Liburdi Engineering Limited

REQUEST FOR TENDER

Building Addition
45 Innovation Drive
Hamilton, Ontario

Prepared for:

Closing Date: October 21, 2026

Document Prepared By:
Kalos Engineering Inc.
300 York Boulevard
Hamilton, Ontario L8R 3K6
Tel: (905) 333-9119

SPECIFICATIONS
FOR

BUILDING ADDITION
45 INNOVATION DRIVE, DUNDAS

ARTICLE 1: CONTRACT DOCUMENTS

All bidders shall consult the Contract Documents. The Contract Documents will consist of the following:

1. Canadian Standard Construction Document, CCDC 2, 2020 Stipulated Price Contract. This document consists of the Agreement between Owner and Contractor, and the General Conditions of the Stipulated Price Contract.
2. Tender Form with Appendices.
3. Instructions to Bidders
4. Contents of Specifications.
5. Supplementary General Conditions.
6. Schedules/Standard Details included in the Specifications.
7. Specifications as listed in Contents of Specifications.
8. Drawings as listed in the Specifications.
9. Addenda issued prior to tender delivery.

ARTICLE 2: ARTICLE 2: OWNER

549090 Ontario Limited (Liburdi Dimetrics Ltd)
400 Highway 6 North
Dundas, Ontario L9H 7K4

ARTICLE 3: ARTICLE 3: PLACE OF BUILDING

45 Innovation Drive
Dundas, Ontario L9H 5V3

ARTICLE 4: ARTICLE 4: DELIVERY OF TENDERS

1. Submit tender

   : In sealed envelope identified as "Tender", and with name of Project and Bidder.

   Deliver tenders and other specified submission to:

: **not later than 2:00:00pm**
: **on October 21, 2026**

To

: 400 Highway 6 North
: Dundas, Ontario L9H 7K4

No tender will be received after this time.

2. Submission of Tender by facsimile or email is unacceptable and will be rejected.

ARTICLE 5: AWARD OF CONTRACT

1. Tenders are to remain open for acceptance by the Owner for a period of thirty (30) days from the date of closing.

2. Separate Prices and Alternate Prices submitted are to remain open for acceptance by the Owner for a period of sixty (60) days from the date of closing.

3. The Owner will not necessarily award a contract to a bidder, or to the bidder submitting the lowest tender.

ARTICLE 6: EXAMINATION

1. Bidders shall examine all Contract Documents, and shall also visit the place of building and carefully examine all conditions affecting the site and work to be done thereon.

2. No payments for extra work will be allowed to the Contractor for conditions which can be determined by examination of the Contract Documents or the site, or both.

ARTICLE 7: TENDERS

1. Submit tenders on unaltered Tender Forms, furnished with the Specification.

2. The Tender shall be Bulk Sum Tender for all the Work included in the Contract Documents.

3. Fill in all blanks in the Tender Form and Appendices as specified and instructed. TENDER DOCUMENTS NOT COMPLETED IN FULL MAY BE REJECTED.

4. Sign and seal tender submitted. Incorporated companies shall affix their corporate seal under the hand of their duly authorized officers.

ARTICLE 8: DISQUALIFICATION OF TENDERS

1. Tenders received after the specified latest delivery time will be disqualified and returned unopened.

2. Upon presentation of evidence of collusion, intent to defraud, or other illegal practices on the part of the bidder his tender will be disqualified whether unopened or not.

ARTICLE 9: QUESTIONS OF CONTRACT DOCUMENTS

1. The Consultant will be responsible for clarification of Contract Documents only as incorporated into Addenda, or otherwise communicated by letter or fax to holders of tender documents on record.

2. Address all queries to:

: Kalos Engineering Inc.
300 York Boulevard,
Hamilton, Ontario L8R 3K6
Email: hankh@kaloseng.ca
Ph: 905-512-2619
ATTENTION: Mr. Hank Huitema

ARTICLE 10: SITE ORIENTATION MEETING

1. A site meeting for all tenderers has been arranged for **October 7, 2026 at 11:00am** to review the site and prepare any questions which will require an answer by addendum.

ARTICLE 11: SOIL INVESTIGATION

1. Soil investigation of the project site for guidance in design and construction was carried out for the Owner by MTE Consultants Inc.

2. A copy of this report is included with this tender package. The report dated June 16, 2023 covers site and soil description, foundation considerations, earthquake loads, lateral earth pressures, drainage considerations, excavations, backfilling requirements, paved areas and borehole logs.

3. Neither the Owner nor Consultant accept responsibility or liability for the

accuracy of the contents of the report.

ARTICLE 12: MATERIAL VARIATIONS

This is a Base Bid Specification. Materials or articles specified by Brand Name, Catalogue Number, Manufacturer's or Supplier's name shall be used for the basis of this Contract. Where more than one such source is specified for the same material or article, the Tenderer must select the one of his choice which will be subject to Consultant's approval.

1. The Tender amount shall be based on the materials and equipment specified.

2. The Tender amount which will be considered is that arrived at after the cost differences of all substitutions which the Owner wishes to make have been applied to the Base Bid.

3. Cost, quality, service and supply being equal, Canadian goods shall have preference over foreign goods. Similarly, local goods shall have preference among Canadian goods. The Contractor shall be responsible for and pay all costs incurred by the Owner and Consultants for review and acceptance or rejection of alternate products substituted or incorporated into the project without the prior written consent of the Consultant.

4. Alternative and Separate Prices specified in Section 01 22 00 - Prices are the only solicited changes to the base bid materials.

Unspecified materials or rejected alternates, if built into the work, shall be replaced with the specified or accepted material at no additional cost to the Owner.

Alternative materials or articles may be proposed by the Tenderer under the following conditions:

1. A list of proposed alternatives, Appendix 'F', shall be attached to the Tender Form in order to be considered by the Consultant.

2. This list should show product names of alternatives and whether any difference will be made in the quoted sum for each alternative, should it be accepted. Differences quoted must include for all necessary changes to the structure, finishes, etc. to accommodate the proposed alternatives.

3. The Consultant has the right to accept any or all such alternatives, in which event the Contract shall be changed accordingly.

ARTICLE 13: DISCREPANCIES

1. The Tenderer shall report to the Consultant all discrepancies, omissions, errors, departures from Building Code Requirements, By-laws and/or good construction practice and points considered to be of dubious intent, so that the Consultant may, at his own discretion, issue instructions by Addenda.

ARTICLE 14: ADDENDA

1. During the Bidding Period, Tenderers may be instructed by Addenda to make additions, deletions or alterations to the Contract Documents. Addenda, if any, will be issued to all Bidders prior to Tender closing date. All Addenda shall become a part of the Contract Documents and they shall be acknowledged in the space provided.

ARTICLE 15: TENDER DOCUMENTS

1. One (1) digital (PDF) copy of Tender documents, for bidding purposes, will be issued by the Project Manager to each of the invited General Contractors.

2. Drawings and specifications covering the Mechanical and Electrical will be included in the bid package.

ARTICLE 16: AGREEMENT TO BOND

1. Submit with Tender an Agreement to Bond of a bonding company to ensure that it will issue a Performance Bond and Labour and Material Payment Bond to the Bidder for the Project.

ARTICLE 17: PERFORMANCE BOND

1. A Performance Bond equal to 50% of the Contract Amount shall be included in the Stipulated Price. Within 7 days of notification of award of contract submit said bond to the Owner.

ARTICLE 18: LABOUR AND MATERIAL PAYMENT BOND

1. A Labour and Material Bond equal to 50% of the Contract Amount shall be included in the Stipulated Price. Within 7 days of notification of award of contract submit said bond to the Owner.

ARTICLE 19: AS CONSTRUCTED DRAWINGS/MANUALS

1. The Contractor shall carry in his tender an amount sufficient to produce the 'As

Constructed Drawing and Manual Documents in a Graphics Based Format (AutoCAD-latest release and Microsoft Word)

2. A holdback of $20,000.00 will be retained by the Owner prior to Substantial Performance of the Project, until submission and acceptance by the Consultant and Sub-Consultants, of the 'As Constructed Drawings and Manuals' by the Contractor has been completed.

ARTICLE 20: SALES TAX

1. The Tender amount shall INCLUDE the Provincial Sales Tax and all other Taxes and Levies in force at the time of tendering. Such tax as may be required by Statute to be shown separately shall be so shown, but shall be included in the Tendered Amount.

2. The Tender amount shall NOT INCLUDE the Federal Goods and Services Tax. Such Tax shall be shown separately on the Tender Form as Extra to the tendered amount.

3. The contractor will indicate on each application for payment as a separate amount the appropriate HST the Owner is legally obliged to pay. This amount will be paid to the Contractor in addition to the amount certified for payment under the Contract.

ARTICLE 21: NON-COMPLIANCE

1. Failure to comply with any of the requirements in these Instructions to Bidders may cause a Tender to be declared improper and immediately rejected.

ARTICLE 22: LIST OF SUBCONTRACTORS

1. Include in Appendix "A" the names of the subcontractors, the Bidder proposes to perform Work under the Contract and include in the Agreement he would sign with the Owner, and attach to the Tender submitted.

2. Subcontractor designated as "OWN FORCES" is not acceptable to the Consultant.

ARTICLE 23: PERCENTAGE FEES ON CHANGES IN THE WORK

1. Bidders shall include Fees for Work to be added to the cost of Work for Changes to the Contract not covered by Unit Prices, on Appendix "B", and attach it to Tender Form submitted.

ARTICLE 24: UNIT PRICES

1. Bidders shall include Unit Prices on Appendix 'C' and attach it to Tender Form submitted.

ARTICLE 25: SEPARATE/ALTERNATE PRICES

1. Bidders shall include the Separate Prices on Appendix 'D' and Alternate Prices on Appendix 'E' and attach it to Tender Form submitted.

ARTICLE 26: COMPLETION DATE/SCHEDULING/PHASING

1. Time is of the essence and it is imperative that all Work be Substantially Completed not later than NOVEMBER 30, 2027. The successful bidder will be expected to be on site no later than Monday, October 16, 2026.

2. Time is of the essence and the General Contractor must include his construction completion date in the Tender Form.

3. The Existing Facility will remain open and in operation at all times during the course of Construction. The Contractor shall take this into consideration with regards to Phasing the Work.

4. Scheduling of work shall be in accordance with Section 01 10 05, General Instructions of the Specifications.

5. Scheduling of Work and co-ordination are essential. The Bidder is requested to submit a critical path schedule with key milestone dates noted to meet the completion date. Bidders shall include this on Appendix 'G' and attach it to the Tender Form submitted.

ARTICLE 27: SEPARATE CONTRACTS

1. The Owner (Project Manager) has or will be arranging Work to be performed on this project by other contractors as outlined in Section 01 10 20 Owner Supplied Equipment and Work.

2. The scheduled start/completion dates for these Works are noted and shall be deemed to be accurate for this Tender.

ARTICLE 28: TEMPORARY FACILITIES

1. Bidders are advised that they are to provide in their Bids, including all costs,

for all temporary heat, hydro, water, protection, etc. and project security, as outlined in Section 01 50 00 - Temporary Facilities and Controls of the specifications.

ARTICLE 29: FAIR WAGE SCHEDULE

1. All Contractors bidding on this project is requested to observe all statutes concerning the Hamilton Fair Wage Schedule.

ARTICLE 30: TOXIC AND HAZARDOUS SUBSTANCES

1. Bidders are advised that should contaminated soil be uncovered, excavation shall continue in the following manner to maintain the schedule.

   .1 Transport the material to a concrete slab designated by the Owner.
   .2 Place polyethylene on the concrete and deposit material on the polyethylene.
   .3 Cover the material with tarpaulins.
   .4 Arrange through the Consultant for the testing and safe disposal of the material.

ARTICLE 31: STOCKPILING OF EXCAVATED MATERIAL

1. Bidders are advised that clean, compactable, excavated material acceptable for backfill, landfill shall be deposited on the site in a location designated by the Owner. Material shall be transported, deposited and compacted in accordance with Section 31 01 00 Earthwork of the specifications.

ARTICLE 32: PERMITS AND FEES

1. The Owner has applied and paid for the Building Permit.

2. The Contractor shall be responsible for applying and paying for, and obtaining all other approvals necessary for the completion of the Work.

3. The cost of all permits and approvals shall be reimbursed by the Owner upon submission with the Contractors first progress billing.

ARTICLE 33: PREQUALIFIED BIDDERS

1. Bidders are advised that this is an Invited Tender with two (2) Contractors requested to submit a bona fide Tender for this project.

2. The following is a list of Prequalified Bidders for the Project:

   - Bestco Construction Ltd.
   - P.Demik Construction Ltd.
   - Schilthuis Construction Inc.

END OF INSTRUCTIONS TO BIDDERS

SPECIFICATIONS
FOR

BUILDING ADDITION
45 INNOVATION DRIVE

NAME OF CONTRACTOR: _____

TO:

GENTLEMEN:

1. I/We, the undersigned Tenderer, declare that we have carefully examined all Tender Documents including the Specifications, Drawings, Schedules, Addenda _____to_____, the Agreement between Owner and Contractor, and the General Conditions of the Contract of the Standard Construction Document, CCDC 2, 2020 Stipulated Price Contract, as supplemented for this Project; and the Instructions to Bidders; and visited and investigated the site, and examined all conditions affecting the Work; and if notified in writing of the acceptance of this Tender within thirty (30) days of the date below, we agree to provide all materials necessary and perform all Work shown and described in these documents for the Stipulated Price of:

   _____(Dollars)

   STIPULATED PRICE **$**_____

   H.S.T. (13%) extra **$**_____

   TOTAL **$**_____

   in lawful money of Canada; included in which are all applicable Provincial Sales and Excise taxes, custom duties, freight, exchange and all other charges.

2. The undersigned agrees, if notified of award of a Contract, to immediately commence Work actively and to complete in _____ weeks and ready for occupancy by the day of _____, 20____.

3. In the Stipulated Price submitted the following Subcontractors are carried and they will perform the Work indicated:

MECHANICAL (Work included for the Mechanical Site services).

: Subcontractor's Tender $.....

Subcontractor: .....

ELECTRICAL (Work included for the Electrical Site Services).

: Subcontractor's Tender: $.....

Subcontractor: .....

MECHANICAL (Work included in Division 26 of the Specifications)

: Subcontractor's Tender: $.....

Subcontractor: .....

ELECTRICAL (Work included in Division 23 of the Specifications)

: Subcontractor's Tender: $.....

Subcontractor: .....

4. The undersigned agrees that the List of Subcontractors, Appendix "A" completed and submitted in accordance with Article 26 of the Instructions to Bidders lists the Subcontractors who will perform the Work indicated.

5. The undersigned agrees that Unit Prices referred to in Article GC 6.1 Changes, Article GC 6.2 Change Order and Article GC 6.3 Change Directive, Appendix "B" completed and submitted in accordance with Article 24 of the Instructions to Bidders will apply to changes to the Contract where applicable.

6. The undersigned agrees that the Separate Prices, Appendix "C" completed and submitted in accordance with Article 25 of the Instructions to Bidders will apply to the Work where and if accepted by the Owner.

7. The undersigned agrees that the Alternate Prices, Appendix "D" completed and submitted in accordance with Article 25 of the Instructions to Bidders will apply to the Work where and if accepted by the Owner.

8. The undersigned agrees that the Alternate Proposals, Appendix "E" completed and submitted in accordance with Article 12 of the Instructions to Bidders will apply to the Work where and if accepted by the Owner.

9. The undersigned agrees that the Construction Schedule, Appendix "F" completed and submitted in accordance with Article 26 of the Instructions to Bidders will apply to the Work required for completion of the project.

10. The undersigned hereby submits that he has carefully examined the site of the proposed Work and existing conditions; the requirements of the construction schedule; and has satisfied himself that all Subcontractors, material suppliers, and equipment suppliers on which this Tender is based are capable of meeting all requirements of the schedule, and of executing the Work in accordance with the Drawings and Specifications, the Instructions to Bidders, Tender Form and Form of Agreement, listed in Article 1 of this Tender Form.

11. The undersigned agrees that this Tender is valid and subject to acceptance by the Owner for a period of thirty (30) days from date of Tender receipt, and that if notified of award of the Contract he will:

    : execute a contract with the Owner on the Specified `Form of Agreement'.
    : furnish to the Owner, in care of the Consultant, copies of Bonds, Insurance Policies, etc. as specified and as required by the General Conditions and Supplementary General Conditions of the Contract.

12. We have attached to this Tender Form the following documents:
    : Agreement to Bond/Bid Bond
    : List of Subcontractors, Appendix "A"
    : Unit Prices, Appendix "B"
    : Separate Prices, Appendix "C"
    : Alternate Prices, Appendix "D"
    : Proposed Alternates, Appendix "E"
    : Construction Schedule, Appendix "F"

13. Signature of Bidder:

( ) ( )
(_____) (_____)
Name of Firm Signed by

( ) ( )
(_____) (_____)
Dated at This day of 2026

Seal

END OF TENDER FORM

1. 1. Herewith is the list of Subcontractors to which reference is made on the submitted Tender Form in Article 5:-

   OWNER: _____

   CONTRACTOR: _____

2. Appendix "A" shall form an integral part of the Tender Form.

3. No changes to the List of Subcontractors will be allowed without the Consultant's express written permission.

4. List each Subcontractor by his firm's proper legal designation, and to indicate whether his business is carried on as an individual, partnership or limited company.

5. The undersigned submits that in proposing the undermentioned Subcontractors he has consulted each and has ascertained to his complete satisfaction that those named are fully acquainted with the extent and nature of the Work involved and of the proposed construction schedule, and that they will execute the Work to conform to the requirements of the Contract Documents.

6. **LIST OF SUBCONTRACTORS**

   Earthwork and Site Clearing _____

   Asphalt Paving _____

   Landscaping _____

   Concrete Reinforcement _____

   Cast-In-Place Concrete _____

   Precast Hollow Core Slabs _____

   Precast Wall Panels _____

   Concrete Finishing _____

   Structural Steel _____

   Miscellaneous Metal _____

Sealants _____

Finish Carpentry/Millwork _____

Roofing and Sheet Metal _____

Metal Doors and Frames _____

Overhead doors _____

Glazing _____

Gypsum Drywall _____

Painting _____

Washroom Accessories _____

7. **SIGNATURE OF BIDDER:**

( ) ( )
(_____) (_____)
Name of Firm Signed By

( ) ( )
(_____) (_____)
Dated at This day of 2026

END OF APPENDIX "A"

1. Herewith is the list of Unit Prices to which reference is made on the submitted Tender Form, in Article 5:-

   OWNER: _____

   CONTRACTOR: _____

2. It is agreed and understood that the following Unit Prices as referred to in Articles GC 6.1, 6.2 and 6.3, CCDC 2, 2020 - Stipulated Price Contract and as supplemented for this project, will apply to changes to the Contract. Included in Unit Prices are materials, labour, equipment, delivery, handling, statutory charges, overhead and profit, and other related charges, and inclusive of all duties and taxes applicable, and similar charges on account of such work, measured complete in place.

3. In addition to the above, the undersigned agrees to submit, when requested by the Consultant, such other Unit Prices as the Owner may require for the purpose of establishing payment for adjustments to the Contract Amount on account of authorized additions or deductions to Work of the Contract. Such Unit Prices shall be based on prices submitted for the Work included in the Tender.

4. **UNIT PRICES**
   (including supply, installation and compaction, haulage and disposal)

MACHINE EXCAVATION:	Extra:____	Credit:____ per cu. m.
HAND EXCAVATION:	Extra:____	Credit:____ per cu. m.
COMPACTION:	Extra:____	Credit:
GRADING:	Extra:____	Credit:____ per cu. m.
BACKFILL		
a) Fill A	Extra:____	Credit:____ per cu. m.
b) Fill B	Extra:____	Credit:____ per cu. m.
c) Fill C	Extra:____	Credit:____ per cu. m.
d) Fill D	Extra:____	Credit:____ per cu. m.
e) Topsoil	Extra:____	Credit:____ per cu. m.
ASPHALT	Extra:____	Credit:____ per sq. m.
SOD	Extra:____	Credit:____ per sq. m.

FORMWORK:
(a) for foundation Extra:____ Credit:____ per sq. m.

(b) for footings Extra:____ Credit:____ per sq. m.

CONCRETE CAISSONS:
Excavate, reinforcing and concrete Extra:_____ Credit:_____ per m.

REINFORCING STEEL:
set in place Extra:____ Credit:____ per ton

CONCRETE IN PLACE:
25MPa excluding work Extra:____ Credit:____ per cu. m.

STRUCTURAL METAL:
as specified in Section 05 10 00 Extra:____ Credit:____ per pound

5. SIGNATURE OF BIDDER:

( ) ( )
(_____) (_____)
Name of Firm Signed By

( ) ( )
(_____) (_____)
Dated at This day of 2026

END OF APPENDIX "B"

1. Herewith is the list of Separate Prices to which reference is made on the submitted Tender Form, in Article 6,

   OWNER: _____

   CONTRACTOR: _____

2. It is agreed and understood that the following Separate Prices if accepted by the Owner will apply to the Contract and include materials, labour, equipment, delivery, handling, statutory charges, overhead and profit, and other related charges, and inclusive of all duties and taxes applicable, and similar charges on account of such work, measured complete in place.

3. The undersigned agrees that the Separate Prices submitted are valid and subject to acceptance by the Owner for a period of sixty (60) days from the Tender receipt.

4. **SEPARATE PRICES**

   : Separate Price No. 1:

   Supply and install elevator (shaft and hoist beam in base contract)

   _____ Dollars ($_____)
   Extra or Credit

   : Separate Price No. 2:

   Supply and install folding partition wall in Training Room (support beam and bulkhead in base contract)

   _____ Dollars ($_____)
   Extra or Credit

   : Separate Price No. 3:

   Supply and install crane runway beams (crane rail by crane supplier)

   _____ Dollars ($_____)
   Extra or Credit

5. SIGNATURE OF BIDDER:

( )	( )
(_____)	(_____)
Name of Firm	Signed By
( )	( )
(_____)	(_____)
Dated at	This day of 2026

END OF APPENDIX "C"

1. Herewith is the list of Alternate Prices to which reference is made on the submitted Tender Form, in Article 7:-

   OWNER: _____

   CONTRACTOR: _____

2. It is agreed and understood that the following Alternate Prices if accepted by the Owner will apply to the Contract and include materials, labour, equipment, delivery, handling, statutory charges, overhead and profit, and other related charges, and inclusive of all duties and taxes applicable, and similar charges on account of such work, measured complete in place.

3. The undersigned agrees that the Alternate Prices submitted are valid and subject to acceptance by the Owner for a period of sixty (60) days from the Tender receipt.

4. **ALTERNATE PRICES**

   : Alternate Price No. 1:

   _____ Dollars ($_____)
   Extra or Credit

   : Alternate Price No. 2:

   _____ Dollars ($)
   Extra or Credit

5. SIGNATURE OF BIDDER:

( )	( )
(_____)	(_____)
Name of Firm	Signed By
( )	( )
(_____)	(_____)
Dated at	This day of 2026

END OF APPENDIX "D"

1. Herewith is the list of Proposed Alternatives (Material Variations) to which reference is made on the submitted Tender Form, in Article 8:-

   to substitute for _____

   _____

   as specified in Section(s) _____ Specifications,

   the following alternatives: _____

   _____

2. The Proposed Alternative is submitted for the following reason:

   _____

   _____

3. We ensure that a comparison has been made of all specified characteristics, that the Proposed Alternative does not alter the intent of the Drawings and Specifications, and we hereunder tabulate significant variations which lessen the performance characteristics and quality of materials, increase the weights and/or dimensions, and substitute different materials for those specified.

For the Specified Project	For the Proposed Alternative
1.	:
2.	:
3.	:
4.	:

   (Attach cuts and engineering specification data if pertinent)

4. **T**he change to the Stipulated Sum tendered if the Proposed Alternative(s) is accepted is:

   1. _____ DOLLARS ($)
      EXTRA/CREDIT

2. _____ DOLLARS ($)
EXTRA/CREDIT

3. _____ DOLLARS ($)
EXTRA/CREDIT

4. _____ DOLLARS ($)

EXTRA/CREDIT

5. SIGNATURE OF BIDDER:

( ) ( )
(_____) (_____)
Name of Firm Signed By

( ) ( )
(_____) (_____)
Dated at This day of 2026

(SEAL)

END OF APPENDIX "E"

1. Herewith is the proposed critical path Construction Schedule to which reference is made on the submitted Tender Form, in Article 9:-

   OWNER: _____

   CONTRACTOR: _____

2. It is agreed that the following schedule has been thoroughly examined and will be maintained throughout the project in order to achieve the Completion date requested.

3. CRITICAL PATH SCHEDULE

4. SIGNATURE OF BIDDER:

( )	( )
(_____)	(_____)
Name of Firm	Signed By
( )	( )
(_____)	(_____)
Dated at	This day of 2026

END OF APPENDIX "F"

THE GENERAL CONDITIONS OF THE STIPULATED PRICE CONTRACT, STANDARD CONSTRUCTION DOCUMENT - CCDC 2 - 2020, shall be considered complete only as amended and supplemented by the following SUPPLEMENTARY GENERAL CONDITIONS.

GC 2.3 REVIEW AND INSPECTION OF THE WORK

Add the following new paragraph:-

2.3.6 The Contractor shall coordinate and incorporate all recommendations of the inspections performed by the Independent Inspection/Testing Agencies, who will be acting as the Consultant's/Owner's authorized agent, as noted in Section 01 21 00 Allowances of the Specifications.

GC 3.14 CLEANUP

Add the following new paragraph:-

3.14.4 The Contractor shall carry out a thorough professional cleaning of all surfaces, fixtures and equipment prior to Substantial Performance of the Contract and Owner Occupancy.

