sheeting or rip-proof Polyethylene Sheeting with tape along edges, around penetrating objects, over cuts and tears, and elsewhere as required providing a continuous membrane to protect underlying surfaces from damage, and to prevent escape of airborne contamination through sheeting into occupied areas.
Porous	Permeable to Mould growth, allowing growth to extend significantly below the immediate surface.
Project Authority	Individual who has overall management responsibility for the project.
P100	A Respirator particulate filter, 99.97% efficient at stopping a 0.3 micrometer aerosol, and resistant to oil droplets, a classification of particulate filters set by NIOSH.
Quality Assurance	Measures of inspection, testing and documentation to promote confidence that the Abatement process will meet the desired goals.
Respirator	A device to protect the user from inhaling a hazardous atmosphere.
Susceptible Occupants	Persons with elevated risks of reacting to Mould exposure, usually due to allergic pre-disposition or compromised immune state. Examples include but are not limited to infants (less than 12 months old), persons recovering from recent surgery, or

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### **Appendix E: Definitions**

	people with immune suppression, asthma, severe allergies, sinusitis or other chronic inflammatory lung diseases.
Unsanitary Water	Water containing the known or presumed presence of harmful micro-organism such as <i>E. coli</i> , viruses or bacteria. Examples of Unsanitary Water include water originating from a sanitary sewer system, or flooding from over-land water or waterways.
Waste Decontamination Facility	A series of two rooms (Double-bagging and Transfer) constructed in such a way as to allow waste and equipment to enter and leave a Mould Abatement area without spreading contaminants beyond the Abatement area.
Worker Decontamination Facility	A series to two rooms (Clean and Dirty) constructed in such a way as to allow persons to enter and leave a Mould Abatement area without spreading the contaminants beyond the Abatement area.

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**NOTES**

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## **Appendix 'F'**

### **University of Guelph Commissioning - IT**

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## REVISION HISTORY

Version	Date	Author	Description of Revision
1.0	September 6, 2018	Audley Lloyd	Initial Release for Comment

## 1.0 Scope

- 1.0 This commissioning guide prescribes the inspection and test procedures. These procedures will help to verify and inspect that the Access Control, Video Surveillance, Intrusion and Duress System has been installed and meets all expectations. These installations will be in conformance with the projects scope of work, specifications, the project design, and the drawings.
- 1.1 The inspections and testing in this commissioning guide shall be documented for the commissioning and acceptance of all systems.
- 1.2 This guide contains commissioning forms for Building #046 Renovations, Guelph, Ontario.
- 1.3 The contractor shall verify successful operations of all components of the Surveillance Cameras system, Access Control system, Intrusion system and Duress alarm system.

## 2.0 Commissioning Standards

This guide prescribes specific examinations to confirm the compliance to the latest edition of applicable codes and standards including the following references:

- 2.1 ANSI/TIA/EIA - 758 Customer-owned Outside Plant Telecommunications Infrastructure Standard;
- 2.2 ANSI/TIA/EIA - 569 Commercial Building Standard for Telecommunications Pathways and Spaces;
- 2.3 ANSI/TIA/EIA -568 Commercial Building Telecommunications Standard;
- 2.4 ANSI/TIA/EIA – 607 Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications;
- 2.5 BICSI Telecommunications Distribution Design Manual; per the systems manufacturer's specifications, installation and warranty requirements.
- 2.6 National Electrical Code. National Electrical Safety Code and other related NFPA Codes and Standards.
- 2.7 Manufacturer's instructions.

## 3.0 Commissioning Guide – Contacts Required

- a. Project Lead Representative:

- b. Contractor Representative:
- c. Client Representative:

## 4.0 Commissioning Guide – References Required

- a. Project Scope
- b. Tender Drawings
- c. Tender Specification
- d. Shop Drawings as submitted to
- e. Equipment/Software Installation Manuals
- f. Equipment/Software Operations Manuals
- g. IP Device Tracking Log
- h. Video Surveillance Commissioning
- i. Access Control Commissioning
- j. Intrusion Detection Commissioning
- k. Duress System Commissioning
- l. Video Surveillance System Verification Checklist (Provided)
- m. Access Control System Verification Checklist (Provided)
- n. Intrusion System Verification Checklist (Provided)
- o. Duress System Verification (Provided)

### 4.1 Commissioning Guide – Checklist Completion

The Checklists will be distributed in electronic form, and the final version must be filled in electronically to ensure complete legibility. Once fully completed and all parties are satisfied, please forward a copy to all parties. Please print two (2) copies of the completed form to be signed off by all parties. One of the printed and signed copies is to be retained by the lead contractor, and the second will go the time client at system turnover.

## 5.0 Physical Security System Component Abbreviations

Device	Description
NVR	Network Video Recorder

REX	Request to Exit Sensor
CM	IP Camera
ES	Electric Strike
DC	Door Contact
ESSC	Electronic Safety and Security Cabinet
PB	Handicap Push Button
ED	Electronic Deadbolt
CTR	Door Controller
OVR	Mantrap door Override
IPTV	IP Monitor
PR	Passive Infrared
ML	Magnetic Lock
KB	Keybox
CR	Proximity Card Reader
CRK	Proximity Card Reader with PIN Keypad

## 6.0 Video Surveillance System

### 6.1 Installation Quality Inspection

The following are items to be inspected to verify they have been completed in accordance with the design specifications:

- Electrical and communications cables have been appropriately sized and selected to ensure that they will support currently installed and future equipment
- Cabling has been run in conduit, cable tray, raceway, above ceiling, below raised floors, in wall cavities or risers as detailed design documentation
- Conduit and cable trays have been effectively secured to ensure that they can support currently installed and future cabling;
- Connections have been correctly terminated and insulated to ensure satisfactory connectivity and protection against faults and interference;
- All IP cameras have been installed at the locations specified in the design documentation;
- Cameras of the specified type (e.g. colour, black and white, fixed, pan tilt zoom; multi-sensor, panoramic, thermal, etc.) have been installed
- Cameras have been correctly secured to protect against operational damage and ensure stability for continuous use;
- External cameras have been provided with adequate protection against moisture and other environmental conditions, through the use of Liquid tight conduit and connectors, proper installation of mounting hardware, gaskets, drip loops and Nema 4X, IP66 or IP67 backboxes

- Operator workstation CPU, LCD screen and peripheral devices have been installed at the specified location. Interconnecting cables have been protected from mechanical damage and have been permanently connected
- Associated equipment such as power supplies and switches have been connected correctly and secured appropriately.

## 6.2 Software Installation Inspection

The following are items to be inspected to verify the application software has been installed and configured on the video surveillance computing equipment.

- All software modules specified in the design documentation or the modules required to perform all specified operation functions have been installed and configured to meet system requirements
- The latest release version of all software modules including patches and upgrades have been provided
- Ensure that all IP cameras are running the latest firmware that is compatible with the Video Management Software (VMS), and any analytics packages that will be deployed as part of the install
- The control equipment hardware has sufficient capacity to support the software routines and functions under worst case demand conditions
- All cameras, system reports, GUI maps, screens and menus have been correctly configured
- Software has been registered to client.

## 6.3 Use Case Functional Test

The following tests shall be performed for each camera:

- Verify that the camera produces a clear picture with the specified resolution
- Verify that cameras having wide dynamic range are installed where specified, and the feature is enabled to allow the camera to capture the desired shot
- Verify that the camera maintains a clear picture and automatically compensates for changing light conditions including day/night change
- Verify that cameras provide complete and correct coverage of the area specified
- Verify that areas of the camera view may be masked to prevent unwanted alarm activation
- Verify that the camera anti-tampering feature has been enabled
- Simulate a tamper alarm and verify that the correct signal is transmitted to the operator workstation

- Simulate a video feed fault and verify that the correct signal is transmitted to the operator workstation
- Verify manually recording; very recording can be played, stopped, paused, rewinded, fast forwarded, advance frame by frame
- Verify that historical data reports may be generated in real-time
- Verify that real time video data analysis functions (record on motion, line cross detection recording, third party analytics, etc.) are performed in real time and the corresponding view displayed on the monitor
- Verify the video surveillance system interfaces with all additional security sub-systems so as intrusion detection, access control system, intercom system, Key Control management systems, etc., to display the correct camera view on the monitor when the corresponding signal is received.