GC 5.1 FINANCING INFORMATION REQUIRED OF THE OWNER

Add the following new paragraphs:-

5.1.3 Reasonable disclosure, for the purpose of this Contract, shall be interpreted as pertaining only to the limits set forth for the Bond Amounts requested as they relate to the monies allotted for the Contract Agreement between the Owner and Contractor.

GC 5.2 APPLICATIONS FOR PROGRESS PAYMENT

Add the following new paragraphs:-

5.2.7 Applications for each payment after the initial request shall include a Statutory Declaration on a form acceptable to the Owner.

5.2.8 Applications for payment of Statutory Holdbacks shall include a Statutory Declaration, and other documents, i.e. Declaration of Completion of Contract, Declaration of Last Supply, as deemed necessary by the Owner.

GC 5.1 FINANCING INFORMATION REQUIRED OF THE OWNER

Add the following new paragraph:-

5.1.3 Reasonable evidence of financing shall only apply to the Stipulated Contract Price only and not be inclusive of any other agreements or arrangements made by the Owner for the Project. All costs incidental to and associated with requests for evidence of financing shall be paid for by the party making such requests.

GC 6.2 CHANGE ORDER

Add the following new paragraph:-

6.2.3 Changes involving an increase in the Contract Sum, evaluated in accordance with GC 6.1, GC 6.2, GC 6.3, GC 6.4, and 6.5, shall be calculated on the following basis:-

- Material cost will be the actual material cost. Labour rates will be the net hourly rates, plus the current fair wage burden currently followed locally.
- Contractors mark-up on General Contract work (completed by own forces) will be 10%
- Contractor's mark-up on Sub-Contractor's work will be 5%.
- Sub-Contractor's mark-up charged on their own work will be 10%.
- Main Sub-Contractor's mark-up on minor subtrade's work will be 5%.
- Contractor and Trade Contractors will not be entitled to charge a fee or charge for overhead and profit on credits to the Contract.

GC 8.2 NEGOTIATION, MEDIATION AND ARBITRATION

Add the following new paragraphs:-

8.2.9 Within five (5) 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:-

a) a copy of the Notice of Arbitration
b) a copy of Supplementary Conditions 8.2.9 to 8.2.15 of this Contract, and
c) 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 (10) 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:-

a) has a vested or contingent financial interest in the outcome of the arbitration;
b) gives the notice of election to the Owner and the Contractor before the arbitrator is appointed;
c) agrees to be a party to the arbitration within the meaning of the rules referred to in paragraph 8.2.6, and
d) agrees to be bound by the arbitral award made in the arbitration.

8.2.11 If the Consultant is not given the written notice required under paragraph 8.2.9, both the Owner and the Contractor are stopped 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 respondent 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:-

a) on application of the Owner or the Contractor, determine whether the Consultant has satisfied the requirement of paragraph 8.2.10, and
b) 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 the 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.

GC 11.1 INSURANCE

Add the following new paragraphs:-

11.1.6 The Contractor shall provide and maintain, in addition to all insurance as set out in General Conditions GC 11.1, a binder to his own policy jointly naming the Contractor, all Subcontractors, the Owner and all Consultants to include:-

a) The addition of Builders Risk and Collapse Factor to the basic coverage for both the existing, renovated, and new facilities for the duration of the Contract and be maintained for a period of twelve (12) months from the date of Substantial Performance of the Work.

END OF SECTION 00 04 01

1.1 DESCRIPTION OF WORK

.1 All Work described in the Specifications, Schedules, Drawings or referred to in the Contract Documents, shall be governed by the General Conditions & Supplementary General Conditions of the Stipulated Price Contract - CCDC 2-2020.

.2 All Work described in Division I includes, but is not restricted to, the following requirements for setting out procedures, administration, standards, approvals, general construction safety/protection of property and people.

.3 Work in these Specifications is divided into descriptive Sections which are not intended to indemnify absolute contractual limits between the Contractor and his Subcontractors, nor between Subcontractors or Suppliers. The Contractor shall be responsible for organizing all division of labour and supply of materials necessary and essential to complete the Project in all its parts, to provide a total enclosure and protection from weather of interior spaces, and as established in the General Conditions of the Contract.

2.1 WORK PERFORMED BY OWNER

.1 As specified in Section 00 10 20.

3.1 WORK COVERED BY CONTRACT DOCUMENTS

.1 Work of this Contract comprises the construction of all works required and as shown for a complete project, including but not limited to the following:-

.1 Stripping and stockpiling of topsoil from entire site.
.2 Cutting/filling/excavation and backfill of site for new structure.
.3 Backfill compaction of granular fill and asphalt paving for new apron, driveways and parking areas.
.4 Sodding, landscaping, concrete curbs, fencing, rough grading and finish grading of site.
.5 Storm sewer services including pipes, spillways, catchbasins, valves, etc.
.6 Water service for fire protection including hydrants, valves, thrust blocks and connections to existing service.
.7 Removal of all debris and excess excavated material from the site.
.8 All work as shown on the Drawings and as specified.
.9 Verification of existing bearing surfaces and building subgrade elevations prepared by other Contractors.
.10 Excavation and backfill for all foundations.
.11 Construction of all footings, foundation walls, and walls above grade.
.12 Backfill/compaction of granular under slab construction of electrical duct bank under slab and construction including finishing of

reinforced concrete slab on grade.

.13 Construction of conventional structure, roof and all connections to existing building.

.14 Construction of enclosing walls for conventional structure, separate price for elevator.

.15 Construction of all interior finishes, doors, frames, fittings and accessories.

.16 Connections to exterior site services, all mechanical and electrical services shown on drawings.

.17 Renovation, Demolition and Alterations to existing structures, as shown on the drawings.

4.1 SOILS INVESTIGATION

.1 A soils investigation of the site has been conducted by an Engineer and a report based on this investigation was prepared. They were prepared for guidance in design and are not a part of the Contract Documents. Neither the Project Manager nor the Owner assume responsibility for the scope, accuracy, or interpretation of the soil investigation report, but offer it only for estimating guidance. A copy of the soils report and bore hole log is available for viewing at the office of the Consultant.

.2 Notify the Project Manager should subsurface conditions differ from the soil investigation report. The Consultant will promptly investigate such conditions and if he finds that they differ materially resulting in either an increase or decrease in cost, an equitable adjustment shall be made to the contract based on either the unit prices as submitted with the Tender or a time and material basis as agreed to.

.3 Contaminated soil shall be dealt with under the terms of the General Conditions of the Contract. Should toxic or hazardous materials be unearthed, notify the Soils Testing Engineer and Consultant immediately, cease Work in the area and carry out containment, excavation and removal at the direction of the Engineer.

.4 The Contractor shall be responsible for variations in subsurface conditions to a maximum variation of $\pm$ 200 mm (8") in depth from conditions indicated on the drawings and soils report. Adjustments required for such variations shall be carried out at no cost increase to the Owner.

5.1 CODES REFERENCE STANDARDS, REGULATORY AGENCIES AND SPECIFICATIONS

.1 Perform all Work in accordance with current Ontario Building Code O. Reg. 163/24 and any other code of Provincial or local application, provided that, in any case of conflict or discrepancy, the more stringent requirements shall

apply and govern.

.2 Perform all Work in accordance with all requirements of the Construction Safety Act, latest edition, of the Province of Ontario, as well as all other applicable regulations of jurisdictional authorities.

.3 Meet or exceed requirements of contract documents, specified standards, codes and referenced documents.

.4 Remedial Work required to review and/or correct Work installed, covered, buried and not inspected shall be carried out at the Contractors expense.

.5 Unless the edition date is specified, consider that references to manufacturer's and published codes, standards and specifications are made to the latest edition, (revision) approved by the issuing organization, current at the date of this Specification.

.6 Reference standards and specifications are quoted in this Specification to establish minimum standards. Work which in quality exceeds these minimum standards shall be considered to conform.

.7 Should the Contract Documents conflict with quoted reference standards or specifications, the General Conditions of the Contract shall govern.

.8 Where reference is made to manufacturer's directions, instructions, inspections or specifications, they shall include full information on storing, handling, preparing, mixing, installing, erecting, applying, anchoring or other matters concerning the materials pertinent to their use and their relationship to materials with which they are incorporated.

6.1 DOCUMENTS REQUIRED

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

.1 Contract Drawings/Specifications/Addenda.
.2 Copy of Approved Current Work Schedule.
.3 Building Permit/Drawings. Construction Record Drawings.
.4 Field Instructions and Site Inspection Reports.
.5 Notices of Change and Change Orders.
.6 Reviewed, Stamped Shop Drawings and Schedule.
.7 Independent Inspection and Field Test Reports.
.8 Authority Inspection Permits, Reports and Certificates.

7.1 WORK SCHEDULE

.1 Provide to the Consultant, within ten (10) working days after Contract award, a construction schedule showing anticipated progress stages, sequencing, milestone dates, delivery dates and final completion of Work within time period required by Contract Documents.

.2 Provide to the Consultant, prior to the first Project Site Meeting a shop drawing schedule showing the discipline, received date, schedule required date, and status of each shop drawing to be provided.

.3 Provide updated schedules on an monthly basis to permit the Consultant to evaluate and communicate to the Owner the status of Work for future Progress Billing purposes.

8.1 SITE MEETINGS/PROGRESS RECORDS

.1 Interim monthly reviews of Work Progress, based on the current Work Schedule, will be conducted by the Project Manager, Consultants and Contractor and any necessary corrections to the schedule shall be noted and updated by Contractor in conjunction with all subtrades and suppliers to the satisfaction of the Consultant, Project Manager at least once every thirty (30) working days. Copies of the updated schedule shall be submitted to the Consultant, Project Manager for their review and comments.

9.1 APPROVAL OF WORK

.1 Where reference is made to jurisdictional authorities, it shall mean all authorities who have within their constituted powers the right to enforce the laws of the place of building.

.2 Where reference is made in these Specifications that Work is to proceed or to meet the approval of jurisdictional authorities, Consultant or others, such approval shall be in writing.

10.1 WORK DURING NON-BUSINESS HOURS

.1 The Contractor is cautioned that the Consultant, Project Manager and/or Sub-Consultants, cannot be committed to site attendance at the site except for normal working hours i.e. Monday to Friday 7:00 am to 6:00 p.m. excluding holidays. All and any Work performed during such times, requiring either the presence of the, Project Manager, Consultants, Owner or other Authorities, and carried out without their specific written prior approval, shall be performed solely at the General Contractor's responsibility.

.2 Notify the Consultant, Project Manager at least ninety-six (96) hours in advance of Work at night (7:00 p.m. to 6:00 a.m.) on weekdays, Saturdays, Sundays and Statutory or declared holidays. Undertake no work during the foregoing times without the Consultant's, Project Manager's written approval.

.3 The Contractor shall be responsible for and pay all costs for City of Hamilton Inspection Fees based on a Cost plus 15% administration fee, which are additional to the inspection fees paid, for all inspections which are carried out on weekdays after 6:00 p.m., Saturdays, Sundays, Statutory or declared holidays.

11.1 PROJECT COORDINATION

.1 Assume full responsibility for the coordination and cooperation of all trades.

.2 Employ a qualified superintendent who shall:-

.1 Be on the site at all times and control all Work throughout.
.2 Have full authority to act on the Consultant's instructions.
.3 Have full knowledge of Construction and this Project in particular.
.4 Not be changed without prior approval of the Consultant.

.3 Co-ordinate use of construction plant and equipment including cranes, hoists, ladders, scaffolds and similar items with the work of the various trades. The cost of such use is subject to whatever arrangement exists between Contractor and trades. Include all costs with respect to construction plant and equipment in the Contract Price.

.4 Co-ordinate all service terminations with appropriate Authorities.

12.1 WORKMEN, SUPPLIERS AND SUBCONTRACTORS

.1 Assign Work only to workmen, suppliers and Subcontractors who have complete knowledge, not only of the conditions of this Specification, but of jurisdictional requirements, reference standards and specifications, in particular of Transport Canada.

.2 Give preference to use of local workmen, suppliers and Subcontractors wherever possible.

13.1 COOPERATION AND COORDINATION OF SUBCONTRACTOR'S WORK

.1 Co-ordinate all construction components in each area and on which subsequent Work depends to facilitate mutual progress, and to prevent conflict between parts of the Work performed by all trades.

.2 The Contractor shall ensure that each of his Subcontractors make known to him, and to other Subcontractors, the environmental and surface conditions required for the execution of the Subcontractor's Work, and the sequence of other's Work required for installation of the Subcontractor's Work.

.3 The Contractor shall ensure that each Subcontractor, before he commences his Work, fully understands the site requirements and conditions preceding and subsequent to his Work, and that each Subcontractor execute his preparatory Work properly as required by the Subcontractors whose Work depends upon it.

.4 Subcontractors/Suppliers who give installation information in error, or too late to incorporate in the Work, shall be responsible for having any and all Work carried out which was thereby additionally made necessary to correct the situation.

.5 Remove Work which has been installed in error, incorrectly or substituted without approval and which is unsatisfactory for subsequent Work immediately at no additional expense to the Owner.

.6 The Contractor shall ensure that setting drawings, templates, and all other information necessary for the location and installation of materials, holes, sleeves, inserts, anchors, accessories, fastenings, connections, and access panels are provided by each Subcontractor whose Work requires co-operative location and installation by other Subcontractors.

.7 Schedule delivery of materials, supplied by one Subcontractor to be installed by another, well in advance of commencement of the installation.

14.1 CONTRACTOR'S USE OF SITE

.1 Do not unreasonably encumber site with materials or equipment. Remove all materials from site as they accumulate daily.

.2 Use of site is limited and restricted to the areas for work and storage as shown on the drawings and as designated by the Consultant.

.3 Restore, at completion of Work, all adjacent property, surfaces, sidewalks, etc. to original condition of commencement of work to satisfaction of the Consultant.

15.1 ACCESS TO SITE

.1 The Contractor shall direct and control access and delivery of all construction materials and equipment onto and within the site. He shall provide flagmen and guards as required.

.2 The Contractor shall be completely responsible for delivery vehicles, and materials and equipment while they are on the site, and shall pay all costs for their immediate removal or relocation should they impede the access of others.

16.1 PARKING

.1 Parking shall be allowed only with the prior approval and in authorized areas as agreed to and directed by the Consultant.

17.1 ACCESS FOR EQUIPMENT

.1 Fitments and other equipment shall be made up in sections of such size as can be easily transported in and through the building to the final location without alteration or damage to the building.

.2 Should it become necessary at any time during the execution of the Work to move materials and/or equipment which have been temporarily placed, when so directed by the, make arrangements with those who are furnishing such materials and equipment to move them or cause them to be moved to a different location as directed without additional charge.

18.1 SETTING OUT OF WORK

.1 The Contractor shall establish necessary lines, levels, and provide batter boards or other means to control the accurate positioning of all elements of work.

.2 The Contractor shall verify all existing grades, property lines and levels shown on the Drawings.

.3 Before commencing installation of Work, verify that it is laid out accurately in accordance with intent of Drawings

.4 and that positions, levels and clearances to adjacent Work are maintained. If Work is installed in wrong location, rectify it before construction continues.

.5 The Contractor shall furnish to the Consultant, certification from a licensed Ontario Land Surveyor that the Building and other parts of the work are located in accordance with the Contract requirements. Setting out of Work shall be in conformity with the Municipal Setback requirements. The Surveyor's Certification shall represent an independent and disinterested verification of the Contractor's layout work. The Surveyor shall promptly verify and certify the lines and levels of any part of the work at any time it may be deemed necessary by the Consultant. Any deviation from the drawings shall be reported to the Consultant in writing within twenty-four (24) hours of discovery.

19.1 EXAMINATION OF SITE BEFORE EXECUTION OF WORK

.1 Examine site, and ensure that each Subcontractor whose Work is related to site conditions has examined it, so that all are fully informed on all particulars, which affect Work thereon and at the place of building, and in order that construction proceeds competently and expeditiously.

.2 Examine completed Work, Work in progress, and Work yet to be carried out by others under other Sections of the Specifications.

.3 Verify dimensions of completed Work in place before fabrication of Work to be incorporated with it.

.4 Verify that previously executed Work and surfaces are satisfactory for installation or application, or both and that performance of subsequent Work will not be affected. Commencement of Work shall constitute acceptance of site conditions and surfaces as satisfactory.

.5 Report to Consultant any and all defects in previously completed Work which will affect the scheduling and quality of all subsequent Work.

.6 No allowance will be made for difficulties encountered in the Work which were in existence or could have been anticipated at the time the Work was tendered.

.7 No allowance will be made for difficulties encountered in the Work which are a result of the lack of co-operation/co-ordination on the part of the Contractor of any of his Trades or Suppliers.

20.1 PROTECTION OF WORK, PROPERTY AND PERSONS

.1 Work shall include necessary methods, materials and construction to ensure that no damage or harm to Work, materials, property and persons results from the Work of this Contract. Temporary facilities relating to protection are specified in Section 01 50 00. Schedule the work so that security and safety is maintained at all times.

.2 Keep excavations Work free of water at all times. Pump dry as required.

.3 Remove snow and ice immediately from building. Carefully remove snow and ice from all finished roof areas.

.4 Keep surfaces on which finish materials will be applied free from grease, oil and other contamination which would be detrimental in any way to the application of finish materials.

.5 Protect finish surfaces of completed Work from damage by restriction of access or by use of physical means suitable to the material and surface location. Establish with each Subcontractor the suitability of such protection in each case.

.6 Give constant close supervision to roofing following installation, during the time they are temporarily protected or exposed to ensure that no damage occurs to them before completion of building. Provide protection especially against damage from traffic or Work performed on top of completed roofing when temperature is over 80^{o}F.

.7 Locate, identify and protect existing services from damages. If necessary, relocate active services to ensure that they function continuously in safety and without risk of damage. Any damage caused to existing services and/or property shall be made good at the Contractor's expense.

.8 Do not damage landscaped areas by piling of surplus soil over them, by dumping of debris over them or compacting the soil within the drip line of the trees/shrubs.

.9 Special precautions to be taken to protect all existing planting on the site. Do not damage or cut root systems of existing trees; stockpile any surplus material over them or use trees for anchorage. Remove only those trees or shrubs which are designated to be removed and/or replanted. Protect, and if damaged make good, adjacent property.

.10 Assume full responsibility for the provision of all protection against rain, wind, snow, ice, storms, frost, heat and vandalism so as to maintain work area free from injury or damage.

.11 Cease work and notify the Consultant if low temperatures make it impossible to continue operations safely in spite of cold weather precautions.

.12 Notify the Consultant should the job be closed down for any reason and assume full responsibility, for providing adequate protection, security, etc. during the shutdown.

.13 The Contractor is cautioned to use appropriate demolition methods in order to fully protect all existing structure. Do not carry out any work in a manner that will endanger any structural members, services.

.14 Take all necessary precautions to protect the occupants, the public, passersby and adjoining property against flying dust and debris.

21.1 FIRE PREVENTION AND SAFETY

.1 The Contractor shall enforce fire protection methods of good housekeeping, and adherence to local and underwriter's fire regulations. Provide ULC approved fire extinguishers, and other fire fighting services and equipment except where more explicit requirements are specified as the responsibility of individual Subcontractors.

.2 Maintain clear emergency exit paths for personnel at all times.

.3 Use only fire resistant tarpaulins and similar protective covering on site.

.4 Ensure that each Subcontractor stores his volatile waste in approved closed containers and removes them from premises daily.

22.1 PUBLIC PROTECTION

.1 When necessary, the Contractor must post a flagman who will be responsible for safety and direction of pedestrian traffic past the site.

.2 Maintain existing exiting routes and access from the existing premises.

23.1 PROVISIONS FOR TRAFFIC

.1 Particular effort shall be applied to the safety of pedestrian flow past the site. Any activity which has potential for interference with pedestrian flow shall first be approved by the Consultant. Provide temporary guide barriers, signage and flagmen as required for safe and efficient control of pedestrian flow.

24.1 MUD TRACKING

.1 The Contractor shall take all steps necessary to prevent the tracking of mud beyond the site and assume all responsibilities for the tracking of mud, dirt and debris resulting from his operations, beyond the site and shall pay all costs necessary for the clean-up resulting from this operation.

25.1 DUST CONTROL

.1 The Contractor shall take such steps as may be required to prevent dust nuisance resulting from his operations from spreading beyond the site.

.2 Where the work requires the sawing of asphalt or the sawing or grinding of concrete, blades and grinders of the wet type shall be used together with sufficient water to prevent the incidence of dust. The cost of all such preventative measures shall be borne by the Contractor.

26.1 SECURITY

.1 The contractor shall provide secure, solid closures to any opening which will not be able to be closed in with the new construction due to any circumstances which may arise.

.2 Ensure that the site security is operating at all times construction is proceeding and that the temporary site enclosure is secured at the end of each days work.

27.1 SALVAGE AND DISPOSAL

.1 Items of antiquity, including coin, art, anthropology, etc. which are on the site at the time of signing of Contract, which are uncovered or unearthed during the construction, shall remain the property of the Owner and shall be turned over to him immediately and without prejudice.

.2 Unless otherwise specified, salvaged material which will not to be reused within the new construction, surplus materials and construction debris shall become property of Contractor. The Contractor shall pay all associated costs and arrange for the safe removal and disposal away from site.

28.1 LOADING OF BUILDING

.1 No one shall store materials in building or utilize it for construction purposes in any manner which would exceed design loading on any building element.

.2 Temporarily support or strengthen parts of the structure subjected to excessive loads during construction.

.3 Place loads on concrete slabs and members only after they have cured as required by this Specification and when approved by the Consultant.

29.1 LOCATION OF APPARATUS

.1 The location of apparatus, fixtures, outlets, etc., shown or specified shall be considered as only approximate. The actual locations shall be as directed and as required to suit the conditions at the time of installation. Before installation the Contractor shall notify the Consultant and ascertain the actual desired final location required. The Consultant shall have the right to change these locations without change to the Contract Sum providing the distance moved does not exceed 3000 mm (10'-0") and the information is given before the installation is made.

30.1 FASTENINGS

.1 Work of each Subcontractor shall include necessary fastenings, anchors, inserts, attachment accessories and adhesives. Where installation part of Work of other Subcontractor, locate devices and co-operate with them as required.

.2 Do not use fastenings which cause spalling or cracking of materials in which installed.

.3 Install metal-to-metal fastenings fabricated of the same metal, or of a metal which will not set up electrolytic action causing damage to fastenings or components, or both, under moist conditions. Use only non-corrosive, galvanized steel or stainless steel fastenings.

.4 Install Work with fastenings or adhesives in sufficient quantity to provide permanent secure anchorage of materials, constructions, components and equipment. Space anchors within limits of load-bearing or shear capacity.

.5 Space exposed fastenings evenly and in an organized pattern. Keep number to a minimum. For exposed fastenings use metal of same material, texture, colour and finish as metal on which they occur.

31.1 CONCEALMENT OF PIPES, DUCTS AND WIRING

.1 Conceal all pipes, ducts and wiring in floor, wall and ceiling construction of finished areas wherever possible. If any doubt arises as to the means of concealment, or the intention of the Contract Documents in this connection, request clarification from the Consultant before proceeding with that portion of the Work.

.2 Where necessary, mechanical and electrical Work shall be laid out well in advance of concrete pouring and furring erection so that provision may be made for proper concealment. All such Work shall be tested, inspected and pipe covering applied where applicable before being concealed.

32.1 CUTTING, FITTING, PATCHING AND REPLACEMENT

.1 Before cutting, drilling or sleeving of any structural load-bearing elements within the project, obtain the Consultant's approval. Do not endanger Work or property by cutting, digging or similar activities. Do not cut or alter the Work of others unless approved by the Consultant, Sub-Consultant or Sub-Contractor whose Work is being altered.

.2 Cutting, drilling, sleeving and patching of Work shall be done by the Subcontractor whose trade Section corresponds to the Work requiring cutting, and where located by Subcontractor who requires the Work

performed for his installations; all under the direct supervision of the Contractor.

.3 Replacement of damaged Work shall be done by the Subcontractor whose trade Section corresponds to the Work requiring patching or replacement, at the expense of the Subcontractor who causes the damage. Cut and drill with true smooth edges, and to minimal, suitable tolerances.

.4 Patching of damaged Work shall be done by the General Contractor and it shall be his responsibility to ensure the remedial Work is carried out expeditiously, and at no expense to the Owner and to the satisfaction of the Consultant. Make patches invisible in final assembly.

.5 Fit construction tightly to ducts, pipes and conduits to stop air movement completely. The Subcontractor whose Work penetrates an element of the building shall ensure that no movement will affect his Work, the joint is sealed and is the element is a fire separation he shall be responsible for maintaining the separation in an approved manner.

33.1 EXISTING SERVICES

.1 Where Work involves capping/cutting or relocation of existing services, carry out work at times directed by governing authorities.

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

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

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

.5 Record location of all new, capped or abandoned site services accurately on "Construction Record Drawings".

.6 All rough-in to point of equipment connection is to be carried out by the Mechanical and Electrical Contractors as part of the General Contract for the Work. This Contractor shall be responsible for setting of the equipment in place and ensuring that all electrical and mechanical connections to this equipment is carried out correctly and as required by the equipment manufacturer.

.7 Final connection to equipment will be carried out under the Work of the General Contract for the Building Alteration and Addition.

.8 Do not interrupt existing services except as approved by the Consultant. Give the Consultant or governing authority seven (7) days clear notice of intention to interrupt existing services.

.9 In the event existing services are uncovered or disrupted accidentally, make complete restoration on a priority basis and provide adequate protection to avoid further disruption until diversion or alternative arrangements are made.