## **7.0 Access Control System**

### **7.1 Installation Quality Inspection**

For all newly installed devices, the following are items to be inspected and verified for all doors, prior to completing the commission test, a visual inspection shall be completed. The inspection shall include:

- Electrical and communications cables have been appropriately sized and selected to ensure that they will support currently installed and future equipment
- Cabling has been run in conduit, cable tray, raceway, above ceiling, below raised floors, in wall cavities or risers as detailed design documentation
- Conduit and cable trays have been effectively secured to ensure that they can support currently installed and future cabling;
- Connections have been correctly terminated and insulated to ensure satisfactory connectivity and protection against faults and interference;
- Confirm reader is level, mounted securely and there are no visual gaps
- Confirm the Door position contact is installed securely in door frame, hole was not over drilled and there is no movement.
- For surface mount contacts, no large gaps and installed on the secure side of door.
- If present, weather stripping should not impede the contact
- Request to Exit device installed on security side of door
- Door Lever function matches door configuration, to provide security and code compliant egress
- Door closes securely with no rubbing or binding
- Readers have all screw caps installed
- ACU ID clearly visible on can

- Verify wiring is labeled... at ACU end labeled with end point device and door number/location identified; at devices location, the ACU the device is wired to, as well the end point device it feeds.

## **7.2 Software Installation Inspection**

The following are items to be inspected to verify the application software has been installed and configured on the computing equipment.

- All software modules specified in the design documentation or the modules required to perform all specified operation functions have been installed and configured to meet system requirements.
- The latest release version of all software modules including patches and upgrades have been provided
- The control equipment hardware has sufficient capacity to support the software routines and functions under worst case demand conditions
- Software has been registered to client.

## **7.3 Use Case Tests**

The use case tests are to certify that the doors functions as intended. The following tests as determined by door type will be performed on each door:

- Access Granted
- Door Held Test
- Door Forced Open
- Auto Operator
- Valid Egress

## **7.4 Doors with Magnetic Lock and Fire Alarm Interface**

When a door(s) contains a magnetic lock, a fire alarm interface is required, thus it will need to be tested for functionality during the ULC verification process. A copy of the fire alarm verification is required before sign off of this door series type. The contractor to ensure proper testing is completed.

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## 7.5 Power Loss Test

The test validation criteria is to ensure that the door functions as intended during an A/C power failure and a complete power failure. An A/C power failure must be simulated by disconnect the UPS feeding a POE powered ACU from A/C power, or power supply feeding the ACU from A/C power, and power supply feeding the door locks from A/C. For total power failures simulations POE power ACU must be disconnected from the POE switch; ACU and strikes feed by a standard power supply is disconnect from A/C and the backup battery is disconnected.

- During A/C power fail simulation, test that valid card presented during a power failure situation within the facility will allow access to be granted/denied/reported as tested above.
- During a total power failure, confirm that door fails in intended state. Doors with strike that are intended to fail secure, fail secure while still allowing code compliant egress. Magnetic lock doors must fail safe to meet code compliant egress.

## 7.6 Elevator Commissioning

The test validation criteria is to ensure that access to control floors is available to authorized card holders only, and elevator movement is tracked.

- Access granted only to floor credential authorized for
- Access denied to unauthorized floors
- Elevator Tracked

## 8.0 Intrusion Detection Commissioning

### 8.1 Installation Quality Inspection

The following items are to be inspected and verified that they have been completed in accordance with the design specifications:

- Electrical and communications cables have been appropriately sized and selected to ensure that they will support currently installed equipment and as per the manufacturer's recommendations and the University standards.
- Cabling has been run in conduit, cable tray, raceway, above ceiling, below raised floors, in wall cavities or risers as detailed design documentation