34.1 DRAINAGE

.1 The Contractor shall ensure that positive drainage is provided to gravel and concrete walkways and asphalt paving, as set in their final positions. Provide constant slopes for drained surfaces to drains and drainage courses.

.2 Provide temporary grading as required to give positive drainage away from building to prevent water damage during the course of construction.

.3 Verify the extent of each area served by a drain, or drainage course, to eliminate possible undrained surfaces. Co-ordinate the Work of involved Subcontractors before each proceeds.

35.1 CLEANING

.1 Each Subcontractor shall clean and remove from his finished Work all stains, soiling, markings, labels, scratches, spatters, droppings, and debris. He shall leave his Work and adjacent finished Work in new condition.

.2 Ensure that only cleaning materials are used which are recommended for the purpose by both the manufacturer of the surface to be cleaned and of the cleaning material.

.3 No debris, waste or excess material shall be burned or buried at site. Ensure that volatile fluid wastes are not disposed of in storm or sanitary sewers or in open drain courses. Do not allow waste material and debris to accumulate in an unsightly or hazardous manner. Provide containers in which to collect waste material and debris. Sprinkle dusty accumulations with water.

.4 Ensure that cleaning operations are scheduled to prevent dust or other foreign matter affecting surfaces which are wet or tacky.

.5 Each Subcontractor shall supply the Contractor with instructions for final cleaning of his Work, and for inclusion in Project Data Book as more exactly specified in each trade Section and in Section 01 70 00.

.6 Ensure that cleanup is carried out daily to provide a neat, orderly and safe site for all personnel working on the site.

.7 The final project cleanup and cleaning of all components shall be carried out by the Contractor in accordance with Section 01 70 00 - Project Closeout.

END OF SECTION 00 10 05

1.1 GENERAL CONDITIONS

.1 Work specified, shown on the Drawings or referred to in the Contract Documents, is governed by the General Conditions and Supplementary General Conditions.

.2 The Owner supplied equipment and items of Work, noted in these specifications and/or shown on the drawings, shall be incorporated into the Work of this Contract. This Contractor shall be responsible for, as part of his contract, the co-ordination of rough-in and completion of these items of Work as they affect his Contract and scheduling. The Owner shall be responsible for approvals, payment and delivery of this portion of the Work and shall notify the Contractor of any changes in status which may affect his scheduling for the entire project.

2.1 WORK PERFORMED BY OWNER

.1 Complete construction of the north park lot addition.

.2 Telephone system and equipment, wiring and connection supplied and installed by the Owner. This contractor shall provide all rough-in co-ordination, empty conduit, junction boxes, and outlets c/w fishwire as specified under Division 16.

.3 Alarm system equipment, wiring and connection supplied and installed by the Owner. This contractor shall provide all rough-in co-ordination, empty conduit, junction boxes, and outlets c/w fishwire as specified under Division 16.

.4 LAN Drop System rack, wiring supplied and installed by the Owner. This contractor shall provide all rough-in co-ordination, empty conduit, junction boxes, and outlets c/w fishwire as specified under Division 26.

.5 Clocks are supplied by the Owner. This Contractor shall provide all conduit, wiring, outlet boxes and installation.

.6 Microwave and refrigerator in Staff Room and conference room supplied by Owner. This Contractor shall provide all conduit, wiring, outlet boxes and installation.

.7 Complete sprinkler system installation to be coordinated by Bidder as well as construction of connection point

.8 Overhead gantry cranes and crane rails.

END OF SECTION 00 10 20

1.1 GENERALLY

.1 Perform all Work in or on existing building in accordance with the Specifications and Architectural, Structural, Mechanical and Electrical Drawings and by tradesmen specializing in such work.

.2 It is to be emphasized that all Work be performed to ensure the integrity of the design and original materials of the existing facility is to be maintained.

2.1 OWNER'S USE OF EXISTING BUILDING

.1 The entire facility will remain in complete operation during the renovation/addition phases of the project. The Contractor, in conjunction with the Consultant and Owner, will develop a phasing sequence of the Work that permits, so far as is practical, the normal operation of the facility. The phasing requirements shall be as defined by written description and/or schematic diagram in the Contract Documents.

.2 The Owner shall be permitted to work within the existing building without hindrance or restrictions. No construction work will take place during the normal operating hours of the facility, which are listed in the Instructions to Bidders, unless instructed otherwise.

.3 The Owner shall have full authority to restrict access and control security to the site and throughout the entire facility. Existing service and delivery accesses are to remain operational at all times during construction.

3.1 CONTRACTOR'S USE OF EXISTING BUILDING

.1 Execute work in existing building at times approved and as mutually agreeable to Owner. Prepare a schedule and give Owner sufficient notice of intention to commence work in a room or area of existing building so that he may prepare the space and determine time work may commence.

.2 Maintain access to service and delivery entrances for use by the Owner. Maintain existing exits to provide proper and safe means of egress from all parts of existing building to open spaces at all times to the approval of the Consultant and jurisdictional authorities. Provide sufficient illumination and exit lights.

.3 Prohibit use of existing washrooms and services in building by construction personnel unless approved by the Consultant.

.4 The Contractor shall coordinate work and make all necessary arrangements with the Owner's security force to ensure that security of the building and control of access by construction personnel are maintained while work is in

progress. All costs for additional security shall be paid for by the Contractor.

.5 The Contractor shall control and limit access of construction personnel to all areas of the existing building and ensure that construction personnel perform work only as required under the Contract and not as access to other work areas, any other purposes.

.6 The Contractor shall maintain all existing heating, air conditioning, ventilation, fire alarm and sprinkler protection, and emergency lighting at levels normal for office requirements throughout the facility during normal business hours for the Owner.

.7 No construction work causing oppressive noise, dust, fumes or hazards within the existing facility shall be carried out during business hours without the installation of temporary enclosures and the approval of the Owner. Execute all work as quietly as possible to achieve least disturbance to Owner.

4.1 PROTECTION

.1 Provide temporary dust screens and security separation at all times, to the Consultant's and Owner's satisfaction, between the Contractor's work area and the remaining operating portion of the facility and as shown on the drawings.

.2 Provide temporary, weathertight, dust tight and lockable partitions between existing building and all new Work. Weatherproof openings made in walls and roofs of existing building, immediately they are opened.

.3 Protection of existing building elements, in particular roofs, air barriers and waterproofing membranes shall be substantial enough to prevent any damage as a result of traffic over, or falling objects penetrating them.

.4 Protection of all property shall include but not be limited to equipment, furniture plantings, walkways and adjacent property other similar items whether included and noted on the drawings or not. Take all precautions to ensure that no structural damage is caused to the existing building and adjacent structures by demolition and alteration work, or by new construction.

5.1 REMOVAL OF EXISTING WORK AND SALVAGE

.1 Ensure during removal that materials, components and similar items to be reused are protected from damage. Provide all necessary supports,

wrappings and other means to protect surfaces, materials and components that are to be removed or remain in place.

.2 Relocation of existing equipment shall be carried out and co-ordinated by this Contractor unless noted otherwise. The Contractor shall ensure that all material and tradesmen necessary for the disconnection and reconnection of equipment to be removed and/or relocated, either by the Contractor or the Owner, shall be present at all times during this Work and shall have available all material necessary to complete the work.

.3 Remove carefully all building elements, components, materials, and equipment noted to be relocated by the Specifications and drawings. Store and protect relocated items until built into new locations. Limit removal of items to smallest areas possible, and make good disturbed adjacent surfaces.

.4 Remove debris and accumulated dirt from existing building immediately as it accumulates. Ensure that during removal operations through the existing building that existing work is not damaged and dirt, debris and dust are not spread.

.5 Maintain work areas in existing building constantly broom clean to avoid tracking of dirt into adjacent areas. Immediately clean up debris resulting from work of Contract that is deposited in existing building outside of work areas. Make a daily inspection to ensure that work and construction access areas are maintained clean and undamaged as specified.

.6 Carry out all cutting, fitting, patching, and replacement of existing components carefully in a manner to provide the least disturbance to all existing finished surfaces.

6.1 SHUTDOWNS AND CONNECTIONS TO EXISTING SERVICES

.1 Provide the Owner with a preliminary schedule of shutdowns of mechanical and electrical services prior to commencement of the work. Shutdowns shall be scheduled for normal working hours to cause minimum interference with normal building operations. After hours shutdowns shall take place no additional cost to the Owner. In no case shall service interruptions affect the total building.

.2 Notification of any interruption or shutdown of any mechanical or electrical service shall be made in writing by the Contractor to the Consultant accompanied by a sketch or full details of the proposed interruption at least two (2) weeks in advance of such interruption.

.3 Temporary and permanent mechanical or electrical services connections are to be made only in consultation with the appropriate governing authority and by prior arrangement. Restore all services to original condition unless specified otherwise.

7.1 REPLACEMENT WORK

.1 Make good materials, and prepare surfaces and repair all existing and new finished surfaces damaged, or disturbed in the existing building.

.2 Finish new surfaces flush with existing surfaces. Make junctions between existing and new or remedial work invisible. Make surfaces adjacent to one another of the same material, unit sizes, colour and texture. Review intended methods of making good with the Consultant prior to commencement of Work.

END OF SECTION 00 10 30

1.1 CONTRACT DOCUMENTS

.1 Work will be performed under one contract; bound by the Agreement between Owner and Contractor, Canadian Standard Construction Document - CCDC 2-2020 Stipulated Price Contract.

.1 GENERAL CONDITIONS

.1 The General Conditions of the Stipulated Price Contract, Standard Construction Document - CCDC 2-2020, and the Supplementary General Conditions, Section 00 04 01 shall form an integral part of this Specification.

2.1 GENERAL REQUIREMENTS

.1 All provisions of each Section of Division 1 shall apply to all other Divisions and Sections of the Specification.

3.1 OTHER CONTRACTORS

.1 Provisional work on this project, as noted below, shall be coordinated by this Contractor within the Work of his Contract.

.2 Interpretation of the limits of all Provisional work shall be the responsibility of the Consultant.

END OF SECTION 01 11 00

1.1 GENERALLY

.1 Perform all Work in or on existing building in accordance with the Specifications and Drawings and by tradesmen specializing in such work.

.2 It is to be emphasized that all Work be performed to ensure the integrity of the design and original materials of the existing facility is to be maintained.

2.1 OWNER'S USE OF EXISTING BUILDING

.1 The facility will remain open at all times. Staff will continue to attend the site full time in the facility. As such, the contractor shall limit his work to the areas defined by the Work.

.2 Accommodations must be made to allow access to staff and possibly external contractors in order to maintain operation to the rest of the facility. In emergency situations the Contractor may need to work in occupied areas within the existing facility.

3.1 CONTRACTOR'S USE OF EXISTING BUILDING

.1 Execute work in existing building at times approved and as mutually agreeable to Owner. Prepare a schedule and give Owner sufficient notice of intention to commence work in a room or area of existing building so that he may prepare the space and determine time work may commence.

.2 Maintain access to service and delivery entrances for use by the Owner. Maintain existing exits to provide proper and safe means of egress from all parts of existing building to open spaces at all times to the approval of the Consultant and jurisdictional authorities. Provide sufficient illumination and exit lights.

.3 Prohibit use of existing washrooms and services in building by construction personnel unless approved by the Consultant.

.4 The Contractor shall coordinate work and make all necessary arrangements with the Owner's security force to ensure that security of the building and control of access by construction personnel are maintained while work is in progress. All costs for additional security shall be paid for by the Contractor.

.5 The Contractor shall control and limit access of construction personnel to all areas of the existing building and ensure that construction personnel perform work only as required under the Contract and not as access to other work areas, any other purposes.

.6 The Contractor shall maintain all existing heating, air conditioning, ventilation, fire alarm and sprinkler protection, and emergency lighting at levels normal for office requirements throughout the facility during normal business hours for the Owner.

.7 No construction work causing oppressive noise, dust, fumes or hazards within the existing facility shall be carried out during business hours without the installation of temporary enclosures and the approval of the Owner. Execute all work as quietly as possible to achieve least disturbance to Owner.

4.1 PROTECTION

.1 Provide temporary dust screens and security separation at all times, to the Consultant's and Owner's satisfaction, between the Contractor's work area and the remaining operating portion of the facility and as shown on the drawings. Provide full coverings to all windows overlooking work area for the duration of the work.

.2 Provide temporary, weather tight, dust tight and lockable partitions between existing building and all new Work. Weatherproof openings made in walls and roofs of existing building, immediately they are opened.

.3 Protection of existing building elements, in particular roofs, air barriers and waterproofing membranes shall be substantial enough to prevent any damage as a result of traffic over, or falling objects penetrating them.

.4 Protection of all property shall include but not be limited to equipment, furniture plantings, walkways and adjacent property other similar items whether included and noted on the drawings or not. Take all precautions to ensure that no structural damage is caused to the existing building and adjacent structures by demolition and alteration work, or by new construction.

5.1 REMOVAL OF EXISTING WORK AND SALVAGE

.1 Ensure during removal that materials, components and similar items to be reused are protected from damage. Provide all necessary supports, wrappings and other means to protect surfaces, materials and components that are to be removed or remain in place.

.2 Relocation of existing equipment shall be carried out and co-ordinated by this Contractor unless noted otherwise. The Contractor shall ensure that all material and tradesmen necessary for the disconnection and reconnection of equipment to be removed and/or relocated, either by the Contractor or the Owner, shall be present at all times during this Work and shall have

available all material necessary to complete the work.

.3 Remove carefully all building elements, components, materials, and equipment noted to be relocated by the Specifications and drawings. Store and protect relocated items until built into new locations. Limit removal of items to smallest areas possible, and make good disturbed adjacent surfaces.

.4 Remove debris and accumulated dirt from existing building immediately as it accumulates. Ensure that during removal operations through the existing building that existing work is not damaged and dirt, debris and dust are not spread.

.5 Maintain work areas in existing building constantly broom clean to avoid tracking of dirt into adjacent areas. Immediately clean up debris resulting from work of Contract that is deposited in existing building outside of work areas. Make a daily inspection to ensure that work and construction access areas are maintained clean and undamaged as specified.

.6 Carry out all cutting, fitting, patching, and replacement of existing components carefully in a manner to provide the least disturbance to all existing finished surfaces.

6.1 SHUTDOWNS AND CONNECTIONS TO EXISTING SERVICES

.1 Provide the Owner with a preliminary schedule of shutdowns of mechanical and electrical services prior to commencement of the work. Shutdowns shall be scheduled for normal working hours to cause minimum interference with normal building operations. After hours shutdowns shall take place no additional cost to the Owner. In no case shall service interruptions affect the total building.

.2 Notification of any interruption or shutdown of any mechanical or electrical service shall be made in writing by the Contractor to the Consultant accompanied by a sketch or full details of the proposed interruption at least two (2) weeks in advance of such interruption.

.3 Temporary and permanent mechanical or electrical services connections are to be made only in consultation with the appropriate governing authority and by prior arrangement. Restore all services to original condition unless specified otherwise.

7.1 REPLACEMENT WORK

.1 Make good materials, and prepare surfaces and repair all existing and new finished surfaces damaged, or disturbed in the existing building.

.2 Finish new surfaces flush with existing surfaces. Make junctions between existing and new or remedial work invisible. Make surfaces adjacent to one another of the same material, unit sizes, colour and texture. Review intended methods of making good with the Consultant prior to commencement of Work.

END OF SECTION 01 14 00

1.1 GENERALLY

.1 Cash allowances specified shall be carried, administered and coordinated by the General Contractor as part of the Work of his Contract.

.2 Include the General Contractor's charges for overhead and profit, on account of all Cash Allowances as specified, in the Contract Price in accordance with the General Conditions of the Stipulated Price Contract. Article GC 4.1 Cash Allowances and Article GC 4.2 Contingency Allowance.

.3 Include with each expenditure from the appropriate Allowances, all applicable taxes as specified in the General Conditions of the Stipulated Price Contract, Article GC 10.1 - Taxes and Duties. HST is extra to the amounts carried for this work.

.4 List all Allowances separately on each and every billing and expend Allowances only on the Consultant's agreement and written instructions.

.5 Credit the Owner with unused portion of all Allowances in statement of reconciliation prior to the final billing for the project. The Consultant will issue a final Change Order to cover this payment.

2.1 CONSTRUCTION CONTINGENCY ALLOWANCE

.1 Include in your tender a Construction Contingency Allowance to cost and perform additional Work as directed by the Consultant and Owner.

A Cash Allowance of Two Hundred Thousand Dollars ($200,000.00).

3.1 CASH ALLOWANCES

.1 For Inspection and Testing Services Specified for:

Section 31 01 00 : Earthworks

A Cash Allowance of Eight Thousand Dollars ($15,000.00).

.2 For Inspection and Testing Services Specified for:

Section 03 30 00 : Cast-in-Place Concrete
Section 32 12 00 : Base, Ballast and Paving

A Cash Allowance of Ten Thousand Dollars ($10,000.00).

.3 For Inspection and Testing Services Specified for:

Section 05 10 00 : Structural Metal Framing
Section 05 30 00 : Metal Decking

.4 For Inspection and Testing Services Specified for:

Section 07 52 00 : Modified Bitumen Roofing

A Cash Allowance of Forty Thousand Dollars ($6,000.00).

.5 For supply of hardware:

Section 08 71 00 : Door Hardware

A Cash Allowance of Forty Thousand Dollars ($40,000.00).

.6 For commissioning

Division 15 : Mechanical

A Cash Allowance of Forty Thousand Dollars ($40,000.00).

END OF SECTION 01 21 00

1.1 GENERALLY

.1 Specified prices shall be complete for the applicable work including statutory charges, overhead and profit, all duties and taxes imposed, and other related charges on account of such work.

2.1 PROVISIONAL ITEMS

.1 Provisional prices as noted below are to be included on the Form of Tender, shall be based on the Scope of Work described in the specifications and are to include for labour, material, delivery, handling, storage, overhead and profit and taxes of such Work measured complete in place. Expressed as an extra or credit to the sum tendered, they shall be used in calculation of the Contract Amount consistent with their acceptance or rejection by the Owners.

.2 The Provisional Prices requested are as follows:

.1 Provisional Price No. 1

Elevator – supply and installed

.2 Provisional Price No. 2

Supply and install folding partition in Training Room.

.3 Provisional Price No. 3

Supple and install crane runway beams.

END OF SECTION 01 22 00

1.1 DESCRIPTION OF WORK

.1 All Work described in the Specifications, Schedules and Drawings or referred to in the Contract Documents, shall be governed by the General Conditions & Supplementary General Conditions of the Stipulated Price Contract - CCDC 2-2020.

.2 All Work described in Division I includes, but is not restricted to, the following requirements for setting out procedures, administration, standards, approvals, general construction safety/protection of property and people.

.3 Work in these Specifications is divided into descriptive Sections which are not intended to indemnify absolute contractual limits between the Contractor and his Subcontractors, nor between Subcontractors or Suppliers. The Contractor shall be responsible for organizing all division of labour and supply of materials necessary and essential to complete the Project in all its parts, to provide a total enclosure and protection from weather of interior spaces, and as established in the General Conditions of the Contract.

2.1 WORK PERFORMED BY OWNER

.1 As specified in Section 00 10 20.

3.1 WORK COVERED BY CONTRACT DOCUMENTS

.1 Work of this Contract comprises the construction of all works required and as shown for a complete project, including but not limited to the following:

<u>Base Bid</u>
The base bid will include shown on the drawings.

Work includes (but not limited to):
- Excavation and removal of soil overburden
- Caisson footings and grade beams
- Granular backfill under floor slab
- Structural steel framing and roof
- Precast exterior wall panels
- Roofing
- New elevator (provisional)
- Interior partitions and mezzanine
- Site services
- New grading and pavement
- Landscaping
- New entrance
- Mechanical and electrical

Work under Provisional Prices is described as follows. Refer to drawings for full extent of the work under each item:

Provisional Items

The following work is provisional, based on funding and Council approval

Provisional Price No. 1
Elevator

Work includes:
- Supply and install all components of new elevator
- Elevator block shaft, footings and hoist beam to be included in base bid

Provisional Price No. 2
Folding partition in Training Room

Work includes:
- Supply and installation of folding partition and all related hardware
- Support beam and bulkhead to be included in base bid

Provisional Price No. 3
Crane runway beams

Work includes:
- Supply and install steel runway beams
- Crane and rails to be provide by owner

4.1 SOILS INVESTIGATION

.1 A soils investigation of the slab area was been completed (and is included in these tender documents).

.2 Contaminated soil shall be dealt with under the terms of the General Conditions of the Contract. Should toxic or hazardous materials be unearthed, notify the Soils Testing Engineer and Consultant immediately, cease Work in the area and carry out containment, excavation and removal at the direction of the Consultant.

.3 The Bidder shall make allowances in his schedule for material testing. The Bidder will not be compensated for lost time of waiting time while testing and/or decisions are being made.

5.1 CODES REFERENCE STANDARDS, REGULATORY AGENCIES AND SPECIFICATIONS

.1 Perform all Work in accordance with all requirements of the Construction Safety Act, latest edition, of the Province of Ontario, as well as all other applicable regulations of jurisdictional authorities.

.2 Meet or exceed requirements of contract documents, specified standards, codes and referenced documents.

.3 Remedial Work required to review and/or correct Work installed, covered, buried and not inspected shall be carried out at the Contractors expense.

.4 Unless the edition date is specified, consider that references to manufacturer's and published codes, standards and specifications are made to the latest edition, (revision) approved by the issuing organization, current at the date of this Specification.

.5 Reference standards and specifications are quoted in this Specification to establish minimum standards. Work which in quality exceeds these minimum standards shall be considered to conform.

.6 Should the Contract Documents conflict with quoted reference standards or specifications, the General Conditions of the Contract shall govern.

.7 Where reference is made to manufacturer's directions, instructions, inspections or specifications, they shall include full information on storing, handling, preparing, mixing, installing, erecting, applying, anchoring or other matters concerning the materials pertinent to their use and their relationship to materials with which they are incorporated.

6.1 DOCUMENTS REQUIRED

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

.1 Contract Drawings/Specifications/Addenda.
.2 Copy of Approved Current Work Schedule.
.3 Building Permit/Drawings. Construction Record Drawings.
.4 Field Instructions and Site Inspection Reports.
.5 Notices of Change and Change Orders.
.6 Reviewed, Stamped Shop Drawings and Schedule.
.7 Independent Inspection and Field Test Reports.
.8 Authority Inspection Permits, Reports and Certificates.

7.1 WORK SCHEDULE

.1 Provide to the Consultant, within five (5) working days after Contract award, a construction schedule showing anticipated progress stages, sequencing, milestone dates, delivery dates and final completion of Work within time period required by Contract Documents.

.2 Provide to the Consultant, prior to the first Project Site Meeting a shop drawing schedule showing the discipline, received date, schedule required date, and status of each shop drawing to be provided.

.3 Provide updated schedules on a monthly basis to permit the Consultant to evaluate and communicate to the Owner the status of Work for future

Progress Billing purposes. Payments will not be approved until schedules are received and approved. Should there be slippage of schedule, a plan to reacquire schedule must be submitted to the Consultant.

8.1 SITE MEETINGS/PROGRESS RECORDS

.1 Interim monthly reviews of Work Progress, based on the current Work Schedule, will be conducted by the Consultant and Contractor and any necessary corrections to the schedule shall be noted and updated by Contractor in conjunction with all subtrades and suppliers to the satisfaction of the Consultant at least once every thirty (30) working days. Copies of the updated schedule shall be submitted to the Consultant for their review and comments.

9.1 APPROVAL OF WORK

.1 Where reference is made to jurisdictional authorities, it shall mean all authorities who have within their constituted powers the right to enforce the laws of the place of building.

.2 Where reference is made in these Specifications that Work is to proceed or to meet the approval of jurisdictional authorities, Consultant or others, such approval shall be in writing.

10.1 WORK DURING NON-BUSINESS HOURS

.1 The Contractor is cautioned that the Consultant and/or Sub-Consultants, cannot be committed to site attendance at the site except for normal working hours i.e., Monday to Friday 7:00 am to 6:00 p.m. excluding holidays. All and any Work performed during such times, requiring either the presence of the Consultants, Owner or other Authorities, and carried out without their specific written prior approval, shall be performed solely at the General Contractor's responsibility.

.2 Notify the Consultant at least ninety-six (96) hours in advance of Work at night (7:00 p.m. to 6:00 a.m.) on weekdays, Saturdays, Sundays and Statutory or declared holidays. Undertake no work during the foregoing times without the Consultant's written approval.

.3 Any work that results in a disruption of the facility must be coordinated at least two weeks in advance with the Owner and Consultant. Disruptions must occur when there are no events scheduled in the facility or may occur outside regular working hours. The owner will not entertain requests for extra as a result of such events. Contractor must plan and account for such events in base bid.

11.1 PROJECT COORDINATION

.1 Assume full responsibility for the coordination and cooperation of all trades.

.2 Employ a qualified superintendent who shall:

.1 Be on the site at all times and control all Work throughout.
.2 Have full authority to act on the Consultant's instructions.
.3 Have full knowledge of Construction and this Project in particular.
.4 Not be changed without prior approval of the Consultant.

.3 Coordinate all service terminations with appropriate Authorities.

12.1 WORKMEN, SUPPLIERS AND SUBCONTRACTORS

.1 Assign Work only to workmen, suppliers and Subcontractors who have complete knowledge, not only of the conditions of this Specification, but of jurisdictional requirements, reference standards and specifications.

.2 Give preference to use of local workmen, suppliers and Subcontractors wherever possible.

13.1 COOPERATION AND COORDINATION OF SUBCONTRACTOR'S WORK

.1 Coordinate all construction components in each area and on which subsequent Work depends to facilitate mutual progress, and to prevent conflict between parts of the Work performed by all trades.

.2 The Contractor shall ensure that each of his Subcontractors make known to him, and to other Subcontractors, the environmental and surface conditions required for the execution of the Subcontractor's Work, and the sequence of other's Work required for installation of the Subcontractor's Work.

.3 The Contractor shall ensure that each Subcontractor, before he commences his Work, fully understands the site requirements and conditions preceding and subsequent to his Work, and that each Subcontractor execute his preparatory Work properly as required by the Subcontractors whose Work depends upon it.

.4 Subcontractors/Suppliers who give installation information in error, or too late to incorporate in the Work, shall be responsible for having any and all Work carried out which was thereby additionally made necessary to correct the situation.

.5 Remove Work which has been installed in error, incorrectly or substituted without approval and which is unsatisfactory for subsequent Work immediately at no additional expense to the Owner.

.6 The Contractor shall ensure that setting drawings, templates, and all other information necessary for the location and installation of materials, holes, sleeves, inserts, anchors, accessories, fastenings, connections, and access panels are provided by each Subcontractor whose Work requires cooperative location and installation by other Subcontractors.

.7 Schedule delivery of materials, supplied by one Subcontractor to be installed by another, well in advance of commencement of the installation.

14.1 CONTRACTOR'S USE OF SITE

.1 Do not unreasonably encumber site with materials or equipment. Remove all materials from site as they accumulate daily.

.2 Use of site is limited and restricted to the areas for work and storage as shown on the drawings and as designated by the Consultant and as approved by the Owner.

.3 Restore, at completion of Work, all adjacent property, surfaces, sidewalks, etc. to original condition of commencement of work to satisfaction of the Consultant.

15.1 ACCESS TO SITE

.1 The Contractor shall direct and control access and delivery of all construction materials and equipment onto and within the site. He shall provide flagmen and guards as required.

.2 The Contractor shall be completely responsible for delivery vehicles, and materials and equipment while they are on the site, and shall pay all costs for their immediate removal or relocation should they impede the access of others.

.3 Owner and staff will require access to the building for daily operation of facility. Accommodations must be made to allow access to staff and possibly external contractors in order to maintain operation to the rest of the facility. In emergency situations the Contractor may need to relinquish control of this area until the facility is back to normal operation.

16.1 PARKING

.1 Parking shall be allowed only with the prior approval and in authorized areas as agreed to and directed by the Consultant.

.2 Construction vehicles must not disrupt daily activities without prior approval.

17.1 ACCESS FOR EQUIPMENT

.1 Fitments and other equipment shall be made up in sections of such size as can be easily transported in and through the building to the final location without alteration or damage to the building.

.2 Should it become necessary at any time during the execution of the Work to move materials and/or equipment which have been temporarily placed, when so directed by the, make arrangements with those who are furnishing such materials and equipment to move them or cause them to be moved to

a different location as directed without additional charge.

18.1 SETTING OUT OF WORK

.1 The Contractor shall establish necessary lines, levels, and provide batter boards or other means to control the accurate positioning of all elements of work.

.2 The Contractor shall verify all existing grades, property lines and levels shown on the Drawings.

.3 Before commencing installation of Work, verify that it is laid out accurately in accordance with intent of Drawings and that positions, levels and clearances to adjacent Work are maintained. If Work is installed in wrong location, rectify it before construction continues.

.4 The Contractor shall furnish to the Consultant, certification from a licensed Ontario Land Surveyor that the Building and other parts of the work are located in accordance with the Contract requirements. Setting out of Work shall be in conformity with the Municipal Setback requirements. The Surveyor's Certification shall represent an independent and disinterested verification of the Contractor's layout work. The Surveyor shall promptly verify and certify the lines and levels of any part of the work at any time it may be deemed necessary by the Consultant. Any deviation from the drawings shall be reported to the Consultant in writing within twenty-four (24) hours of discovery.

19.1 EXAMINATION OF SITE BEFORE EXECUTION OF WORK

.1 Examine site, and ensure that each Subcontractor whose Work is related to site conditions has examined it, so that all are fully informed on all particulars, which affect Work thereon and at the place of building, and in order that construction proceeds competently and expeditiously.

.2 Examine completed Work, Work in progress, and Work yet to be carried out by others under other Sections of the Specifications.

.3 Verify dimensions of completed Work in place before fabrication of Work to be incorporated with it.

.4 Verify that previously executed Work and surfaces are satisfactory for installation or application, or both and that performance of subsequent Work will not be affected. Commencement of Work shall constitute acceptance of site conditions and surfaces as satisfactory.

.5 The Contractor is responsible for a pre-construction survey of the existing facility and surrounding site to limit liability. This survey must be provided to the Owner.

.6 Report to Consultant any and all defects in previously completed Work

which will affect the scheduling and quality of all subsequent Work.

.7 No allowance will be made for difficulties encountered in the Work which were in existence or could have been anticipated at the time the Work was tendered.

.8 No allowance will be made for difficulties encountered in the Work which are a result of the lack of cooperation/coordination on the part of the Contractor of any of his Trades or Suppliers.

20.1 PROTECTION OF WORK, PROPERTY AND PERSONS

.1 Work shall include necessary methods, materials and construction to ensure that no damage or harm to Work, materials, property and persons results from the Work of this Contract. Temporary facilities relating to protection are specified in Section 01 50 00. Schedule the work so that security and safety is maintained at all times.

.2 Keep excavations Work free of water at all times. Pump dry as required.

.3 Remove snow and ice immediately from building. Carefully remove snow and ice from all finished roof areas.

.4 Keep surfaces on which finish materials will be applied free from grease, oil and other contamination which would be detrimental in any way to the application of finish materials.

.5 Protect finish surfaces of completed Work from damage by restriction of access or by use of physical means suitable to the material and surface location. Establish with each Subcontractor the suitability of such protection in each case.

.6 Give constant close supervision to roofing following installation, during the time they are temporarily protected or exposed to ensure that no damage occurs to them before completion of building. Provide protection especially against damage from traffic or Work performed on top of completed roofing when temperature is over 80^{o}F.

.7 Locate, identify and protect existing services from damages. If necessary, relocate active services to ensure that they function continuously in safety and without risk of damage. Any damage caused to existing services and/or property shall be made good at the Contractor's expense.

.8 Do not damage landscaped areas by piling of surplus soil over them, by dumping of debris over them or compacting the soil within the drip line of the trees/shrubs.

.9 Special precautions to be taken to protect all existing planting on the site. Do not damage or cut root systems of existing trees; stockpile any surplus material over them or use trees for anchorage. Remove only those trees or

shrubs which are designated to be removed and/or replanted. Protect, and if damaged make good, adjacent property.

.10 Assume full responsibility for the provision of all protection against rain, wind, snow, ice, storms, frost, heat and vandalism so as to maintain work area free from injury or damage.

.11 Notify the Consultant should the job be closed down for any reason and assume full responsibility, for providing adequate protection, security, etc. during the shutdown.

.12 The Contractor is cautioned to use appropriate demolition methods in order to fully protect all existing structure. Do not carry out any work in a manner that will endanger any structural members, services.

.13 Take all necessary precautions to protect the occupants, the public, passersby and adjoining property against flying dust and debris.

21.1 FIRE PREVENTION AND SAFETY

.1 The Contractor shall enforce fire protection methods of good housekeeping, and adherence to local and underwriter's fire regulations. Provide ULC approved fire extinguishers, and other fire fighting services and equipment except where more explicit requirements are specified as the responsibility of individual Subcontractors.

.2 Erection of hoarding must be in compliance with the building code, fire code. Ensure that sprinklers, fire alarms, exiting, etc for the facility are not compromised. Contractor will be responsible for applying for any permits or meeting the requirements of the applicable codes.

.3 Maintain clear emergency exit paths for personnel at all times.

.4 Use only fire-resistant tarpaulins and similar protective covering on site.

.5 Ensure that each Subcontractor stores his volatile waste in approved closed containers and removes them from premises daily.

22.1 PUBLIC PROTECTION

.1 When necessary, the Contractor must post a flagman who will be responsible for safety and direction of pedestrian traffic past the site.

.2 Maintain existing exiting routes and access from the existing premises.

23.1 PROVISIONS FOR TRAFFIC

.1 Particular effort shall be applied to the safety of pedestrian flow past the site. Any activity which has potential for interference with pedestrian flow shall first be approved by the Consultant. Provide temporary guide barriers,

signage and flagmen as required for safe and efficient control of pedestrian flow.

24.1 MUD TRACKING

.1 The Contractor shall take all steps necessary to prevent the tracking of mud beyond the site and assume all responsibilities for the tracking of mud, dirt and debris resulting from his operations, beyond the site and shall pay all costs necessary for the clean-up resulting from this operation.

.2 Clean up must happen daily to the satisfaction of the City.

25.1 DUST CONTROL

.1 The Contractor shall take such steps as may be required to prevent dust nuisance resulting from his operations from spreading beyond the site.

.2 Where the work requires the sawing or grinding of concrete, blades and grinders of the wet type shall be used together with sufficient water to prevent the incidence of dust. The cost of all such preventative measures shall be borne by the Contractor.

.3 The contractor shall complete a full cleaning of the facility at project completion.

26.1 SECURITY

.1 The contractor shall provide secure, solid closures to any opening which will not be able to be closed in with the new construction due to any circumstances which may arise.

.2 Ensure that the site security is operating at all times construction is proceeding and that the temporary site enclosure is secured at the end of each day's work.

27.1 SALVAGE AND DISPOSAL

.1 Items of antiquity, including coin, art, anthropology, etc. which are on the site at the time of signing of Contract, which are uncovered or unearthed during the construction, shall remain the property of the Owner and shall be turned over to him immediately and without prejudice.

.2 Unless otherwise specified, salvaged material which will not to be reused within the new construction, surplus materials and construction debris shall become property of Contractor. The Contractor shall pay all associated costs and arrange for the safe removal and disposal away from site.

28.1 FASTENINGS

.1 Work of each Subcontractor shall include necessary fastenings, anchors,

inserts, attachment accessories and adhesives. Where installation part of Work of other Subcontractor, locate devices and cooperate with them as required.

.2 Install Work with fastenings or adhesives in sufficient quantity to provide permanent secure anchorage of materials, constructions, components and equipment. Space anchors within limits of load-bearing or shear capacity.

.3 Space exposed fastenings evenly and in an organized pattern. Keep number to a minimum. For exposed fastenings use metal of same material, texture, colour and finish as metal on which they occur.

.4 Repair of existing surfaces as a result of temporary fastening are the responsibility of the contractor.

29.1 CONCEALMENT OF PIPES, DUCTS AND WIRING

.1 Conceal all pipes, ducts and wiring in floor, wall and ceiling construction of finished areas wherever possible. If any doubt arises as to the means of concealment, or the intention of the Contract Documents in this connection, request clarification from the Consultant before proceeding with that portion of the Work.

.2 Where necessary, mechanical and electrical Work shall be laid out well in advance of concrete pouring and furring erection so that provision may be made for proper concealment. All such Work shall be tested, inspected and pipe covering applied where applicable before being concealed.

30.1 CUTTING, FITTING, PATCHING AND REPLACEMENT

.1 Before cutting, drilling or sleeving of any structural load-bearing elements within the project, obtain the Consultant's approval. Do not endanger Work or property by cutting, digging or similar activities. Do not cut or alter the Work of others unless approved by the Consultant, Sub-Consultant or Sub-Contractor whose Work is being altered.

.2 Cutting, drilling, sleeving and patching of Work shall be done by the Subcontractor whose trade Section corresponds to the Work requiring cutting, and where located by Subcontractor who requires the Work performed for his installations; all under the direct supervision of the Contractor.

.3 Replacement of damaged Work shall be done by the Subcontractor whose trade Section corresponds to the Work requiring patching or replacement, at the expense of the Subcontractor who causes the damage. Cut and drill with true smooth edges, and to minimal, suitable tolerances.

.4 Patching of damaged Work shall be done by the General Contractor and it shall be his responsibility to ensure the remedial Work is carried out

expeditiously, and at no expense to the Owner and to the satisfaction of the Consultant. Make patches invisible in final assembly.

.5 Fit construction tightly to ducts, pipes and conduits to stop air movement completely. The Subcontractor whose Work penetrates an element of the building shall ensure that no movement will affect his Work, the joint is sealed and is the element is a fire separation he shall be responsible for maintaining the separation in an approved manner.

31.1 EXISTING SERVICES

.1 Where Work involves capping/cutting or relocation of existing services, carry out work at times directed by governing authorities.

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

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

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

.5 Record location of all new, capped or abandoned site services accurately on "Construction Record Drawings".

.6 All rough-in to point of equipment connection is to be carried out by the Mechanical and Electrical Contractors as part of the General Contract for the Work. This Contractor shall be responsible for setting of the equipment in place and ensuring that all electrical and mechanical connections to this equipment is carried out correctly and as required by the equipment manufacturer.

.7 Final connection to equipment will be carried out under the Work of the General Contract for the Building Alteration and Addition.

.8 Do not interrupt existing services except as approved by the Consultant. Give the Consultant or governing authority seven (7) days clear notice of intention to interrupt existing services.

.9 In the event existing services are uncovered or disrupted accidentally, make complete restoration on a priority basis and provide adequate protection to avoid further disruption until diversion or alternative arrangements are made.

32.1 CLEANING

.1 Each Subcontractor shall clean and remove from his finished Work all stains, soiling, markings, labels, scratches, spatters, droppings, and debris.

He shall leave his Work and adjacent finished Work in new condition.

.2 Ensure that only cleaning materials are used which are recommended for the purpose by both the manufacturer of the surface to be cleaned and of the cleaning material.

.3 No debris, waste or excess material shall be burned or buried at site. Ensure that volatile fluid wastes are not disposed of in storm or sanitary sewers or in open drain courses. Do not allow waste material and debris to accumulate in an unsightly or hazardous manner. Provide containers in which to collect waste material and debris. Sprinkle dusty accumulations with water.

.4 Ensure that cleaning operations are scheduled to prevent dust or other foreign matter affecting surfaces which are wet or tacky.

.5 Each Subcontractor shall supply the Contractor with instructions for final cleaning of his Work, and for inclusion in Project Data Book as more exactly specified in each trade Section and in Section 01 30 00.

.6 Ensure that cleanup is carried out daily to provide a neat, orderly and safe site for all personnel working on the site.

.7 The final project cleanup and cleaning of all components shall be carried out by the Contractor in accordance with Section 01 70 00 - Project Closeout.

END OF SECTION 01 26 36

1.1 ADMINISTRATIVE DOCUMENTATION

.1 The Contractor shall be responsible for arranging, collecting, compiling and maintaining on the site all current documents, reports, minutes and affidavits etc. as specified and required by the Consultant and jurisdictional authorities for their review and use.

2.1 PRECONSTRUCTION MEETING

.1 Immediately after award of Contract attend a meeting, arranged by the Consultant, with the Owner, sub-consultants, Contractor and Sub-contractors to document the responsibilities and necessary activities of the Contractor, Subcontractor and Suppliers during construction, establish procedures for cooperation and coordination of all participants during construction and to set forth the lines of communication for all correspondence for the Project.

3.1 PROJECT SITE MEETINGS

.1 Arrange for the Consultant, Owner and Subcontractors to attend Project Site Meetings to discuss project scheduling, document interpretation and contemplated revisions to the project.

.2 Provide physical space and make arrangements for bi-weekly Project Site Meetings at times and dates mutually agreed to with the Consultant, Sub-consultants and Owner.

.3 The Contractor shall record all minutes of meetings and forward distribution to all parties involved within 48 hours of the meeting.

.4 Arrange for Sub-Contractors representatives to attend the site meetings approximately one (1) hour after the Project Site Meeting to discuss specific items of Work which require the interpretation or clarification of the documents with the Consultant and Consultants. Provide a proposed agenda listing information, problems and concerns requiring resolution with the Consultant and/or Sub-consultants.

4.1 SITE PROGRESS RECORDS

.1 Maintain on the site a permanent record, in a format acceptable to the Consultant, of the progress of construction, site conditions, inspections and schedule of the Work. The record shall include:-
- .1 Commencement and completion dates of each trades Work.
- .2 Daily weather conditions
- .3 Scheduling, inspections and approvals
- .4 Status of materials, deliveries etc.

.5 Site conditions encountered.

5.1 CONSTRUCTION SCHEDULE

.1 The Contractor shall be responsible for maintaining the completion date as set out in Construction Schedule prepared, submitted and approved and shall advise the Consultant immediately if any changes to deliveries or conditions will cause delays which would affect the completion date.

.2 The Contractor shall review the current Project Schedule with all Subcontractors and Suppliers and note any variances which have occurred since the last meeting which may affect the scheduled completion of the project.

.3 The Contractor shall correct, revise, update and otherwise maintain the schedule during progress of construction. Provide a revised and updated schedule to the Consultant, Owner, and Subcontractors.

.4 Contractor must maintain a Contemplated Change Orders, Change Orders, Change Directives, Site Instruction, Shop Drawings and Requests for Information log identifying status, reason, costs etc. This list must be issued with site meeting minutes.

END OF SECTION 01 32 00

1.1 GENERALLY

.1 The Contractor shall be responsible for preparing, for the first project site meeting, a schedule of all requested and required submittals listing all shop drawings, samples, reports, manuals, drawings intended for submission to the Consultant.

.2 The Contractor shall coordinate and distribute all submissions, to the Consultant as well as Subtrades and suppliers, to ensure that the flow of documents is performed in a timely manner to maintain the construction schedule.

.3 All submittals specified and requested in all Sections of these Specifications shall be made by the General Contractor, directly to the Consultant. Submit copies to the Sub-Consultants and jurisdictional authorities only on the instructions or in agreement with the Consultant.

.4 Submissions containing substitutions or alternates will be returned immediately by the Consultant or Sub-Consultants.

1.2 CONSTRUCTION SCHEDULES

.1 Submit in accordance with Section 01 00 50.

1.3 SHOP DRAWINGS

.1 The Consultant shall review, stamp and return the digital copy of all shop drawings marked "No Comments", "Comments as Noted" or "Revise and Resubmit". A copy of all shop drawings marked "No Comments or Comments as Noted" shall be retained at the site for the Consultant, Consultants and trades to review. Only drawings stamped "Revise and Resubmit" need be resubmitted. The Contractor shall be responsible for printing the reviewed shop drawings.

.2 Submit to the Consultant one (1) digital (PDF) copy of all shop drawings for the items of Work noted throughout this Specification, and in accordance with GC 3.11 of the Agreement.

.3 Submit shop drawings for signs, hoardings, fences, barricades, shoring and bracing, hoists, temporary supports, enclosures, stairs and similar Work specified in Division 1 when requested by the Consultant or jurisdictional authorities in accordance with their requirements.

.4 The Owner is to be given the opportunity to review all shop drawings. Only the Consultant will provide acceptance.

.5 The Contractor shall check, stamp, sign and make notations he considers necessary on shop drawings before each submission. Shop drawings not checked and signed will be returned without review.

.6 Do not proceed with Work dependent on shop drawing information until Consultant's and Contractor's review is finalized. Shop drawings marked, "No Comments" shall not relieve the Contractor of his responsibility for execution of Work in accordance with Contract Documents.

.7 The following information shall be shown on shop drawings:-

- title, project name, date, scale, manufacturer, fabricator and installer.
- materials, finishes, fabrication and erection dimensions.
- clear and obvious deviations or proposed changes from drawings or specifications.

Project specific details to indicate construction arrangement of parts, connections, anchorage, fastener type, and interconnections with other Work.

- mechanical and electrical requirements and characteristics when applicable.
- information to verify that superimposed loads will not affect function, appearance and safety of this or related Work.
- assumed design loadings, material specifications for load-bearing members.
- dimensions and dimensioned locations of proposed chases, sleeves, cuts and holes in structural members.
- Engineer's seals, calculations and notations as required.

.8 Submit only digital (PDF) copies of shop drawings. Digital copies (only) will be returned.

.9 Fabricate Work exactly as shown on shop drawings. If shop practice dictates revisions, revise drawings and resubmit.

1.4 SAMPLES AND MOCK-UPS

.1 Submit to Consultant samples and mock-ups for the materials noted throughout these specifications and in accordance with GC 3.11 of the Agreement.

.2 Samples labelled to show title, project, Contractor, Manufacturer and date. Submit samples of adequate size to show the colour, texture, thickness, shape, jointing, fastening and otherwise represent the material in its intended use on this specific Project. Submit the manufacturers complete range of samples unless the Consultant has selected one (1) or more

specific types to be used.

.3 The Materials used on this Project shall match approved samples in all aspects including quality, colour, texture and finish. Materials installed without approval of samples shall be removed and replaced at the Contractors expense.

1.5 AFFIDAVITS

.1 Submit to the Consultant affidavits, in duplicate signed and notarized by a responsible officer of the certifying company for the specified products noted in other Sections of the Specification.

1.6 GUARANTEES AND WARRANTIES

.1 Provide the extended guarantees as specified in each applicable Section of this Specification.

.2 Extended guarantees shall commence on termination of the standard one-year guarantee granted in this Contract as specified in Article GC 12.3 - Warranty of the General Conditions, and shall be an extension of these same provisions.

.3 Each extended guarantee shall be submitted in a format, identical to the other and as approved by Consultant.

1.7 MAINTENANCE MANUAL AND OPERATING INSTRUCTIONS

.1 Submit Maintenance Manuals to the Consultant at completion of Project prior to application for Certificate of Substantial Performance. Maintenance Manual shall consist of shop drawings, extended guarantees and Project Data Book.

.2 The Project Data Book Shall

- consist of two (2) USB (digital) copy.
- have a title sheet, or sheets preceding data on which shall be recorded Project name, date, list of contents and Contractor's and Subcontractors' names
- be organized into applicable Sections of Work with each section separation by hard paper dividers with plastic covered tabs marked by Section
- contain only typed or printed information and notes, and neatly drafted drawings
- contain Warranties/Guarantees including extended Warranties/Guarantees with the names, addresses and phone numbers for servicing.

- contain maintenance and operating instructions on all building, and mechanical and electrical equipment
- contain maintenance instructions as specified in various Sections and as referenced in Section 01 15 00
- contain brochures and parts listed on all equipment sources of supply for all proprietary products used in the Work
- contain lists of supply sources for maintenance of all equipment in Project of which more detailed information is not included above
- contain finished hardware schedule
- contain charts, diagrams and reports specified in Divisions 15 and 16.
- contain one (1) copy of final reviewed, stamped and signed shop drawing issued for Project, on which have been recorded changes made during fabrication and installation caused by unforeseen conditions.

1.8 EXTRA STOCK

.1 Supply extra stock at completion of Project as specified in other Sections of this Specification.

1.9 INSPECTION LABORATORY REPORTS

.1 Submit reports in duplicate unless specified otherwise, signed by a responsible officer of the inspection and testing laboratory, for the items as specified in other Sections of the Specifications in Articles entitled, "Source Quality Control" and "Field Quality Control".

1.10 APPLICATION FOR PAYMENT

.1 Applications for Payment must be accompanied by:

.1 The Contractor's Statement of Payment.
.2 Progress Draw showing a schedule of values of various trades and for various parts of the work in a format acceptable to the Consultant.
.3 A Statutory Declaration, duly signed by the Contractor and all Subcontractors, stating that all Subcontractors and suppliers have been paid to date and that there are no liens outstanding or filed.
.4 Letter of Good Standing from Workers' Compensation Board.

1.11 CONSTRUCTION RECORD DRAWINGS

.1 The Contractor will be provided with two sets of prints to be used as Record Drawings on which he shall mark clearly "IN RED, IN A NEAT AND LEGIBLE MANNER", all deviations from the Contract Documents in the Work as constructed, caused by site conditions and including Consultant originated changes, Contractor/Sub-Contractor originated

changes, Site Instructions, Supplementary Instructions, Addenda, instructions by correspondence and Jurisdiction authority approvals. Carefully record location of concealed elements which are required for maintenance, alteration work, and building additions, including elements of foundation, horizontal and vertical location of utilities and appurtenances, location of internal utilities concealed in construction, and all field changes of dimension and detail. Eradicate all obsolete information.

.2 Maintain record drawings in good condition, available at all times for inspection by Consultant's site representatives, and do not use for construction purposes.

END OF SECTION 01 33 00

1.1 GENERAL REQUIREMENTS

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

2.1 INSPECTION

.1 The materials furnished by the Contractor shall be inspected by the Contractor and Inspection/Testing Agency at the source, time of delivery and at such other times as requested by the Consultants.

.2 The review of the information covering materials and equipment by the Consultants shall in no way release the Contractor or Inspection/Testing Agency from his responsibility for the proper design, installation and performance of any material, equipment or arrangement or from the liability to replace same should it prove defective or deficient.

3.1 INSPECTIONS BY OWNER

.1 The inspection and testing for all earthwork including subgrade, bearing surfaces, granular fill and cast-in-place concrete shall be carried out by the Owners own forces in accordance with this Specification.

.2 The Owner shall pay all costs associated with the testing/inspections carried out by their own forces (under cash allowance).

.3 The Contractor shall ensure that the testing/inspection is carried out in conformance with these specifications including samples, reporting, etc.

4.1 INDEPENDENT INSPECTION AGENCIES

.1 Independent Inspection/Testing Agencies will be engaged by the Consultant for the purpose of inspecting and/or testing portions of Work as outlined in the specifications.

.2 Cost of such services for each portion of the Work noted, shall be paid for by the Contractor as part of the Cash Allowance specified under Section 01 05 00. Do not expend such allowances without approval of the Consultant.