- Conduit and cable trays have been effectively secured to ensure that they can support currently installed and future cabling;
- Connections have been correctly terminated and insulated to ensure satisfactory connectivity and protection against faults and interference;
- All sensors have been installed at the locations specified in the design documentation;
- Sensors of the specified type (e.g. PIR, contact, sounder, photoelectric detector, glassbreak detector, shock sensors) have been installed at the locations specified in the design documentation
- Sensors have been correctly secured to protect against operational damage and ensure stability for continuous use
- Associated power supplies have been installed, connect to A/C and have backup batteries installed.
- Backup batteries have been labeled with an in-service date

## 8.2 Use Case Functional Test

The following tests shall be performed for each endpoint sensor as identified, as part of an intrusion walk test when the system is armed:

- Verify PIR sensor is detecting movement and reporting alarm condition
- Verify door contact sensor is detecting when the distance between the magnet and the reed switch is outside the manufacturer's specked distance. Confirm reporting alarm conditions when armed. Confirm all 24-hour doors go into alarm, while the overall intrusion detection system is disarmed. Confirm entry/exit delay on all designated entry doors
- Verify Glassbreak sensor is detecting a glass break and reporting alarm condition. All glassbreak test must be performed using the glassbreak manufacturer's glassbreak test kit
- Verify shock sensor is detecting vibration and reporting alarm conditions
- Verify sounder/speaker fires on alarm and reporting of alarm condition takes place
- Verify all non-24-hour end points, can armed and disarmed
- Simulate a wire cut by disconnect the circuitry to end point devices to simulate trouble conditions, and that the trouble condition is being reported correctly.
- Simulate an A/C failure and verify the trouble is reported correctly. Also, verify that the alarm system functions as intended both in an armed and disarmed state
- Ensure that each alarm condition tested, is capture and reported to a third-party and/or in-house monitoring station, via the primary communication method.

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## 9.0 Duress Alarm Commissioning

### 9.1 Installation Quality Inspection

The following items are to be inspected and verified that they have been completed in accordance with the design specifications:

- Electrical and communications cables have been appropriately sized and selected to ensure that they will support currently installed equipment and as per the manufacturer's recommendations and the University standards.
- Cabling has been run in conduit, cable tray, raceway, above ceiling, below raised floors, in wall cavities or risers as detailed design documentation
- Conduit and cable trays have been effectively secured to ensure that they can support currently installed and future cabling;
- Connections have been correctly terminated and insulated to ensure satisfactory connectivity and protection against faults and interference;
- Panic buttons have been installed at the locations specified in the design documentation
- Panic buttons have been correctly secured to protect against operational damage and ensure stability for continuous use
- Annunciator consoles and/or workstation monitor have been installed at the locations specified in the design documentation
- Associated power supplies have been installed, connect to A/C and have backup batteries installed.
- Backup batteries have been labeled with an in-service date

### 9.2 Use Case Functional Test

The following tests shall be performed for each endpoint panic button as identified, as part of duress alarm walk test when the system:

- Verify panic button activation is reporting alarm condition
- Verify on panic button activation that the light outside the interview room is illuminated.
- Verify the alarm condition is being reported to the Annunciator console and/or workstation monitor, that a room location is being reported, and the room location is accurate.
- Verify that the alarm condition is being reported to campus police via Onyxworks

- Verify the alarm condition remains present on the Annunciator console and /or workstation, and the light outside the interview room door stays illuminated until the system is reset
- Simulate a wire cut by disconnect the circuitry to panic buttons to simulate trouble conditions, and that the trouble condition is being reported correctly.
- Simulate an A/C failure and verify the trouble is reported correctly.

## **10.0 Worksheets**

- The worksheets that follow are to be reproduced on Tabloid (11" x 17") sheets prior to the commencement of all inspections and testing.
- Results will be recorded in the worksheets and the worksheets will be reviewed and approved by the project lead prior to system acceptance.

## Video Surveillance System Commissioning Worksheet

[illegible]

### Access Control Commissioning Worksheet

[illegible]



### Intrusion Detection Commissioning Worksheet

[illegible]

[illegible]

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Contractor Signature:									
Client Signature:									

[illegible]

Contractor Signature:

Client Signature:



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