.3 The Contractor shall ensure that the inspection/testing is carried out in conformance with these specifications, including sampling and reports.

.4 Equipment required for executing inspection and testing by the appointed agencies shall be provided by them for their specific use.

.5 Employment of Inspection/Testing Agencies does not relax the responsibility of the Contractor to perform the Work in accordance with the

Contract Documents.

.6 If defects are revealed during inspection and/or testing, the appointed agency will request additional inspection and/or testing to ascertain full degree of defect. Correct defects and irregularities as advised by the Consultant at no cost to the Owner.

.7 Allow Inspection/Testing Agencies access to the Work, offsite manufacturing and fabrication plants. Co-operate to provide reasonable facilities for such access.

5.1 PROCEDURES

.1 Prepare schedule of testing to be given to testing company. Notify the appropriate agency and Consultant a minimum of two (2) working days in advance of the requirement for tests, in order that attendance arrangements can be made.

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

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

6.1 REJECTED WORK

.1 Remove defective Work, whether the result of poor workmanship, use of defective products or damage and whether incorporated in the Work or not, which has been rejected by the Consultant as failing to conform to the Contract Documents. Replace or re-execute in accordance with the Contract Documents.

.2 Make good other Contractor's work damaged by such removals or replacements promptly.

.3 If in the opinion of the Consultant it is not expedient to correct defective Work or Work not performed in accordance with the Contract Documents, the Owner may deduct from the Contract Price the difference in value between the Work performed and that called for by the Contract Documents, the amount of which shall be determined by the Consultant.

7.1 REPORTS

.1 Reports shall contain the following information:
.1 Date and time of inspection or test.
.2 Weather conditions and ambient air temperatures during the

inspection.

.3 Testing method employed by proper standard reference and specific paragraph or other detailed information as applicable.

.4 Inspection description and details and other relevant information.

.5 Test results in detail, complete with applicable graphs and other clarifying documents and information.

.6 Printed name and signature of person having conducted inspection or test, and name, title and signature of Supervisor having verified the report.

.2 Inspection and Testing Agency shall provide written report for each inspection and test made, one (1) copy to the Consultants; two (2) copies to the Contractor direct, who shall forward one (1) copy to the Sub-Contractor, supplier or manufacturer concerned and two (2) copies for the data books.

8.1 TESTS AND MIX DESIGNS

.1 Furnish test results and mix designs as requested and required.

END OF SECTION 01 40 00

1.1 GENERALLY

.1 Work shall include temporary facilities and controls required as construction aids or by jurisdictional authorities, or as otherwise specified. Install to meet needs of construction as Work progresses. Maintain during use, remove at completion of need and make good adjacent Work and property affected by their installation.

.2 Work shall include fixed or portable structures as shown and as required for storage, offices, washrooms, etc. as required for safety, security and to meet the needs of the construction project and the Owner as otherwise specified. Access/use of the facility washrooms is not permitted.

.3 Temporary facilities shall include provisions for construction safety as required by the Construction Safety Act of the Province of Ontario, as well as all other applicable regulations of jurisdictional authorities.

.4 Construct temporary Work of new materials unless use of second-hand materials is approved by the Consultant.

.5 Ensure that structural, mechanical and electrical characteristics of temporary facilities are suitable and adequate for use intended. Be responsible that no harm is caused to persons and property by failure of temporary facilities because of placing, location, stability, protection, structural sufficiency, removal or any other cause.

.6 Prepare shop drawings and specifications of temporary Work, and submit for approval if required by jurisdictional authorities and to the Consultant in accordance with Section 01 33 00.

.7 Pay all costs for any and all temporary facilities and controls including, but not limited to, permits, transportation, set-up, maintenance and leases.

2.1 CONSTRUCTION AIDS

.1 Erect scaffolding independent of building walls, and remove promptly when no longer required. Do not allow scaffolds to interfere with continuing "Work".

.2 Each user of scaffolding which is not his own shall be responsible for its examination and testing before using it. He shall make it secure if necessary, or shall notify the Contractor in writing that he will not commence Work until it is made secure; otherwise, he will be held responsible for accidents and acceptance of the scaffolding.

.3 Work shall include temporary enclosure for building as required to protect it, in its entirety or in its parts, against the elements, to maintain environmental conditions required for Work within the enclosure, and to prevent damage to materials stored within. Design enclosures to withstand wind pressures required for the building by jurisdictional authorities. Use structural framing of building for support of temporary enclosure framing only upon verification that the load limits of the building frame will not be exceeded, and upon approval of the Consultant. Keep surfaces of enclosures free of snow and ice to avoid overloading of building structure. Erect enclosures to allow complete accessibility for installation of materials during the time enclosures remain in place.

3.1 PROTECTIVE FENCES, DEVICES, BARRICADES

.1 Install temporary constructions to ensure protection to the public, premises and all personnel as specified other Sections of this Specification and the General Conditions of the Contract.

.2 Work shall include barricades for traffic control, and to prevent damaging traffic over finished areas, sidewalk and curb protection, as well as safety barricades, hoardings and otherwise as may be required.

.3 Erect protective hoarding/enclosure around the work area and as depicted on the drawings to protect the adjacent area from debris, dust and noise. The enclosure shall be dust tight and maintained as such for the duration of construction. Access to Owner and staff must be accommodated. Additional, access to all required exit must be maintained. Verify all items to be protected with the Consultant prior to commencement of work.

4.1 SECURITY

.1 Maintain security of construction site by control of access through enclosing fences during times Work is in progress, and by locking hardware otherwise.

.2 Maintain security at all times construction is shut down because of a strike or a lockout, or for whatever reason the project is unoccupied.

5.1 TEMPORARY WATER, ELECTRICITY, HEAT, LIGHTING

.1 The provision of water, electricity, heat and lighting required for construction of the facilities, for the duration of the project with be available from the building.

.2 The Contractor shall supply electric power for all construction purposes. Make connections available to any part of the Work within distance of a 100'-0" extension. Provide power at temporary storage sheds and field office and classroom facility.

.3 Make connections for electric power for construction purposes (not heating or welding) at only the main switchboard, after it is installed. Feed from a separate sub-feed switch.

.4 Temporary electric service shall include distribution conductors and necessary components. Provide a power centre for miscellaneous tools and equipment with weatherproof distribution box, a minimum of four 20 Amp grounded outlets, and circuit breaker protection for each outlet.

.5 The Contractor shall heat building during construction to maintain temperature for working surface, and during conditions required by all specified materials. Use only heating methods approved by the Consultant and jurisdictional authorities. Salamanders will not be permitted.

.6 Provide lighting for:

- emergency evacuation, safety and security throughout the Project at intensity levels required for jurisdictional authorities
- performance of Work throughout areas as required, evenly distributed, and at intensities to ensure that proper installations and applications are achieved
- performance of finishing Work in areas as required, evenly distributed and of an intensity of at least 15 foot candles.

.7 Make arrangements for connections to water, sewer, gas, electric and telephone utilities as required for temporary use during construction. Pay connection and disconnection charges, and for use of services required by construction.

.8 Temporary office or lunch location for the contractor shall be in a trailer outside and is the contractor’s responsibility to maintain.

6.1 DUST CONTROL

.1 Prevent spread of dust beyond the construction site by wetting or by other means approved by the Consultant. Provide coverings for bleachers to protect from dust. A thorough cleaning of all areas including roof structure, where dust may collect shall be completed at the end of the project.

END OF SECTION 01 50 00

1.1 CONSTRUCTION SAFETY MEASURES

.1 Observe and enforce construction safety measures required by National Building Code 2025, Part 8, Provincial Government, Workers' Compensation Board and municipal statutes and authorities.

.2 In event of conflict between any provisions of above authorities, the most stringent provision governs.

2.1 FIRE PROTECTION

.1 Eliminate fire hazards and prevent damage to work, materials, equipment and other property, both public and private.

.2 Provide and maintain in working order, adequate temporary Underwriters' labelled fire extinguishers and locate in prominent positions, to the approval of authorities having jurisdiction.

3.1 FIRST AID

.1 Provide and maintain on the site in a clean, orderly condition, completely equipped first aid facilities which shall be readily accessible at all times to all employees.

.2 Designate certain employees who are properly instructed to be in charge of first aid. At least one such employee shall always be available on the site while work is being carried on.

.3 A telephone call list for summoning aid, such as doctors, ambulances, Pulmotors, and rescue squads from outside sources shall be conspicuously posted.

4.1 OVERLOADING

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

5.1 FALSEWORK

.1 Design and construct falsework in accordance with CSA S269.1-16 (R2021).

6.1 DISPOSAL OF WASTES

.1 Do not bury rubbish and waste materials on site.

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

.3 Fires and burning of rubbish on the site shall not be permitted.

7.1 POLLUTION CONTROL

.1 Control emissions from equipment and plant to local authorities' emission requirements.

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

.3 The contractor shall take appropriate precaution for activities generating excessive levels of noise. These works are to be scheduled outside of facility operating hours as directed by City staff.

8.1 TOXIC AND HAZARDOUS WASTE

.1 Prior to commencement of Work, ensure that all reasonable precautions have been taken to determine if toxic or hazardous substances are present on the site.

.2 Address unforeseen conditions expeditiously and report to the Consultant, jurisdiction having authority, immediately, any conditions found on the site.

.3 Do not bury any waste material on the site which could be deemed to be considered toxic or hazardous.

END OF SECTION 01 51 00

1.1 GENERALLY

.1 Reference to material and equipment includes all products to be incorporated into the Work as specified in these Specifications, and which may otherwise referred to as materials, equipment, components and similar terms or more broadly as products. Obtain specified products from suppliers in the same locality as the Project insofar as possible without prejudice to the scheduling of the project.

.2 Products for use in the Project and on which the tender was based shall be in production at that time, with a precise model and shop drawings available for viewing.

.3 Where equivalent products are specified, or where alternatives are proposed, these products claimed by the Contractor as equivalent shall be listed on the tender form and be comparable in construction, type, function, quality, performance and appearance, as determined by the Consultant. Where specified equivalents noted in the base tendered price, are accepted for incorporation into the Work, they shall be subject to final approval by the Consultant for suitability on this project.

.4 Products delivered to the Project site for incorporation into the Work, shall be considered the property of the Owner and shall not be removed from the site without written authorization from the Owner.

.5 Do not install permanently incorporated labels, trademarks and nameplates in visible locations unless required for operating instructions or by jurisdictional authorities.

2.1 SPECIFIED PRODUCTS

.1 Products specified by manufacturer's name, brand name or catalogue reference shall be the basis of the bid and shall be supplied for the Work without exception in any detail, subject to allowable substitution as specified. Where several proprietary products are specified, any one of the several shall be acceptable.

.2 For products specified by reference standards, the onus shall be on the supplier to establish that such products meet reference standard requirements. The Consultant may require affidavits from the supplier, as specified, to prove compliance. Products exceeding minimum requirements established by reference standards will be accepted for the Work if such products are compatible with and harmless to Work with which they are incorporated.

3.1 APPROVAL OF PRODUCTS

.1 Wherever in this Specification it is specified that products shall meet approval of jurisdictional authorities, Underwriters, Consultants or others, such approval shall be in writing.

4.1 SUBSTITUTION OF PRODUCTS DURING PROGRESS OF WORK

.1 No substitution for products shall be permitted. If the specified product cannot be delivered to maintain construction schedule and if the delay is caused by conditions beyond the Contractor's, Sub-Contractors or Suppliers control, the Contractor shall notify the Consultant immediately that alternate materials are requested to be reviewed.

.2 Substituted materials installed, without the approval of the Consultant, shall be removed and all costs associated with the correction of the Work, including all Costs incurred by the Owner, Consultant and Sub-Consultants, shall be the responsibility of the Contractor.

.3 Obtain approval for substitutions from the Consultant. Application for approval of substitutions shall be made only by Contractor. Process proposals for substituted Work in accordance with procedures established for changes in the Work.

.4 Submit, with request for substitution, documentary evidence that substituted products are equal to, or superior to, approved products, and a comparison of price and delivery factors for each product.

.5 It shall be the responsibility of the Contractor to ensure that substituted products can be both physically and dimensionally incorporated in the Work with no loss of intended function, performance or space. The Contractor shall be responsible for additional installation costs required by incorporation of substituted products and for adaptations made otherwise necessary to ensure that above requirements are satisfied.

5.1 PRODUCT HANDLING

.1 Manufacture, pack, ship, deliver and store products so that no damage occurs to structural qualities and finish appearance, not in any other way detrimental to their function or appearance, or both.

.2 Ensure that products, while transported, stored or installed, are not exposed to an environment which would increase their moisture content beyond the maximum specified.

.3 Schedule early delivery of products to enable Work to be executed without delay. Before delivery, arrange for receiving at site.

.4 Deliver package products, and store until use, with manufacturer's seals and labels intact.

.5 Label packaged products to describe contents, quantity and other information as specified.

.6 Product handling requirements may be repeated, and additional requirements specified, in other Sections.

6.1 STORAGE AND PROTECTION

.1 Store products on site or in storage sheds with secure protection against all harmful environmental conditions. Prevent damage, adulteration, staining and soiling of materials while stored.

.2 Store manufactured products in accordance with manufacturer's instructions, when such instructions are attached to products or submitted by him.

.3 Store steel, lumber, masonry units, and similar products on platforms raised clear of ground. Store finished products under cover at all times.

.4 All damaged products will be rejected for use, and thereupon shall be immediately removed from site.

.5 Store and handle flammable liquids and other hazardous materials in approved safety containers and as otherwise prescribed by safety authorities. Store no flammable liquids or other hazardous materials in bulk within the Project.

.6 All damaged products will be rejected for use and thereupon shall be immediately removed from site.

.7 Storage and special protection requirements may be repeated and additional requirements specified, in other Sections.

7.1 DEFECTIVE PRODUCTS AND WORK

.1 Products and Work found defective; not in accordance with the Specifications; or defaced or injured through negligence of the Contractor, his employees or Subcontractors, or by fire, weather or any other cause shall be rejected.

.2 Remove rejected products and Work from the premises immediately.

.3 Replace rejected products and Work with satisfactory products with no delay after rejection. Previous inspection and payments shall not relieve

the Contractor from the obligation of providing sound and satisfactory Work in compliance with this Specification.

.4 Costs for replacement of defective material installed shall be the responsibility of the Contractor.

END OF SECTION 01 60 20

1.1 GENERAL CONDITIONS

.1 Work specified, shown on the Drawings or referred to in the Contract Documents, is governed by the General Conditions and Supplementary General Conditions.

.2 The Owner supplied equipment and items of Work, noted in these specifications and/or shown on the drawings, shall be incorporated into the Work of this Contract. This contractor shall be responsible for, as part of his contract, the co-ordination of rough-in and completion of these items of Work as they affect his Contract and scheduling. The Owner shall be responsible for approvals, payment and delivery of this portion of the Work and shall notify the Contractor of any changes in status which may affect his scheduling for the entire project.

2.1 WORK PERFORMED BY OWNER

.1 Material testing during construction (paid under Cash Allowance)

.2 Chemical testing of existing sub-surface soil for contaminants (paid under Cash Allowance).

.3 Building Permit

.4 Sound System – contractor to provide empty conduits

.5 Security System – contractor to provide empty conduits

.6 Data System – contractor to provide empty conduits

.7 Training room and staff room equipment

.8 Exterior and interior signage.

.9 Overhead gantry crane

END OF SECTION 01 64 00

1.1 FINAL CLEANING

.1 Before final inspection, replace all material damaged during construction or which is otherwise defective, marred or deficient.

.2 In addition to requirements for cleaning-up specified in the General Conditions of the Contract and as specified in the various sections of the Specifications, the Work by the Contractor shall include one (1) final cleaning by skilled cleaning specialists prior to Substantial Completion of the project and Occupancy by the Owner.

.3 Final cleaning shall remove dust, stains, paint spots, soil, grease, fingerprints and accumulations of construction materials in accordance with manufacturer's instructions for each material. This Work shall include but not be limited to:

: remove temporary protections and make good defects before commencement of final cleaning.
: washing of exterior and interior concrete floors.
: cleaning and polishing of glass.
: wiping, dusting and washing as necessary of floors, walls and ceilings.

.4 Maintain final cleaned state of the project, or portions thereof, until Owner has taken possession of project.

.5 Cleaning shall include all areas of the facility affected by construction including top of beams and roof structure where dust raised during construction may have settled.

2.1 DEMONSTRATION OF SYSTEMS

.1 Each Subcontractor shall give a complete demonstration in the presence of the Owner of the operation of all systems and equipment installations once they are complete and when the Consultant is advised that the building is to be handed over to the Owner. Responsible personnel from the Subcontractors whose Work is being demonstrated shall be present as required at these demonstrations.

3.1 CONSTRUCTION RECORD DRAWINGS

.1 Record, on white prints, Work constructed differently than shown on Contract Documents. Record all changes in the Work caused by site conditions; by Owner, Consultant, Sub-Consultants, Contractor and Sub-contractors originated changes; and by site instructions, supplementary instructions, field orders, change orders, addenda, correspondence and

directions of jurisdictional authorities. Accurately record location of concealed structure and mechanical and electrical services, piping, conduits, pull boxes, junction boxes and similar Work not clearly in view, the position of which is required for maintenance, alteration Work and future additions. Do not conceal critical Work until its location has been recorded.
A $20,000 holdback will be retained until As-built drawings are submitted and accepted.

.2 Make records in a neat and legibly printed manner with a non-smudging medium.

.3 Identify each record drawing as "Project Record Copy", maintain drawings in good condition, do not use them for construction purposes and make available to the Consultant at all times.

.4 Provide one hard copy of construction record drawings plus one (1) USB (digital) copy.

4.1 SUBSTANTIAL COMPLETION CERTIFICATE

.1 The following articles, in addition to those set forth under the General Conditions of the Contract, are to be submitted to the Consultant before issuance of the Substantial Performance Certificate.

.2 General

.1 Building Permit Copy of Drawings and Specifications, Building Permit, and all other permits/inspection approvals/documentation received during the course of construction from all Authorities.
.2 Verification of Fire Alarm, Emergency Lighting and Sprinkler System
.3 Copies of all Independent inspection reports as specified.
.4 Construction Record Drawings.
.5 Maintenance Manuals and Operating Instructions.
.6 Copies of all Warranties and Manufacturers inspection reports.
.7 Preliminary Deficiency List prepared by the Contractor for review by all trades and the Consultant and Sub-Consultants.

5.1 FINAL DOCUMENTATION

.1 Provide the following documentation as applicable before completion will be declared:
.1 Adjusted and reconciled cash allowances.
.2 Written statement of completion from Contractor and all other declarations as requested by the Consultant.
.3 Original copy of newspaper listing, as required under the Construction Act.

.4 Abstract of title from Registrar of Land Registration and/or Certificate of Encumbrances at termination of lien period.

6.1 FINAL INSPECTION AND CLOSE-OUT

.1 Arrange for, conduct and document final inspections, close-out and take-over at completion of Work of this Specification in accordance with procedures described in OAA/OGCA TAKE-OVER PROCEDURES, OAA/OGCA Document No. 100, December 12, 2007.

END OF SECTION 01 70 00

1 General

1.1 GENERAL REQUIREMENTS

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

1.2 WORK IN OTHER SECTIONS

.1 Related Work Specified in Other Sections:

Section 01 03 00	:	Work in Existing Building
Section 01 50 00	:	Temporary Facilities and Controls
Section 03 30 00	:	Cast-in-Place Concrete
Division 22	:	Plumbing
Division 15	:	Plumbing, Heating, Ventilation and Air-Condition
Division 26	:	Electrical
Section 31 01 00	:	Earthwork

1.3 QUALIFICATIONS

.1 Execute work of this Section only by a firm who specializes in such work, has adequate equipment and skilled tradesmen to perform it expeditiously, and is known to have been responsible for demolition work similar to that specified, during a period of at least the last five years.

1.4 REQUIREMENTS OF REGULATORY AGENCIES

.1 Perform demolition work in accordance with latest edition requirements of CSA S350-M1980 (latest edition), the Fire Protection Act and the Occupational Health and Safety Act and Regulations for Construction Projects of the Province of Ontario, Section 01 00 50 General Instructions of the specifications and as otherwise required by jurisdictional authorities to save persons and property from harm resulting from work of this Section.

1.5 SALVAGE AND DISPOSAL OF MATERIALS

.1 Assume responsibility for demolition and removal of elements noted to be removed or altered in the condition they are at time notified of award of demolition contract.

.2 All excess materials resulting from the demolition necessary for the project, except as specified or noted on the drawings, shall become the property of the Contractor who shall remove the same as quickly as possible to his designated disposal area. The retention of materials on the site for sale or salvage purposes is forbidden. Burning of materials and/or debris on the

site is strictly forbidden.

.3 Remove, clean, store, and protect all specified salvage items until required to be built into the project.

.4 Remove debris daily, immediately as it accumulates. Do not overload trucks and otherwise take means to prevent spillage during travel.

.5 The Owner will undertake testing of existing services and subsoil below the building footprint. The Contractor shall make arrangement in his schedule to accommodate this time. Testing shall include but not limited to pressure testing of heat system piping, sampling of piping and chemical testing for contaminants.

1.6 ACCESS TO SITE

.1 Provide for complete and safe access at all times to the building for the Owner and the public to the areas designated for continuous operations by the Owner.

.2 Do not impede pedestrian or vehicular traffic on public ways within or adjacent to the premises by Work in progress or stored materials.

2 Products

Not Applicable

3 Execution

3.1 EXAMINATION

.1 Before commencing any demolition Work, ensure in examination of the site that all possible factors concerning the demolition have been investigated, and in particular the following are known:-

.1 Methods and means available for material handling, disposal, storage and transportation.
.2 Method of construction of structures, fixtures and services to be demolished.
.3 Disconnection of services to all fixtures completed.
.4 Hoarding and temporary barriers installation completed.

.2 Review demolition Work to be performed in its entirety with the Consultant. Do not proceed without his approval of demolition methods which will be used.

3.2 SPECIAL PROTECTION

.1 Ensure that adjacent private and public properties, both within and without the premises, are protected from damage resulting from work of this Section. Protection shall consist of fences, barricades, signs, and substantial constructions to provide physical protection. Property shall include, but not be limited by, structures and their finishes and appurtenances; site improvements; trees, planting and landscaping; furnishings, fixtures, hardware and equipment.

.2 Protect existing items designated to remain and materials designated for salvage. In event of damage, immediately replace such items or make repairs to approval of Consultant and at no additional cost to the Owner.

.3 Post danger signs in conspicuous locations to warn persons that demolition is in progress. Barricade all access by unauthorized persons to areas in which demolition is in progress.

3.3 EXISTING SERVICES

.1 Verify the location of all existing services within the project boundary prior to commencing work. Arrange and pay for the disconnection, capping and plugging of all gas, water, sewer, hydro, telephone and other services to the buildings at the property line. In each case, the utility company involved shall be notified in advance, and its approval obtained before commencing that portion of the work.

.2 Do not interrupt existing services except as approved by the Consultant. Give the Consultant seven (7) days clear notice of intention to interrupt existing services. In the event existing services are uncovered or disrupted accidentally, make complete restoration on a priority basis and provide adequate protection to avoid further disruption until diversion or alternative arrangements are made.

3.4 SCHEDULE OF SALVAGE & RELOCATION

.1 Ensure that the specifications and drawings are referred to for the complete extent of this Work. Carry out all salvage under the supervision of the applicable Subcontractor whose Work includes the reinstallation of that specific product.

.2 Elements noted to be removed, relocated and reinstalled shall include but not be limited to the following:-

3.5 RESTORATION

.1 Remove hoarding, barricades and other temporary construction on

completion of demolition.

.2 Reinstate areas immediately adjacent to the work to match the condition of adjacent undisturbed work. Backfill all excavations and compact to provide uniform, even surface.

END OF SECTION 02 41 10

1 General

1.1 SECTION INCLUDES

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

1.2 WORK IN OTHER SECTIONS

.1 Related Work Specified in Other Sections

Section 03 20 00	:	Concrete Reinforcement
Section 03 30 00	:	Cast-in-Place Concrete
Section 31 01 00	:	Earthworks

1.3 REFERENCE STANDARDS

.1 Do concrete formwork in accordance with:
CAN/CSA-A23.1-19: Concrete Materials and Methods of Concrete Construction
CAN/CSA-A23.2-19: Test Methods and Standard Practices for Concrete

1.4 CO-ORDINATION

.1 Install anchors, sleeves, bolts, inserts, drains, expansion joint components and other items supplied under other sections of the specifications required to be built into, anchored to, or passing through concrete work, in co-ordination with the other trades.

.2 Supply templates for setting all anchorages required for the buildings and shelters.

1.5 DESIGN OF FORMWORK

.1 Assume full responsibility for the complete structural design and construction of formwork including shoring and bracing to resist vertical and horizontal loads due to the weight of wet concrete, self weight of forms, wind, fluid pressure of concrete, and other forces arising from equipment used in placing the concrete.

2 Products

2.1 MATERIALS

.1 Formwork Lumber: Plywood and wood formwork materials to CAN/CSA-A23.1/A23.2. Formwork materials used on site shall be new and acceptable to the Consultant, prior to erection. Panels shall be fabricated

for use as form panels, finished one side, with sealed edges and a minimum thickness of 17mm. Panels shall be smooth and free from defects which would show up on concrete surfaces exposed to view.

.2 Form Coating: Formaseal as manufactured by Master Builders for wood forms.

.3 Form Stripping Agent: CPD colourless non-staining odourless or as recommended by manufacturer of form liner.

.4 Joint Tape: non staining, water impermeable, self releasing, where required.

.5 Form Ties: removable or snap-off metal ties, fixed or adjustable length, free of devices leaving holes larger than 25 mm dia. in concrete surface, and not leaving metal closer than 25 mm to the surface of the concrete for walls. Snap tie length shall suit wall thickness as noted on drawings.

.6 Tie Hole Plugs: 25 mm dia. tapered PVC hole plugs.

.7 Form Ties/Supports: External clamping devices to retain form tight, uniform and easily removable around all columns.

3 Execution

3.1 ERECTION

.1 Verify lines, levels and column centres before proceeding with formwork and ensure dimensions agree with drawings.

.2 Construct forms to produce finished concrete conforming to shape, dimensions, locations and levels indicated within tolerances required by CAN/CSA-A23.1, and to produce acceptable finish where exposed.

.3 Construct falsework in accordance with CAN/CSA-S269.3.

.4 Obtain approval from soils testing engineer for bearing surfaces prior to erection of forms.

.5 Obtain Consultant's approval for use of earth forms.

.6 Hand trim sides and bottoms and remove loose earth from earth forms before placing concrete.

.7 Align form joints and make watertight. Keep form joints to minimum.

.8 Use (25) mm chamfer strips on external corners of beams, joints, columns, walls etc., exposed to view.

.9 Form chases, slots, openings, drips, recesses, expansion and control joints as indicated.

.10 Provide blocking and anchorage for hollow metal frames set to be cast into forms.

.11 Clean formwork in accordance with CAN/CSA-A23.1 before placing concrete.

.12 Forms shall remain in place for a minimum duration of 48 hours for footings, curbs, etc. and all other non self-supporting structural components.

.13 Re-use of formwork and falsework subject to requirements of CAN/CSA-A23.1.

.14 Be responsible for the safety of the structure, both before and after the removal of forms, until the concrete has reached its specified 28 day strength.

.15 When forms are stripped during the curing period, cure and protect the exposed concrete in accordance with Section 03300.

.16 Movement and displacement of formwork during construction, variations in excess of specified tolerances and marked and disfigured surfaces that cannot be repaired by specified methods will be considered defective work performed by this Section.

.17 Reconstruct defective formwork and replace concrete and reinforcement placed in defective formwork at no additional cost to the Owner.

END OF SECTION 03 10 00

1 General

1.1 SECTION INCLUDES

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

1.2 WORK IN OTHER SECTIONS

1. Related Work Specified in Other Sections

Section 03 10 00	:	Concrete Formwork and Accessories
Section 03 30 00	:	Cast-in-Place Concrete

1.3 REFERENCE STANDARDS

Do reinforcing work in accordance with:

CSA-A23.1-19: Concrete Materials and Methods of Concrete Construction
CSA A23.2-19: Test Methods and Standard Practices for Concrete
CSA G30.3-M1983 (R1998): Cold-Drawn Steel Wire for Concrete Reinforcement
CSA G30.18-21: Carbon Steel Bars for Concrete Reinforcement
ACI 315-2004 (SP66): Detailing Manual
ACI 315R-04: Manual of Structural and Placing Drawings for Reinforced Concrete Structures
CSA W186-21: Welding of Reinforcing Bars in Reinforced Concrete Construction

1.4 SHOP DRAWINGS

.1 Submit shop drawings in accordance with Section 01 33 00.

.2 Indicate bar sizes, spacing, location and quantities of reinforcement, mesh, mechanical splices, chairs, spacers and hangers with identifying code marks to permit correct placement without reference to structural drawings; (to Reinforcing Steel Manual of Standard Practice - Metric Supplement 1992 by Reinforcing Steel Institute of Ontario).

.3 Detail placement of reinforcing where special conditions occur.

.4 Design and detail lap lengths and bar development lengths to CSA-A23.3, unless otherwise indicated.

1.5 SUBSTITUTES

.1 Substitution of different size bars permitted only upon written approval of the Consultant.

2 Products

2.1 MATERIALS

.1 Reinforcing Steel: billet steel, deformed bars to CAN/CSA G30.18, unless indicated otherwise. Use Grade 400R bars for all reinforcing unless noted otherwise, to sizes as shown on the drawings.

.2 Welded Wire Fabrics: Where no reinforcement is shown, provide 152 x 152 MW 18.7 x MW 18.7 (6" x 6" x 6/6) welded wire fabric at 37mm (1½") below the finished surface of slabs on grade or walks, or toppings 62mm (2½") in thickness or greater. Lap ends and sides of fabric in accordance with requirements of CSA Standard CAN/CSA-A23.1, but in any event, not less than 300mm (12").

3 Execution

3.2 FABRICATION

.1 Fabricate reinforcing in accordance with CSA-A23.1.

.2 Obtain Consultant's approval for locations of reinforcement splices other than shown on steel placing drawings.

.3 Ship bundles of bar reinforcement, clearly identified in accordance with bar list.

3.3 STORAGE OF REINFORCING

.1 Reinforcing shall be stored off the ground to keep it free from dirt and to maintain its fabricated form.

3.4 FIELD BENDING

.1 Do not field bend reinforcement except where indicated or authorized by the Consultant.

.2 When field bending is authorized, bend without heat, applying a slow and steady pressure.

.3 Replace bars which develop cracks or splits.

3.5 PLACING

.1 Place reinforcing steel as indicated on reviewed shop drawings and in accordance with CSA-A23.1.

.2 Obtain Consultant's approval of reinforcing steel and position.

.3 Locate reinforcing bars to provide proper concrete cover. Reinforcing cover will be carefully inspected by the Consultant, and reinforcing with inadequate cover will not be acceptable.

.4 Fold all the wires behind bars, away from form faces. In the ice slab, bend down all tie wires on the wire mesh, away from the surface.

.5 Modify bars on site to accommodate box-outs, inserts, etc., as directed by the Consultant.

3.6 FIELD CUTTING OF REINFORCING

.1 Field cut reinforcing bars only where permitted by the Consultant.

END OF SECTION 03 20 00

1 General

1.1 SECTION INCLUDES

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

1.2 WORK IN OTHER SECTIONS

1. Related Work Specified in Other Sections

Section 0310 00	:	Concrete formwork and accessories
Section 03 20 00	:	Concrete reinforcing
Section 31 01 00	:	Earthwork
Section 07 60 00	:	Flashing and Sheet Metal
Section 06 10 00	:	Rough Carpentry
Division 23	:	Heating, Ventilation and Air Conditioning

1.3 REFERENCE STANDARDS

CSA-A23.1-19 – Concrete Materials and Methods of Concrete Construction
CSA A23.2-19 – Test Methods and Standard Practices for Concrete
CAN/CSA A3000-98 A3000-18 Cementitious Materials Compendium
CAN/CSA-A362-93: Blended Hydraulic Cement

1.4 SAMPLES

1. At least (3) weeks prior to commencing work, inform the Consultant of the proposed mix design and proposed source of ready mixed concrete.

2. A sample of the finishes shall be prepared and remain as the minimum acceptable standard for the project.

1.5 CERTIFICATES

1. Provide certification that plant, equipment, and materials to be used in concrete comply with requirements of CSA-A23.1.

2. Provide certification that mix proportions selected will produce concrete of specified quality and yield and that strength will comply with CSA-A23.1.

1.6 QUALITY ASSURANCE

1. The Contractor shall employ an independent inspection and testing company to carry out all testing and inspection as required. The Consultant will appoint the inspection and testing company. The cost of inspection and

testing shall be paid by the Owner, as specified in Division 1.

2. Samples and methods of moulding shall conform to the requirements of CSA-A23.2.

3. Additional testing shall be made if there is a distinct change in job conditions or if required by the Consultant or the authority having jurisdiction.

4. Compression tests shall be performed in accordance with CSA-A23.2 and good practice.

5. Failure to meet strength requirements will result in rejection of materials, strengthening or replacement of those portions that failed to develop the specified strength.

6. Concrete slump shall be tested at time that cylinders are cast and at such other times deemed necessary.

7. The addition of water and admixtures on the site is hereby prohibited and unacceptable for the project.

1.7 SUBMITTALS

1. Submit shop drawings in accordance with Section 01300 Submittals.

2 Products

2.1 MATERIALS

.1 Formwork: As specified in Section 03 10 00.

.2 Reinforcing Steel: As specified in Section 03 20 00.

.3 Portland Cement: to CAN/CSA-A5/A8/A362.

.4 Water: to CSA-A23.1.

.5 Aggregates: To CSA-A23.1. Coarse aggregates to be normal density.

.6 Air Entraining Admixture: To CAN/CSA-A23.5.

.7 Chemical Admixtures: To CAN/CSA-A23.56 water reducing type WN. Consultant to approve accelerating or set retarding admixtures during cold and hot weather placing.

.8 Non-Shrink Grout: Sika M-Bed Superflow or approved equal.

.9 Premoulded Membrane: Shall be Sealtight 7100-312 (PMPC), W. R. Meadows.

.10 Floor Hardener: Ashford Formula by Curecrete Chemical Company. Application shall be by flood method, after minimum 10 days cure of the ice slab. Saturate the surface with the Ashford Formula using a low-pressure, high-volume sprayer. Keep the entire surface glistening wet with Ashford Formula for a minimum 30 minutes. After the 30 minute application period, use a broom or mop to remove any puddles or concentrations of the Ashford Formula from the slab.

2.2 CONCRETE MIXES

.1 Proportion normal density concrete in accordance with CSA A23.1, to give following properties for concrete in foundation walls, footings and any other unspecified concrete:
- .1 Cement: Type GU Portland cement, minimum 325 kg/m3
- .2 Maximum 25% slag cement content
- .3 Minimum compressive strength at 28 days: 25 MPa.
- .4 Nominal size of coarse aggregate: 20 mm.
- .5 Slump at time and point of discharge: 50 to 100 mm.
- .6 Air content: 0 to 3%.

.2 Proportion normal density concrete in accordance with CSA-A23.1, to give following properties: for concrete in slabs-on-grade:
- .1 Cement: Type 10 Portland cement, minimum 325 kg/m^3
- .2 Maximum 25% slag cement content
- .3 Minimum compressive strength at 28 days: 32 MPa.
- .4 Nominal size of coarse aggregate: 15 mm.
- .5 Slump at time and point of discharge: 150 to 200 mm. Slump at end of pump hose: 150 to 180 mm.
- .6 Air content: 0 - 3% maximum.

.3 Proportion normal density concrete in accordance with CSA-A23.1, to give following properties: for concrete in exterior structural slabs and sidewalks/curbs:
- .1 Cementitious Materials Compendium minimum 325 kg/m3
- .1 Maximum 25% slag cement content
- .2 Minimum compressive strength at 28 days: 32 MPa.
- .3 Class of exposure: C-2.
- .4 Nominal size of coarse aggregate: 20 mm.
- .5 Slump at time and point of discharge: 60 to 100 mm.
- .6 Air content: 5 to 8%.

.4 Proportion normal density concrete in accordance with CSA-A23.1, to give following properties: for concrete in grouted masonry blocks and concrete in metal pans.
- .1 Cementitious Materials Compendium minimum 325 kg/m3
- .2 Maximum 25% slag cement content
- .3 Minimum compressive strength at 28 days: 20 MPa.
- .4 Nominal size of coarse aggregate: 10 mm.
- .5 Slump at time and point of discharge: 50 to 100 mm.
- .6 Air content: 0 - 3% maximum.

.5 Do not change job mix formula without prior approval of the Consultant.

.6 In addition to 28 day strength tests, 7 days test may be carried out. If average strength at 7 days is less than 70% of specified 28 day strength, check mix at once and adjust to ensure required strength is obtained.

3 Execution

3.1 CONTRACTOR QUALIFICATION

.1 All work in placing and finishing of the concrete slab must be completed but an experience. The Bidder shall submit a minimum of five (5) projects of similar scale, completed in the last 5 years, technology and complexity. Provide reference criteria as outlined in CCDC-11. Preference will be given to contractors with municipal experience.

3.2 WORKMANSHIP

.1 All concrete shall be as set forth in CSA-A23.1 and shall be composed of cement, fine and coarse aggregates and water.

.2 Concrete shall be delivered and discharged within 1½ hours after the introduction of the mixing water at the batch plant.

.3 Mixing, placing, compaction, curing, hot and cold weather protection shall conform to CSA-A23.1. Use power vibrators in sufficient number and in location and duration to the Consultant's complete satisfaction as required.

.4 Obtain the Consultant's approval before placing concrete. Provide 24 hour notice prior to placing of concrete.

.5 Pumping of concrete is permitted only after approval of equipment and mix.

.6 Ensure reinforcement and inserts are not disturbed during concrete

placement in order to maintain proper coverage.

.7 Prior to placing of concrete obtain the Consultant's approval of proposed method for protection of concrete during placing and curing in adverse weather.

.8 Maintain accurate records of poured concrete items to indicate date, location of pour, quality, air temperature and test samples taken.

.9 Do not place load upon new concrete until authorized by the Consultant.

3.3 INSERTS

.1 Co-ordinate and verify that the Electrical Contractor has set all ducts, boxes and other inserts and openings as indicated or specified elsewhere. Sleeves and openings greater than 100 x 100 mm not indicated on structural or civil drawings must be approved by the Consultant.

.2 Coordinate with refrigerant contractor and Owner for all inserts including but not limited to temperatures sensors, dasherboard inserts and goal net inserts.

.3 Do not eliminate or displace reinforcement to accommodate inserts or hardware. If inserts cannot be located as specified, obtain approval of all modifications from the Consultant before placing of concrete.

3.4 FINISHING

.1 Provide steel trowel finish on all concrete surfaces to in accordance with Section 03 35 00.

3.5 CURING AND PROTECTION

.1 Cure and protect newly finished slabs and steps in accordance with CSA-A23.1, Section 21.

.2 Coat exterior slabs, curbs with curing compound and leave for 30 days. Apply sealer after curing period has expired.

.3 Cure finished concrete surfaces in a manner which will leave the surface with a uniform appearance and with a minimum of discolouration after drying. Ensure that curing compounds are compatible with adhesives for finishes to be applied later.

.4 For all concrete slabs that are to remain exposed, curing compound is to be applied at a rate required for use as a sealer/hardener, in accordance with the manufacturer's instructions.

3.6 FIELD QUALITY CONTROL

.1 Inspection and testing of concrete and concrete materials will be carried out by a Testing Laboratory designated by the Consultant in accordance with CSA-A23.1.

.2 The Consultant will take additional test cylinders during cold weather concreting. Cure cylinders on job site under same conditions as concrete which they represent.

.3 Inspection or testing by Consultant will not augment or replace contractor quality control nor relieve him of his contractual responsibility.

3.7 TOLERANCES

.1 Cast-in-Place concrete shall be constructed within the dimensional tolerances specified in CSA-A23.1, as specified elsewhere in this section. Concrete floor slabs shall be constructed as moderately flat slabs and within the tolerances listed below.

.2 Conform in line, level and plumbness to the following tolerances. These are maximum values.

.3 Variation from level or from grades shown in floor slab:

:	In any 3m (10')	-	3 mm (1/8")
:	Overall	-	6 mm (1/4")

.4 Variation from level or from grades shown in floors grade:

:	In any 3m (10')	-	3 mm (1/8")
:	In any bay up to 6m (20')	-	6 mm (1/4")
:	In any 12m (40')	-	12 mm (1/2")

.5 Variation in size and location of sleeves, floor open and the like and in location of bolts, inserts and fastenings:

:		-	6 mm (1/4")

.6 Variation in location of bolts, inserts, sleeves and fastenings when in group:

:		-	3 mm (1/8")

.7 Variation in cross-section of slabs, walls and piers:

:	Maximum oversize	-	3 mm (1/8")

: Maximum undersize - 3 mm (1/8")

.8 There shall be no variations from required level at junction of walls and floors.

.9 Where drains occur, floors shall be properly and uniformly sloped to allow complete drainage of the area.

3.8 DEFECTIVE CONCRETE

.1 Concrete is defective when:
.1 Containing visible honeycombing or embedded debris.
.2 Concrete damaged by freezing or which is unsatisfactory due to placement at too high a temperature.

.3 Average 28 day strength of any three consecutive strength tests is less than specified minimum 28 day strength.
.4 Any 28 day strength test result in less than 88% of specified minimum 28 day strength.
.5 Cracking occurs in locations other than at control and construction joints.
.6 Curing is not carried out strictly according to the specifications.

.2 Remove and reconstruct in entirety any defective concrete footing, slabs, walls as directed by the Consultant.

3.9 COLD WEATHER PROTECTION

.1 Refer to CSA Standards CSA-A23.1 and CSA-A23.2 Provisions and Publications. Include for tarped heated enclosures - no non-freeze additives such as calcium will be tolerated on this project.

END OF SECTION 03 30 00

1 GENERAL

1.1 GENERAL REQUIREMENTS

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

1.2 WORK IN OTHER SECTIONS

.1 Related Work Specified in Other Sections

Section 03 10 00	:	Concrete Formwork
Section 03 30 00	:	Cast-in-Place Concrete
Section 06 10 00	:	Rough Carpentry
Division 16	:	Heating, Ventilation and Air Conditioning

1.3 QUALIFICATION

.1 The work of this Section shall be carried out by an established concrete finishing company having a proven record of satisfactory workmanship for a period of at least 5 years prior to this contract and approved by the Consultant.

1.4 SCOPE OF WORK

.1 Supply all materials, labour and service to provide acceptable finishes to all concrete floors, exterior slabs and exterior steps where indicated or required.

.2 Supply all labour, materials and equipment necessary and as required to provide acceptable finishes for all concrete floor slabs, exterior concrete sidewalks, aprons, steps, traffic deck and exposed concrete retaining walls where noted on drawings and specified herein.

1.5 REFERENCE STANDARDS

CSA-A23.1-19: Concrete Materials and Methods of Concrete Construction
CSA-A23.2-19: Test Methods and Standard Practices for Concrete

2 Products

2.1 MATERIALS

.1 Concrete Mixes: As specified in Section 03 30 00.

.2 Curing and Sealing Compounds: As specified in Section 03 30 00.

.3 Concrete Hardeners: As specified in Section 03 30 00.

.4 Formwork: As specified in Section 03 10 00.

.5 Admixtures: As specified in Section 03 30 00.

.6 Retarders: As specified in Section 03 30 00.

3 Execution

3.1 CURING AND PROTECTION

.1 Cure, seal and protect newly finished slabs and steps in accordance with CSA-A23.1, Section 21, and as specified in Section 03 30 00.

3.2 CONCRETE FINISHING

.1 General: Finish surfaces of all concrete in a manner acceptable for the installation of finished floor materials or if exposed in a manner acceptable to the Consultant.

.2 Broom Finish: Concrete floor surfaces, which are to receive quarry, ceramic tile or precast terrazzo, and exterior sidewalks and concrete paving Type 1 shall have a fine broom finish after trowelling.

.3 Steel Trowel Finish: All interior concrete floors, and concrete curbs which are to receive special flooring, resilient flooring or remain exposed, shall have steel trowel finish. After surfaces have been floated, steel trowel with machine trowels to produce a smooth, dense, hard surfaces with close surface tolerances.

.4 Control Joints: Sawcut control joints as shown on drawings. Maximum spacing of control joints 3000mm in each direction. Co-ordinate locations with finished floor control joints. Sawcut joints within 24 hours of placing and to a depth as detailed on drawings.

END OF SECTION 03 35 00

1 General

1.1 GENERAL REQUIREMENTS

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

1.2 WORK IN OTHER SECTIONS

.1 Related Work Specified in Other Sections

Section 03 10 00	:	Concrete Formwork & Accessories
Section 03 30 00	:	Cast-in-Place Concrete
Section 04 20 00	:	Unit Masonry
Section 05 10 00	:	Structural Metal Framing
Section 09 90 00	:	Painting

1.3 QUALIFICATION

.1 The work of this Section shall be carried out by an established concrete precasting company having a proven record of satisfactory workmanship for a period of at least 5 years prior to this contract and approved by the Consultant.

1.4 SCOPE OF WORK

.1 Supply all materials, labour and service to provide acceptable finished precast concrete floors, where indicated on the structural drawings.

1.5 REFERENCE STANDARDS

.1 Perform work of this Section to meet specified requirements of C.S.A. Standard CSA-A23.1-19, Concrete Materials and Methods of Concrete Construction.

.2 Additionally perform work of this Section to meet specified requirements of CSA-A23.4-19, Prestressed Concrete.

.3 Concrete shall have a minimum compressive strength of 25 MPa at transfer and 40 MPa at 28 days.

.4 The prestress strand shall be uncoated 7-wire cable conforming to CAN3-G279.2. Withdrawn.

.5 Precast slabs shall be manufactured by an extrusion process using smooth rigid steel forms and cut to length as required on the project.

1.6 SYSTEM DESCRIPTION

.1 Structural Requirements: Fabricate slabs to support dead loads, and live loads as indicated on Drawings, with maximum deflections of

: 1/360 of the span where ceilings are suspended from the slabs.

: 1/240 of the span where ceilings are not suspended from the slabs.

.2 Tolerances: Ensure that subfloor surfaces under finish flooring are levelled by filling compound or other means to within 3.2mm under a 3m long straightedge and within a maximum variation of 1.5mm in any running 300mm.

.3 Designer Qualifications: Design and supervise fabrication of precast hollow core concrete slabs specified in this Section by professional engineers licensed to practice at the place of building.

1.7 REQUIREMENTS OF REGULATORY AGENCIES

.1 Fabricate precast hollow core concrete slabs that are validated by ULI, ULC or NRC tests for fire-protection or fire-resistance ratings in complete accordance with the test design specification. Precast hollow core concrete slabs provided otherwise, and which require a fire rating, will be approved only on presentation of affidavits that it is acceptable to the authorities having jurisdiction.

1.8 INSPECTION SERVICES

.1 Submit affidavits that precast hollow core concrete slabs have been fabricated to meet requirements of the Specifications. Include copies of mill tests of reinforcement incorporated, and compression test results of tests made for each 38 cu.m, or part, of concrete.

1.9 SUBMITTALS

.1 Design Data: Submit, with shop drawings, calculations pertaining to the design of slabs including reinforcement, anchorage, connections and estimated camber, and in the same manner as for shop drawings.

.2 Submit shop and erection drawings.

.3 Include documentation of manufacturing procedures including means of checking strand slippage, concrete strength at time of detensioning, and methods used to determine slippage and concrete strength.

.4 Affix the seal of the engineer, signed and dated, who is responsible for structural analysis and design of cellular concrete slabs on each shop

drawing and supporting document.

.5 Affidavits: Submit affidavits as specified in this Section for products, if requested.

.6 Production Reports: Submit test reports of strand slippage with a performance evaluation of each slab.

1.10 DELIVERY, STORAGE AND HANDLING

.1 Handle, transport and store precast hollow core concrete slabs as required by specified reference standards, and by use of methods devised or approved, or both, by fabricator to prevent staining, soiling and damage.

.2 Store precast hollow core concrete slabs to clear ground or other bearing surfaces, to prevent overstress, warp, twist, accumulation of water and snow in depressions and holes, and to afford free movement of air on all sides of each unit.

1.11 SITE CONDITIONS

.1 Environmental Requirements: Grout in anchorage and joints, and patch concrete, only when air and surface temperatures exceed 4 deg. C and will remain so until grout has cured.

2 Products

2.1 MATERIALS

.1 Incorporate materials to meet specified requirements of CSA-A23.4-16, and as required to meet specified performance.

.2 Reinforcement:

.1 Mild Steel Bars: Billet steel to meet specified requirements of CAN/CSA-G30.18-09 (R2019).

.2 Prestressing Tendons: Uncoated, 7 wire strand, high tensile steel to meet specified requirements of CSA G279-1975 (R1998).

.3 Water: Verify that no salts are present that will cause efflorescence.

.4 Bearing Pads: 3.2mm thick tempered hardboard, smooth on each side, to meet specified requirements of CGSB Specification 11-GP-3M, Type 2.

.5 Grout: Cement grout consisting of one part portland cement mixed with 2½ parts sand and sufficient water for placing and hydration.

.6 Sealant: To suit manufacturer's standards.

.7 Core Insulation: Rigid polystyrene to meet specified requirements of CGSB 41-GP-14a Type 4.

.8 Levelling Topping: Shall be cementitious based, minimum 3 mm in thick over the entire floor area (gypsum based products are not acceptable). The finish shall be smooth so as to prevent the telegraphing of finish through the floor covering.

.9 Bonding Agent: Shall be Sikadur-32 Mi-Mod or approved equal.

3 Execution

3.1 EXAMINATION

.1 Verify, before delivery of materials to site, that construction to receive precast slabs is located correctly and at proper levels.

.2 Ensure that bearings are clean, smooth and level, and provision has been made for proper anchorage.

.3 Defective hollow core concrete slab installation caused by unsatisfactory construction previously completed will be considered the responsibility of this Section.

3.2 PREPARATION

.1 Take particular care to protect finished surfaces that are exposed to view from mortar droppings and smears.

.2 Protect visible edges of slabs that are exposed to possible damage.

.3 Protect slabs from damage from welding by use of non-combustible shielding.

3.3 FABRICATION

.1 Fabricate slabs:

.1 To meet specified requirements of reference standards for fabrication and manufacturer's certification.

.2 To ensure that finished dimensions are within specified tolerances.

.3 To meet or exceed performance requirements.

.4 With concrete consolidated through full cross-section of slabs to provide full bond with reinforcement, and surfaces free of cold joints and honeycombing.

.5 With cambers incorporated.

.6 To include closure slabs of special widths to suit Project conditions.

.7 With surfaces of a uniform appearance where exposed to view, and with no visible seams.

.8 With raked finish where topping is to exceed 25 mm.

.2 Concrete:

.1 Of mix designed by fabricator to meet requirements of Specifications.

.2 Normal weight, with compressive strength of 40 MPa at 28 days.

.3 Reinforcement:

.1 Cover reinforcement with concrete to a thickness required by jurisdictional authorities to provide fire protection.

.2 Minimum strength of concrete at detensioning shall be 25 MPa.

.3 Record strand slippage.

.4 Curing: Cure slabs by normal curing process.

.5 Finishing: Provide smooth finishes as approved by the Consultant for carpet and vinyl tile floor finishes and for painting of ceiling.

3.4 INSTALLATION

.1 Install slabs with uniform joint widths, and units aligned straight, plumb, level and square. Cumulative dimensional error in position of slabs will not be allowed.

.2 Install bearings and set slabs on them dry.

.3 Coordinate the location of holes through slabs with consultant drawings, and cut holes through slabs to ensure that no damage is caused to slabs or reinforcement.

.4 Supply information required for installation of anchors, supports, inserts and similar accessories that are required by this Section and are installed by other Sections. Assist or supervise, or both, in their installation.

.5 Install and grout in anchorage.

.6 Drypack completely under the edges of slab (full length) above and between beams, walls, etc.

.7 Do not grout one cell of the core throughout the length of the slab installation, to provide for installation of electrical, telephone and data services.

.8 Fill joints and keys between slabs completely with grout. Saturate surfaces of joints and keys with water before grouting.

.9 Apply skim coat of concrete over each floor area to provide a level smooth substrate for installation of finish flooring within tolerances as per CSA-A23.4 and as specified in Section 03 30 00.

.10 Do not install chipped, cracked, blemished, stained or otherwise defective units.

.11 Caulk between abutting slabs and at joints between slabs and adjoining construction to meet specified requirements in applicable sections of this specification.

3.5 ADJUSTMENT AND CLEANING

.1 Patch holes and damaged surfaces where exposed to view with concrete to match adjacent area. Use bonding agent if required to ensure bond. Finish patches to match precisely the colour and texture of adjacent area. Remove and repatch areas that do not match.

.2 Co-ordinate location and size of holes with applicable sub-trades. Repair oversized, misaligned and incorrect openings in a manner acceptable to the Consultant.

.3 Clean surfaces of slabs exposed to view after joint treatment is complete. Use fibre brushes, water and mild cleaning agents only as recommended by precast fabricator. Remove deposits of foreign material, dirt, soil and stains. Do not use tools which will damage finish surfaces. Rinse thoroughly with clean water after cleaning.

.4 Protect adjoining surfaces from damage during cleaning.

END OF SECTION 0340 00

1 General

1.1 DESCRIPTION

.1 The General conditions of the Contract and Supplementary General Conditions apply to this Division, except as qualified herein and/or excluded.

.2 Refer to drawings and specifications.

1.2 WORK INCLUDED

.1 Design, supply, delivery and installation of:

.1 Precast concrete insulated wall panels.

.2 Field sealing of all precast concrete wall panels inside where accessible and outside between precast panels and between precast and foundation walls.

.3 Take delivery and cast into precast work boxes/inserts/openings required by other trades.

.2 Supply information required for installation of bracing, supports, inserts and similar accessories required for work under this contract supplied and installed by others.

1.3 Related Work

Section 03300	:	Cast-in-Place Concrete
Section 07200	:	Thermal Protection
Section 07900	:	Sealants
Section 08500	:	Windows
Section 07800	:	Fire & Smoke Protection

Supply and installation of:

.1 Hollow metal frames: Section 08 10 00 - Metal Doors & Frames.

.2 Structural steel framing except around door openings: Section 05 41 00 - Structural Metal Framing.

.3 Field caulking between precast concrete and masonry.

1.4 REFERENCE STANDARDS

CSA A23.1:19, Concrete Materials and Methods of Concrete Construction
CSA A23.2:19, Methods of Test for Concrete
CSA A23.3:19, Design of Concrete Structures
CSA A23.4:21,Precast Concrete-Materials and Construction
CSA A283:19,Qualification Code for Concrete Testing Laboratories
CAN/CSA G164-18, Hot Dip Galvanizing of Irregularly Shaped Articles
CSA W186:21, Welding of Reinforcing Bars in Reinforced Concrete Construction
CSA W47.1:19, Certification of Companies for Fusion Welding of Steel Structures

1.5 QUALIFICATIONS OF MANUFACTURER

.1 Fabricate precast concrete elements certified by the Canadian Standards Association in the appropriate categories according to CSA Standard A23.4 "Precast Concrete - Materials and Construction". The precast concrete manufacturer shall be certified in accordance with the CSA Certification Program for Architectural and Structural Precast Concrete prior to submitting a tender and must specifically verify as part of his tender that he is currently certified in the appropriate categories:

(A) Precast Concrete Products - Architectural

(I) Non-Prestressed or (II) Prestressed

(B) Precast Concrete Products - Structural

(I) Non-Prestressed or (II) Prestressed

(C) Precast Concrete Products - Speciality

(I) Non-Prestressed or (II) Prestressed

Only precast concrete elements fabricated by certified manufacturers are acceptable to the Owner. Certification must be maintained for the duration of the fabrication and erection for the project. Fabricate precast concrete elements in accordance with Ontario Building Code requirements.

.2 The insulated precast concrete manufacturer shall be a member in good standing with the Canadian Precast/Prestressed Concrete Institute (CPCI) and have a proven record and satisfactory experience in the design, manufacture and erection of insulated precast concrete facing units of the type specified. The company shall have adequate financing, equipment, plant and skilled personnel to detail, fabricate and erect the work of this Section as required by the Specification and Drawings. The size of the plant shall be adequate to maintain the required delivery schedule.

1.6 BY-LAWS AND CODES

.1 Conform with applicable requirements of Ontario Building Code, National Building Code and local authorities having jurisdiction.

.2 Design and provide reinforcement, anchors and supports as required by codes and to Consultant's approval. Submit relevant design data prepared by a registered structural engineer for approval if so requested by the Consultant.

1.7 ALLOWABLE TOLERANCES

.1 Conform with requirements of CSA A23.4-Section 10.

.2 Refer to related Sections of this Specification and fabricate work to accommodate specified tolerances.

1.8 SOURCE QUALITY CONTROL

.1 In addition to quality control, an independent inspection and testing company may be appointed by the Owner to verify compliance with this Specification.

.2 Cooperate with Inspector to facilitate his work.

.3 Cost of independent inspection to be paid by the owner.

1.9 SHOP DRAWINGS

.1 Prepare and submit shop drawings in accordance with the General Conditions of the contract, CSA A23.4 and CSA A23.3, and as specified below. Submit in accordance with Section 01 33 00.

.2 Submit fully detailed and dimensioned drawings showing method of fastening and sealing. Indicate type of finish and other pertinent information on each shop drawing.

.3 Show exact location of inserts and anchors required to be cast in precast units for interface elements.

.4 Show the system of identifying units for erection purposes on shop drawings and apply a similar mark on units at time of manufacture.

.5 Provide Shop Drawings to obtain approvals from the authorities having jurisdiction prior to fabrication of the insulated precast panels.

.6 Each drawing submitted shall bear stamp and signature of a professional engineer registered in the Province of Ontario.

1.10 SAMPLES

.1 Provide samples of insulated precast cladding for approval. Unless otherwise noted, the minimum sample size shall be 300 x 300 x 25 mm. Finish exposed face as described under "finishes" elsewhere in this Section. Make samples to obtain approval. All work shall match the approved production run panel colour range.

1.11 WARRANTY

.1 Provide standard warranty with a duration of one (1) year in accordance with the General Conditions. Warranty shall be in writing and shall warrant materials and workmanship under this Section to be free from defects for the period stipulated.

1.12 DELIVERY, STORAGE AND PROTECTION

.1 Accept full responsibility for delivery, handling and storage of units.

.2 Deliver, handle and store precast units in a near vertical plane at all times, and by methods approved by the manufacturer. Do not permit units to contact earth or staining influences or to rest on corners.

1.13 DESIGN

.1 Requirements: Design and fabricate insulated panels, brackets and anchorage devices so that when installed they will:

.1 Compensate for allowable construction tolerances in structure to which they are secured.

.2 Tolerate structural deflection of span/360 due to live load and distortion of structure, without imposing load on panel assembly.

.3 Adequately sustain themselves, and superimposed wind, snow loads, without exceeding deflection of span/360.

.4 Permit no water infiltration into the building under design loads.

.2 Design loads shall be as specified by the Ontario Building Code.

.3 Panels to be non-composite or composite as required to meet unsupported span requirements.

2 Products

2.1 MATERIALS

.1 Cement white cement colouring material], aggregates, water admixture: to CSA A23.4 and CSA A23.1.to match existing wall panels

.2 Exposed aggregate [and special facing materials]: [quartz] [dolomite] [granite] [marble] [river stone] to match selected finish sample.

.3 Use same brand and source of cement and aggregate for the entire project to maximize the uniformity of coloration and other mix characteristics.

.4 Reinforcing steel: to CSA A23.4.

.5 Forms: to CSA A23.4.

.6 Hardware and miscellaneous materials: to CSA A23.4.

.7 Anchors and supports: to CSA G40.21, Type [400W].

.8 Welding materials: to CSA W47.1and CSA W186.

.9 Bearing pads: smooth, high impact plastic.

.10 Shims: steel.

2.2 CONCRETE MIXES

.1 Unless otherwise noted or specified, use concrete mix designed to produce a minimum of 35 MPa compressive cylinder strength at 28 days, with a maximum water/cement ratio to CSA A23.4.

.2 Use white or grey cement in facing matrix

.3 Air Entrainment of Concrete Mix: Refer to CSA A23.4

.4 Use of calcium chloride not permitted.

2.3 REINFORCEMENT AND ANCHORS

.1 Paint anchors after fabrication with zinc rich primer. Touch up anchors with zinc rich primer after welding.

.2 If panels are prestressed, conform to CSA A23.3.

2.4 FABRICATION

.1 Production of insulated precast concrete wall panels, fabricate units to CSA A23.4.

.2 Mark each precast unit to correspond to identification mark on shop drawings for location.

.3 Mark each precast unit with date cast.

.4 Ensure that surfaces to receive sealant are smooth and free of laitance to provide a suitable base for adhesion. Ensure that release agents do not deleteriously affect the sealing of the joints.

.5 Cast panels in accurate rigid moulds designed to withstand high frequency vibration. Set reinforcing anchors and auxiliary items as shown on the drawings. Cast in anchors, blocking and inserts supplied by other Sections as required to accommodate their work.

.6 Anchors, lifting hooks, shear bars, spacers and other inserts or fittings required shall be as recommended and/or designed by manufacturer for a complete and rigid installation. Each shall conform to requirements of local building By-Laws. Lift hooks shall be adequately sized to safely handle panels according to panel dimension and weight. Anchors/inserts shall be concealed where practical.

.7 Burn off exposed lift cables paint and fill in if required.

2.5 FINISH

.1 Finish and colour of precast units to match existing.

.2 Fluted finish: achieve finish using trapezoidal form liners or other mechanical methods.

.3 Smooth finish: as cast using smooth steel form liners.

.4 Exposed aggregate finish:

.1 Apply even coat of retardant to inside face of forms.

.2 Remove panels from forms after concrete hardens.

.3 Expose coarse aggregate by washing and brushing away surface mortar.

.4 Expose aggregate to depth required.

.5 Sandblast finish: in order to expose aggregate face, sandblast surface to depth to match approved sample.

.6 Interior panel finish to be smooth steel trowel or smooth form finish.

3 Execution

3.1 GENERAL

.1 Erect precast work in accordance with CSA-A23.4.

.2 Supply anchors for precast units required to be cast into the concrete frame to Contractor for installation. Provide such items in ample time to meet construction program. Supply layout drawings locating accurately the position of all cast in items to be installed by other Sections.

.3 Structural Engineer to sign-off on building stability prior to precast erection.

3.2 INSTALLATION

.1 Set precast concrete units, straight, level and square.

.2 Non-cumulative Erection Tolerances as per CSA A23.4.

.1 Joint dimension.

.2 Joint taper.

.3 Edge alignment.

.4 Faces of adjacent panels.

.5 Bowed panels.

.3 Fasten units in place as per approved connection detail shop drawings. Protect work from damage by weld splatter.

.4 Clean field welds with wire brush and touch up with galvafroid paint or zinc rich primer.

.5 Remove temporary shims and spacers from joints of non-load bearing panels after fastening but before sealant is applied.

.6 Apply sealant and joint backing to exterior and interior joints to provide a complete weathertight installation in accordance with Section 07 90 00. All exterior joints are to be vented.

3.3 CLEANING

.1 If required, clean exposed face work by washing and brushing only, as precast is erected. Use approved masonry cleaner if washing and brushing fails to achieve required finish. Remove immediately materials which set up or harden. This section is not responsible for soiling or damage by others.

END OF SECTION 0345 00

1 General

1.1 GENERAL REQUIREMENTS

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

1.2 WORK IN OTHER SECTIONS

.1 Related Work Specified in Other Sections

Section 03 30 00 : Cast-in-Place Concrete
Section 05 10 00 : Structural Metal Framing
Section 05 50 00 : Metal Fabrications
Section 07 60 00 : Flashing and Sheet Metal
Section 07 90 00 : Joint Protection
Section 08 10 00 : Doors & Frames
Section 31 01 : Earthwork

.2 Products Supplied Under Work of Other Sections

and Installed Under Work of This Sections

Section 08 10 00: Doors and Frames

1.3 QUALIFICATIONS

.1 Execute work of this section only by a contractor who has adequate equipment and skilled tradesmen to perform it expeditiously and is known to have been responsible for satisfactory installations similar to that specified during a period of at least five years.

1.4 REFERENCE STANDARDS

CAN/CSA-A5/A8/A362-93 - Blended Hydraulic Cement
CAN/CSA-A165 SERIES-14 (R2019) - Concrete Block Masonry Units
CAN/CSA A82:14 (R2018), ASTM C216-10 – Fired Masonry Brick Made from Clay or Shale
CSA A371-14 (R2019) – Masonry Construction for Buildings
CSA S304.14 (R2019) – Design of Masonry Structures
CSA-A23.1:19 - Concrete Materials and Methods of Concrete Construction

.1 Install flashings in masonry as follows:

.1 Install flashings under exterior masonry bearing on foundation wall.

1.5 SUPERVISION

.1 Work of this Section shall be executed under the continuous supervision and direction of a competent foreman for each class of work.

.2 One thoroughly experienced, reliable and competent tradesman shall be in charge of mortar mixing.

.3 Ensure that all items required to be built into masonry walls by all other trades are known and co-ordinated prior to commencement of work.

.4 Consult the approved shop drawings for all sections of the specifications to determine the exact location of items to be built into masonry.

1.6 SUBMITTALS

.1 Submit for approval clearly labelled samples of masonry materials to be used in the work. Submit for approval any alternative materials if requested by the Consultant.

.2 Provide a mock-up sample, 1200mm HIGH by 1800mm LONG, for each of the following items, prior to commencing work:-
: exterior block

1.7 DEFECTS DEFINED

.1 In addition to non-compliance with specified requirements or other contract requirements, the following will be considered defect:

.1 Shrinkage in individual units and erected walls.

.2 Spalling, efflorescence, cracking or chipping of units.

.3 Poor colour or texture blending of units.

.4 Surface deterioration dusting.

.5 Discolouration, crumbling and similar deterioration of mortar, grout.

.6 Failure of built in items to remain anchored.

1.8 STORAGE OF MATERIALS

.1 Store cementitious material in accordance with CAN/CSA-A5/A8/A362. Store aggregates in accordance with CSA-A23.1. Stack masonry units to avoid chipping. Manufacturer's seals and labels shall be intact. Refer to cold weather protection Article 3.6 for requirements of preheating masonry materials prior to building in.

1.9 WIND BRACING

.1 Brace walls during construction until the structure provides sufficient lateral support. **This is a mandatory requirement**.

1.10 PROTECTION

.1 Cover top of completed and partially completed masonry walls not protected by permanent work. Use waterproof coverings draped 600 mm (min.) down each side of wall and securely anchored. **This is a mandatory requirement.**

2 Products

2.1 MATERIALS

.1 General: Use only materials specified herein.

.2 Water: Verify that water used contains no salts to cause efflorescence.

.3 Concrete Masonry Units:

.1 Bubble cured units or Autoclaved units to meet requirements of CSA-A165 Series 14.

.2 Type H/15 A/M normal weight block.

.3 Size Metric

.4 Special Shapes - Supply corner block, "L" shape block, bullnose block, header block, lintel block and the like as shown on the drawings, or as required.

.4 Glass Fibre Board: Glass fibre insulation, semi-rigid board, density of 20.8 kg/m^3 (1.3 lbs./cu.ft.).

.5 Bellows for Control and Expansion Joint: Bituminous membrane type compatible with wall membrane.

.6 Dampproof/Thru-Wall Flashing: Fibre reinforced membrane, coated one side with 0.61 kg/m^2 (2 oz./sq.ft.) copper, to meet quality standard of Copper-Bar by Gummed Papers Limited or Bituminous reinforced membrane manufactured by Monsey Bakor Inc.

.7 Asphalt Emulsions: As specified in CGSB 37-GP-2M.

.8 Brick Vents: Flexible PVC offset "T" shape with vertical leg slotted to allow passage of air, for installation in vertical joints, to meet quality standard of

GOODCO brick vent.

.9 Wall Reinforcing: As shown on Structural drawings.

.10 Flexible Anchor: To suit conditions and to allow for differential movement between the structure and masonry work. Typically: 4.76 mm (3/16") diameter steel, galvanized, bent into an equilateral triangular shape with its apex flexibly secured to structure, and with its two legs terminating in 25 mm (1") inward bent hooks extending a minimum of 100 mm (4") into masonry anchored.

.11 Wall Ties: 22 gauge galvanized corrugated steel.

.12 Stud Anchors: 14 gauge, hot-dipped galvanized steel plate anchors with 4.76mm (3/16") diameter galvanized steel wire ties for cavity wall.

.13 Bond Anchor: 4.76 mm (3/16") diameter steel galvanized with 50 mm (2") end bent 90^{o}.

.14 Galvanizing: To specified requirements of ASTM Specification A153, Class B.3 coatings, for all bolts and hardware, ASTM Specification A116, Class 3 coating, for masonry ties other than above.

.15 Cleaner: Vanatrol as manufactured by C.P.D., Ratio 6:1 unless otherwise noted by brick/mortar/grout manufacturer. (MURIATIC ACID NOT ACCEPTED).

3 Execution

3.1 GENERAL WORKMANSHIP

.1 Employ properly qualified masons for laying up masonry units.

.2 Distribute exposed masonry units of varying colours, tones and textures evenly over wall surface to avoid patches and streaks and to produce a pleasing appearance.

.3 Gaining to meet spandrels, etc., leaving courses uneven or with visibly thicker mortar joints will not be acceptable. Any such work must be removed and rebuilt to approval of Consultant.

.4 Construct masonry evenly in maximum lifts of 1200 mm per working day. Rake back ends of unfinished walls; do not tooth and bond new masonry.

.5 Chases, fixtures, outlets must be built - not cut. Co-ordinate with Mechanical and Electrical.

.6 Install aluminium and hollow metal door frames by building in lugs and filling voids with mortar. Keep frames free of mortar stains. Protect as required.

.7 Chipped or blemished units may be used where concealed. Chipped, cracked or broken units are considered deficiencies where exposed to file and shall be removed and replaced.

.8 Build masonry with accurately plumbed faces, truly horizontal bed joints and accurately aligned vertical joints.

.9 Notwithstanding current trade practices in this regard, fill all vertical collar and bed joints through the entire wall thickness solidly with mortar.

.10 Cut masonry neatly with a carborundum saw where it comes in contact with the structure and where else required and build tightly against the structure except where expansion control and deflection joints are required. Build masonry up and neatly fit to all openings, and all anchors for frames for such openings shall be built securely into joints.

.11 Do all cutting, fitting and patching in masonry work to receive work of other trades. Install items supplied by other trades to be built into masonry walls, plumb, level, rigid and secure. Build in all miscellaneous metal work, loose lintels, bearing plates, sleeves, anchor bolts, wood nailer and all other items which require building into the masonry. Set access doors with front face flush with final wall finish. Locate such fittings precisely as directed.

3.2 LINTELS

.1 Set loose lintels supplied under Section 05100 for bridging openings in masonry.

.2 Bridge openings not exceeding 450 mm in width with 6 mm mild steel plate lintels bearing 100 mm on each side of opening. Width of plate shall be wall thickness less 25 mm. Joint at lintel to be dry packed. Provide minimum brick vents per lintel at 800 o/c.

.3 Install concrete block lintels where indicated on drawings. Fill with 25 MPa concrete and reinforce as shown. Temporarily support until concrete is cured.

3.3 STRUCTURAL BEARING

.1 Install bearing pads in all load bearing walls to receive structural components by:

: Two courses of solid masonry units at least 400mm (16") in upper course and 800mm (32") long in lower course or by lintel blocks at least 800mm (32") long filled with 25MPa (3600 psi) concrete and

reinforced with two 10mm (3/8") diameter bars, in bearing course only.

: Co-ordinate this work with fixing devices provided under the work of Section 05100.

3.4 DAMPPROOF COURSE/THRU-WALL FLASHINGS

.1 Install bituminous membrane on walls and partitions rising from footings below grade and in locations indicated on Drawings. Lap and seal all joints. Install thru-wall flashings at all lintels, grade junctions and roof junctions and in locations indicated on the drawings. Lap and seal all joints.

3.5 CONTROL JOINTS

.1 Control joints shall be located at maximum spacings of 4800 to 6000 centres and be located as shown on the drawings.

3.6 COLD WEATHER PROTECTION

.1 Refer to the Ontario Masonry Contractor's Association's provision and publications. Include for tarped heated enclosures, heated mortar mixing pans - no non-freeze additives such as calcium will be tolerated on this project.

3.7 BONDING

.1 Lay face brick and concrete block units coursing in running bond pattern. Lay soldier and header coursing. Corbel brick piers and friezes as shown on drawings.

.2 Lay brick coursing to course every second block course. Course soldier coursing to course on three stretcher courses.

.3 Construct quoins, header courses and soldier and corbelling to protrude 25mm.

.4 Lay stone in random pattern. Dry pack solid all stone.

.5 Cut brick to provide opening dimensions shown only as necessary. Cut ends are not to be exposed.

.6 Anchor brick to back-up at 400 o/c vertical and horizontal maximum with ties.

3.8 JOINTS

.1 Ensure cavity width is maintained and keep free of droppings. Back trowel

to prevent build-up of mortar.

.2 Rake brick joints to size and depth in accordance with recommended trade practices.

.3 Keep control joints, expansion joints and air spaces free from mortar and droppings.

.4 Construct Control Joints in locations shown. DO NOT SAW CUT. Sealing to be carried out in conformance with Section 07900. Install bellows to maintain membrane air barrier integrity. Keep joints free of mortar droppings.

.5 Make joints of uniform thickness with vertical joints plumbed over each other. Do not butter corners of units, allow mortar scrapings in joints excessively or shift and tap units after mortar has initially set.

.6 For solid masonry units completely fill with mortar both bed and vertical joints.

.7 For hollow masonry units ensure that mortar covers all available bearing surfaces fully and fills vertical joints, except for weep and vent holes.

.8 When work is resumed on walls previously laid with mortar either partially or totally set, remove loose masonry and mortar from top and adjoining surfaces. Remove mortar completely when masonry is removed and replaced with new.

.9 Form tooled concave joints for concrete block walls wherever exposed to view, whether behind cabinets, fitments, and wall accessories, or not. When mortar has become "thumbprint" hard by a tool having a minimum 500mm long bearing surface to avoid uneven depressions. Clean off burrs with trowel or burlap.

.10 Rake out joints at juncture of interior and exterior walls with columns, at intersections of walls and partitions where joint reinforcement is installed, and at other caulked joints.

.11 Form reglets required for metal flashing in masonry.

.12 Flush-in solidly with mortar between cavity filler strips and interior face of brick veneer.

.13 Cut joints off flush where treatment is not otherwise specified. No mortar shall protrude from joints on wall surfaces to which insulation will be applied.

.14 Install insulation using adhesive recommended by the manufacturer.

Insulation is to be tight fitting with no joints.

3.9 LAYING MASONRY

.1 Stop off horizontal runs of walls by racking back a half unit in each horizontal course: do not tooth.

.2 Wet clay and shale masonry units before placing. Do not wet concrete units. Wet faces of work in place before laying new work. Units shall not have water adhering to their surfaces when laid; but shall be wet only to ensure that complete hydration takes place, during hot drying weather, and when unit absorption rates are greater than 0.025 oz/sq.in./ minute, so that the initial rate of absorption does not exceed above rate when laid.

.3 Distribute masonry units of varying colours and textures to avoid spotty appearance over wall surfaces exposed to review. Do not use units which contrast too greatly with overall range.

.4 Use chipped and blemished units only where concealed. Do not use defective or broken units. Do not lay concrete units that will appear smooth or slick where exposed to view, whether painted or not.

.5 Brace walls and piers continuously during construction until structure provides support.

.6 Extend all walls to construction above except where otherwise noted on Drawings. Leave deflection space over non-load bearing walls as specified later.

.7 Cope, cut and split concrete masonry units with power-driven abrasive discs. Cut units wherever electrical outlets, grilles, and pipes occur. Allow 4 mm minimum clearance around items which are incorporated in walls.

.8 Lay hollow concrete masonry units so that effective shells rest and align one over the other. If they do not in bond courses, use solid bonding units.

.9 Install solid masonry units at all locations required for fixing of handrails, metal partitions and accessories of all description.

.10 Flush smooth with mortar masonry surfaces that flashings rest against to ensure that they are not punctured.

.11 Install brick vents at 600 mm (24") o.c. in vertical joints of masonry courses that rest on dampproofing and thruwall flashing and at top of masonry wall at steel lintels.

.12 Locate bearings and piers as indicated on Drawings; provide solid masonry units at bearings. Grout under bearing plates installed on masonry with

non-shrink grout.

.13 Cooperate at all times with persons carrying out the work.

.14 Keep cavity spaces free of mortar in cavity walls.

.15 Build, do not cut, chases. Do not incorporate chases in walls of 200mm (8") thick or less, nor locate them within 500mm (20") of lateral support provided for wall, nor exceed one-third of wall thickness for chase depth. Provide lintels over chases that exceed 500mm (20") in width and that are more than one-third of wall thickness in depth. Locate adjoining chases with a minimum clear distance between them of four times wall thickness.

3.10 MASONRY REINFORCING

.1 Reinforce all masonry walls using joint reinforcement in horizontal joints.

.2 Place joint reinforcement continuously in horizontal joints. Lap a minimum of 150mm (6") at splices.

.3 Reinforcing Schedule

: Inner Wythe of Cavity Walls (Non Load Bearing): Heavy duty joint reinforcement every second course between bonding ties.

: Load-Bearing Exterior and Interior Walls: Heavy duty joint reinforcement every block course.

: Non-Load-Bearing Partitions: Standard joint reinforcement every second course with additional course over all openings carried at least 800 mm (32") beyond jambs.

: Refer to Structural Drawings for size and placement of vertical reinforcing steel.

.4 Do not reinforce face veneers.

.5 Where changes in wall thicknesses occur extend horizontal reinforcement 500 mm (20") beyond on each side. Carry reinforcement all around every course in masonry cover to structural steel.

.6 Do not carry reinforcement through control or expansion joints.

.7 Wherever walls and partitions intersect one another, or each other, continue reinforcement through. Do not carry it through where lateral support anchors are installed, or intersection occurs at a solid pier.

3.11 MASONRY ANCHORAGE AND SUPPORT

.1 Anchor masonry construction to ensure its stability and to withstand loads imposed by intended use and by natural elements.

.2 Anchor masonry construction at structural steel work with flexible anchor every 400mm (16") in height. Weld flexible tab section of anchor to structural steel.

.3 Unless indicated or specified otherwise, space anchors at a maximum of 600mm (24") vertically and 800mm (32") horizontally.

.4 Wall Anchorage:

: For Non-Load-Bearing Partitions: Anchor partitions that abut or intersect other walls or partitions by corrugated galvanized wall ties spaced at not more than every third course apart vertically or by joint reinforcement.

: For Load-Bearing Exterior and Interior Walls: Anchor walls that face or abut other load-bearing walls or solid masonry piers by toothing, or blocking, with 100 mm (4") minimum and 200 mm (8") maximum offsets into which strap anchors are set at a maximum spacing of 800 mm (32") vertically. Use lateral support anchors, but with 75 mm (3") hooks. Extend anchors a minimum of 450 mm (18") into masonry at both sides of intersection. Where this is not possible, install cross pins in lieu of hooks to provide equivalent anchorage. At corners, provide true bonding of at least 50% of the units of one wall imbedded in the other. Provide for caulked joints at intersecting walls as part of the work of Section 07 90 00.

.5 Lateral Support: shall be provided for masonry walls and partitions as indicated on Drawings, specified, and required by jurisdictional authorities; perpendicular to wall faces; and either horizontally or vertically to wall panel edges. Provide lateral support for interior walls and partitions.

: Horizontally: by wedging masonry against structure, by clips or dowel plates specified in Section 05 50 00 at a maximum spacing of 1800mm (6'-0") o.c. where concealed in the final work or by continuous cover angles where exposed.

: Vertically: at junction with poured-in-place concrete by corrugated metal veneer anchors spaced at not more than every third course apart, one for every 4" or part thereof of masonry wall thickness, securely fastened to concrete by an approved method.

.6 Deflection Space:

: Provide a deflection space between tops of non-load-bearing walls and partitions and structures to prevent transference of structural loads to masonry.

: Fill deflection space with Type AF100 glass fibre board compressed to 50% of original thickness to completely fill space.

: Deflection space shall be 1" unless otherwise designated on Drawings.

: Co-ordinate work with installation of lateral support specified in Section 05 50 00.

3.12 DAMPPROOF FLASHING

.1 Install dampproof flashing continuously through exterior masonry walls, under sills and elsewhere as indicated on Drawings. Lap joints 150 mm (6").

.2 Flush up surfaces to receive dampproof flashing with mortar, and install flashing. Ensure that no coarse aggregate or other protrusions will pierce flashing, and protect it until work resumes.

.3 Through-wall flashings shall be dressed through full thickness of exterior wythe, across airspace and turn-up at least 150 mm (6") against inner wythe applied with approved adhesive. Install flashings prior to application of cavity wall insulation to details as shown on Drawings.

.4 When mortar bed for flashing has set resume laying of masonry.

.5 Where flashing is exposed to view or must bridge air-space without support, use sheet metal flashings provided and installed as part of the work of Section 07560. Install sheet metal flashings after dampproof flashings but prior to others.

3.13 MECHANICAL LOUVRES, GRILLES, UNIT VENTILATORS

.1 Construct openings in wall to accommodate sizes and details required by mechanical trades.

.2 Seal completely around penetrations to prevent air infiltration.

3.14 PATCHING

.1 Patch masonry walls damaged by installation of work specified under other Sections, and which have been rejected as defective or otherwise

damaged.

3.15 POINTING AND CLEANING

.1 Point all holes in mortar joints and in concrete masonry unit faces.

.2 Cut out defective mortar joints and repoint.

.3 Wash down and brush brick and grout/mortar to remove mortar laitance and stains. Use specified cleaners only. Consult with brick/block/grout and mortar supplier for solution strength and recommendations.

.4 Clean concrete masonry units with brushes and as otherwise recommended by the supplier to remove mortar and stains.

.5 Do not use wire brushes for cleaning.

.6 Should specified cleaning methods be insufficient, proceed with other methods only with approval of the Consultant.

.7 Protect adjacent materials and work from damage while cleaning.

END OF SECTION 04 20 00

1 General

1.1 GENERAL REQUIREMENTS

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

1.2 WORK IN OTHER SECTIONS

.1 Related Work Specified in Other Sections

Section 03 30 00	:	Cast-in-Place Concrete
Section 05 30 00	:	Metal Decking
Section 05 50 00	:	Metal Fabrications
Section 08 10 00	:	Doors and Frames
Section 09 90 00	:	Painting and Coating

.2 Products Supplied Under Work of this Section and Installed Under Work of Other Sections

Section 0330 00 : To install anchor bolts and loose bearings plates

1.3 REFERENCE STANDARDS

CSA S16-19: Design of Steel Structures
CSA W59-18: Welded Steel Construction (Metal Arc Welding)
CSA G40.20-13 (R2018): General Requirements for Rolled or Welded Structural Quality Steel
CSA G40.21-13 (R2018): Structural Quality Steel
CSA W48-14: Filler Metals and Allied Materials for Metal Arc Welding
CAN/CSAG164-18: Hot Dip Galvanizing of Irregularly Shaped Articles
ASTM F3125/F3125M-15a: Standard Specification for Structural Bolts, Steel, Heat Treated 830 MPa Minimum Tensile Strength

The Ontario Building Code, (O. Reg. 332/12)

.1 Do structural steel work in accordance with CAN/CSA-S16.14 latest edition except where specified otherwise.

.2 Do welding in accordance with CSA W59-13 except where specified otherwise.

.3 All work shall conform to National Building Code and any other Provincial or local application, provided that, in any case or conflict or discrepancy, the more stringent requirements shall apply and govern.

.4 CAN/CSA-S16.1 latest edition, "Limited States Design of Steel

Structures" shall be the basis for design and construction of all structural steel on this project.

1.4 SOURCE QUALITY CONTROL

.1 Submit 2 certified copies of mill reports covering chemical and physical properties of steel used in this work.

.2 Submit affidavits from the manufacturer or fabricator that materials supplied comply with this Specification.

.3 At least one-third of the joists are to be fabricated and ready for delivery prior to calling the inspection company, thus limiting the number of visits required to three (3). All deficiencies are to be corrected prior to delivery.

.4 The Owner will appoint an independent inspection and testing company to ensure that the Work of this Section is performed in accordance with the Specifications. The cost of all inspections/testing shall be paid for from the cash allowance allocated for this in Section 01050 - Allowances.

1.5 DESIGN OF DETAILS AND CONNECTIONS

.1 Design details and connections in accordance with requirements of CAN/CSA-S16, latest edition, to resist forces, moments and shears indicated.

.2 For non-standard connections, submit sketches and design calculations stamped and signed by qualified professional Engineer registered in the Province of Ontario.

.3 For standard connections, select details from CISC Handbook of Steel Construction to ensure structural adequacy.

.4 Submit shop fabrication details stamped and signed by a qualified professional licensed in the Province of Ontario.

1.6 SHOP DRAWINGS

.1 Submit shop drawings in accordance with Section 013 30 00 Submittals.

.2 Indicate shop and erection details including cuts, copes, connections, holes, bolts and welds. Indicate welds by welding symbols defined in CSA-W59-18.

.3 Submit copy of erection drawings to the Consultant for review and reference.

.4 Submit a copy of stamped shop drawings for the cold formed steel, including all connections.

.5 Submit all weld procedures pertinent to the work prior to or along with the first submission of shop drawings, for subsequent review and acceptance by the Consultant.

1.7 STORAGE AND HANDLING

.1 Handle all materials with the necessary care to prevent damage to fittings, finishes and alignments.

.2 Materials damaged due to faulty storage or handling shall be repaired or replaced, without additional expense to the Owner, all to the satisfaction of the Consultant.

.3 Replace promptly all items verified as received in a damaged condition.

1.8 EXAMINATION

.1 Examine surfaces with which Work is to be anchored or connected.

.2 Report to the Consultant, all unsatisfactory conditions likely to prevent or prejudice the proper installation of the work.

.3 Commencement of Work implies unconditional acceptance of substrate and surface and condition to which all members are to be anchored and secured.

1.9 QUANTITY OF ITEMS

.1 Where a component, device, item or part of material is referred to in the singular number, such reference shall mean as many as are required to complete the work.

2 Products

2.1 MATERIALS

.1 Structural steel: to CAN/CSA-G40.21 Grade 350W for rolled sections and plates, Grade 350W for Hollow Structural sections.

.2 Anchor bolts: to CAN/CSA-G40.21, Grade 300W.

.3 Bolts, nuts and washers: to ASTM A325M.

.4 Welding materials: to CSA W48 Series.

.5 Shop paint primer: to CGSB 1-GP-40M. Refer to Formulas in Section 09900.

.6 Hot dip galvanizing: galvanize steel, where indicated, to CAN/CSA G164, minimum zinc coating of 600 g/m^2.

.7 Cold Formed Steel: to CSA S136

.8 Lintels: As required to complete all work as part of this project. Steel Lintels shall be approved over all openings including mechanical, electrical and architectural drawings and as shown on the drawings.

3 Execution

3.1 INSPECTION AND CO-ORDINATION

.1 The Contractor shall field check all dimensions and elevations affecting his trade at the site. All discrepancies shall be reported to the Consultant before proceeding with the work.

.2 The Contractor shall report in writing all defects in the work prepared under other sections of the Specifications which will affect the work of this Section. Commencement of the work will imply acceptance of previously prepared work.

.3 Verify all requirements and dimensions of existing, proceeding and following Work before commencing fabrication.

3.2 FABRICATION

.1 Fabricate structural steel, as indicated, in accordance with CAN/CSA-S16.1 and in accordance only with reviewed and stamped shop drawings.

.2 Supply fastenings, anchors and accessories required for fabrication and erection of Work. Make exposed metal fastenings and accessories of same material, texture, colour and finish as base metal on which they occur unless otherwise shown or specified. Keep exposed fastenings to absolute minimum and inconspicuous, spacing them evenly and setting them out neatly. Make fastenings of permanent type.

.3 Beams shall be rolled sections, combined as noted. Beam connections shall be standard double angle clip type, developing full strength of all the members.

.4 Clean all steel members by scraping, wire brushing or other effective

means to remove loose mill scale, rust, oil or other foreign matter. Surfaces shall be thoroughly dry before painting.

.5 Apply one (1) shop coat of paint, conforming to CGSB 1-GP-40D primer, to all surfaces except surfaces to be in contact with or encased in concrete and surfaces and edges to be field welded or high tension bolted.

.6 Apply two (2) shop coats of paint, conforming to CGSB 1-GP-40D primer to all surfaces which will be inaccessible after assembling. Touch up all bolts, welds and surfaces of connecting members damaged during construction.

.7 All steel exposed to weather including steel lintels in exterior walls shall be hot dip galvanized.

.8 All members shall be assembled true and without twists or open joints. Shop connections shall be welded.

.9 High tensile bolted connections, where used, shall be in accordance with CAN/CSA-S16 latest edition. Holes shall be accurately spaced and of size to allow insertion of bolts of 1.5 mm (1/16") diameter less than hole diameter.

.10 Welding shall be executed so as to avoid damage or distortion to the work. Welds on exterior work shall be continuous to provide proper weathering; all welds on exposed finished work shall be ground smooth.

.11 There shall be no burning of holes in members in the shop or field without the permission of the Consultant. If consent is given, burned members shall be finished to an acceptable appearance.

.12 Mark materials in accordance with CAN/CSA-G40. Do not use die stamping. If steel is to be left in unpainted condition, place marking at locations not visible from exterior after erection. Shop mark bearing assemblies and splices for fit and match.

3.3 ERECTION

.1 Erect structural steel as indicated in accordance with CAN/CSA-S16 latest edition and in accordance with shop drawings.

.2 Continuously seal members by continuous welds where indicated. Grind smooth.

.3 Obtain written permission of the Consultant prior to field cutting or altering of structural members.

.4 Touch up shop primer to bolts, rivets, welds and burned or scratched surfaces at completion of erection.

.5 Erection of structural steel on site shall be properly co-ordinated by the Contractor with the work of all other trades. Co-ordinate the work to incorporate all electrical appurtenances, and protect same from damage during erection.

.6 Bolted assemblies for base connections shall not be tightened until at least 72 hours after the grout pad has been placed.

.7 All bolts shall be tightened by using a suitable torque wrench, torquing as required in CAN/CSA-S16 latest edition.

.8 Damaged work will not be accepted on site. Damaged work arriving on site will be returned to the shop for repair and/or refinishing.

.9 All temporary supports shall be attached to the work in such a manner so as not to mar the surface on the finished section.

.10 All steel shall be set accurately to the lines and elevations shown on the Drawings.

.11 Assume full responsibility for the correct plumbing, alignment and setting of all members; set all guys, braces, etc., necessary to maintain the structure during erection, and until such time as the work of other trades is in place.

3.4 OPEN WEB STEEL JOISTS

.1 Minimum bearing, unless otherwise detailed, shall bear 63.5mm (2½") on steel and 100mm (4") on concrete or masonry. Where joists span from one side only they shall bear directly over centre of beam unless otherwise shown. Open web steel joists and their design shall conform to CAN/CSA-S16 latest edition.

.2 Shoes are to be designed so that the allowable bearing pressure on the supporting material is not exceeded.

.3 Provide bridging in accordance with CAN/CSA S16 latest edition.

.4 Extend and if necessary deepen top chords of joists with cantilevered ends to carry the specified loading indicated or implied.

END OF SECTION 05 10 00

1 General

1.1 GENERAL REQUIREMENTS

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

1.2 WORK IN OTHER SECTIONS

Related Work Specified in Other Sections

Section 05 10 00	:	Structural Metal Framing
Section 05 5000	:	Metals Fabrication
Section 06 10 00	:	Rough Carpentry
Section 07 60 00	:	Flashing and Sheet Metal
Section 09 90 00	:	Painting and

1.3 REFERENCE STANDARDS

CSA S136S1:19: North American Specification for the Design of Cold-Formed Steel Structural Members.
CSA W59-13: Welded Steel Construction (Metal Arc Welding)
CSAW47.1:09 (R2019): Certification of Companies for Fusion Welding of Steel
CSA W48-18: Filler Metals and Allied Materials for Metal Arc Welding

.1 Work of this section shall conform to CSA-S136-16 and to meet the specified requirements of the Canadian Sheet Steel Building Institute "Standard for Steel Roof Deck" and "Standard for Steel Floor Deck".

.2 Welding shall meet requirements of CSA-W59-13 and undertaken to meet requirements of CSA-W47.1:09 (R2019) and CSA-W55.3-08 (R2018)

1.4 DESIGN CRITERIA

.1 Metal deck shall be of suitable design and thickness to safely support the indicated live and dead loading over the spans shown without exceeding the maximum working stress of 143.8 MPa.

.2 Deflection under live load only shall be not more than 1/240th of span for roof units, and 1/360th for floor units.

.3 Metal roof deck and composite concrete slab sections shall have a depth not less than 38mm (1½").

.4 Metal deck units shall span over three or more supports except where structural steel layout does not permit.

1.5 QUALIFICATIONS

Execute the work of this Section only by a Subcontractor who has adequate plant, equipment and skilled tradesmen, and is known to have been responsible for satisfactory work similar to that specified during a period of at least five years.

1.6 SHOP DRAWINGS

Submit shop drawings in accordance with Section 01 33 00 Submittals.

1.7 PRODUCT HANDLING

.1 Deliver materials as required for erection. If storage becomes necessary stack bundles of steel deck on wood blocking clear of ground and tilted slightly so as to avoid water lying on the material. Storage area to be as close to the building as is practical.

.2 Protect deck against damage. Damaged materials shall be replaced by this Contractor without extra cost to the Owner.

.3 Protect the work of other trades from damage during erection, welding, and cutting operations, and make good any such damage where caused.

2 Products

2.1 MATERIALS

.1 Metal roof deck shall be fabricated from galvalume coated steel, standard AZ150 steel deck conforming to ASTM A792/A792M-10(2015).

.2 Metal roof deck for all roof areas except noted below shall be fabricated from zinc-coated steel conforming to A.S.T.M. designation A446-G5T Grade 'A' minimum steel, with a minimum decimal core thickness of 0.76 mm and a zinc coating class of G90.

.3 Incombustible, non-hygroscopic glass fibre insulation, with a density of 1.1 lbs. per cubic foot, shaped to completely fill all flutes on the top side of acoustic deck.

.4 Metal deck shall be manufactured by Robertson, Vic-West, or Canadian Metal Rolling Mills.

2.2 FLOOR DECK ACCESSORIES

.1 Cover plates shall be of the same material gauge as decking or of greater

thickness, if required. Closures shall be tight to prevent leakage of concrete. Form to match deck contour, minimum 6 inches wide.

.2 Column flashing shall be provided to close spaces between floor units and columns, weld in place.

.3 End closures shall be provided to close open ends of cells at columns, walls and openings in floors.

.4 Closures shall be provided for closing voids between cells over partitions that are perpendicular to direction of cells. Closures may be rubber or steel metal. Closures above fire-resistant partitions shall be sheet metal at both sides of partition. Fibrous glass insulation shall fill spaces between pair of closures.

.5 Provide angles and other steel members not designated as structural steel or miscellaneous metal work, but which are required for a complete and rigid deck installation.

3 Execution

3.1 INSTALLATION

.1 The metal roof units shall be placed on the supporting steel framework and adjusted to final position before being permanently fastened. Each unit shall be brought to proper bearing on the supporting structure. The roof units shall be placed in straight alignment for the entire length of run of cells and with close registration of the cells of one unit with those of abutting units.

.2 Align deck end to end to provide accurate fit with corresponding sections, with sections parallel, level and straight. All laps over supporting members shall be uniform and a minimum of 100 mm length, countersunk to provide proper nesting for deck thickness greater than 1.5 mm. Touch up all welds and fasteners with paint.

.3 Deck units shall be securely fastened to the steel framework at the ends of the units and at intermediate supports by welds not less than 20 mm diameter, spaced not more than 300 mm along the steel frame or in other manner approved by the Consultant. Where two units abut, each unit shall be welded to the steel frame. Welds shall be free of sharp points or edges.

.4 All welds for roof deck shall be made so that the finished deck surface is capable of sustaining an upward force of 1.44 kN/m^2.

.5 The side laps of adjacent units shall be fastened between supports by clinching at intervals not exceeding 600 mm, or by 25 mm long welds at

intervals not exceeding 1 m.

.6 Damaged, bent or dished sheets shall be rejected and removed from the site.

.7 Install closures running parallel to flutes of deck to stiffen deck at roof edges.

3.2 OPENINGS

.1 For openings 150 mm to 450 mm in diameter or square, provide not less than 50 mm x 50 mm x 6 mm angle reinforcing to frame across holes in direction perpendicular to flutes, and weld at least two flutes on each set of holes.

.2 Do not cut openings until final sizes have been verified on shop drawings or until steel framing provided under other sections of work is in place.

.3 For openings larger than 450mm in diameter or square, refer to Structural, Mechanical and Architectural drawings for sizes and locations.

3.3 TOUCH UP AND REPLACEMENT

.1 Touch up adjacent primed surfaces burned, scratched or otherwise damaged during erection with prime paint to match shopcoat, when erection is completed.

.2 Paint over bare areas on galvanized surfaces and welds with zinc rich paint.

.3 Replace dented, punctured or weld perforated deck where exposed to view.

END OF SECTION 05 30 00

1 General

1.1 GENERAL REQUIREMENTS

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

1.2 WORK IN OTHER SECTIONS

.1 Related Work Specified in Other Sections

Section 03 40 00	:	Precast Hollow Core Slabs
Section 04 20 00	:	Unit Masonry
Section 05 10 00	:	Structural Metal Framing
Section 05 30 00	:	Metal Decking
Section 05 50 00	:	Miscellaneous Metal
Section 06 20 00	:	Finish Carpentry & Millwork
Section 07 52 00	:	Modified Bitumen Roofing
Section 08 10 00	:	Metal Doors &Frames
Section 09 21 00	:	Gypsum Board
Section 09 51 23	:	Acoustic Tile Ceilings
Division 15	:	Mechanical
Division 23	:	Electrical

1.3 SCOPE OF WORK

.1 Work of this Section shall include the supply and installation of all load bearing and non -load bearing steel studs including all fasteners, bridging and bracing.

1.4 QUALIFICATIONS

.1 Execute Work of this Section only by a Subcontractor who has adequate plant, equipment and skilled tradesmen to perform it expeditiously, and is known to have been responsible for satisfactory applications similar to that specified during a period of at least five (5) years.

1.5 PRODUCT HANDLING

.1 Package all materials and store off the ground and covered until ready for use.

1.6 SUBMITTALS

.1 Submit Shop Drawings to Consultant for approval prior to erection of all load bearing steel studs in accordance with Section 01 33 00 - Submittals.

2 Products

2.1 MATERIALS

.1 Load-bearing, Wind-Loaded and Non-loadbearing Channels: to ASTM C645-81, 3_" (92mm) and/or 4" (102.0mm) stud size, roll formed from min. 0.048 gauge electrogalvanized steel sheet, for screw attachment of composite building panel. Knock-out service holes at 460mm centres. Deflection for 25 p.s.f. horizontal load to be limited to ^{L}/360mm. Refer to Structural Drawings for extent of loadbearing steel stud walls. Include all bridging necessary for the heights shown.

.2 Floor and ceiling tracks: to ASTM C645-81, in widths to suit stud sizes, 38mm flange height.

.3 Furring channels: to CSA A82.30-M1980, 38mm and 19mm.

3 Execution

3.1 ERECTION

.1 Align partition tracks at floor, steel deck and framing, and ceilings, and secure at 600mm o.c. maximum.

.2 Place studs vertically at 600mm o.c. and not more than 50mm from abutting walls, and at each side of openings and corners. Position studs in tracks at floor and ceiling. Cross brace steel studs as required to provide rigid installation to manufacturer's instructions.

.3 Erect metal studding to tolerance of 3mm in 3000mm.

.4 Attach studs to bottom track and ceiling track using screws. Secure and brace back to structure as required to prevent movement.

.5 Attach gypsum board and/or exterior sheathing where noted, securely with tight fitting joints.

.6 Co-ordinate simultaneous erection of studs with installation of service lines. When erecting studs ensure web openings are aligned.

.7 Erect track at head of door opening to accommodate intermediate studs. Secure track to studs at each end. Install intermediate studs above opening in same manner and spacing as wall studs.

.8 Install wood blocking securely anchored to studs for anchorage of fixtures, accessories, brackets, etc. as shown on drawings.

END OF SECTION 0541 00

1 General

1.1 GENERAL REQUIREMENTS

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

1.2 WORK IN OTHER SECTIONS

.1 Related Work Specified in Other Sections

Section 03 30 00	:	Cast-in-Place Concrete
Section 06 10 00	:	Rough Carpentry

.2 Products Supplied Under Work of This Section and Installed Under Work of Other Sections

Section 03 30 00	:	Cast-in-Place Concrete

1.3 REFERENCE STANDARDS

CSA S16-19: Design of Steel Structures
CSA W59-18: Welded Steel Construction (Metal Arc Welding)
G40.20-13: General Requirements for Rolled or Welded Structural Quality Steel
CSA G40.21-13: Structural Quality Steel
CSA W47.1-19: Certification of Companies for Fusion Welding of Steel
CSA W48-18: Filler Metals and Allied Materials for Metal Arc Welding
CAN/CSA G164-18: Hot Dip Galvanizing of Irregularly Shaped Articles
The Ontario Building Code, (O. Reg. 350/12)

1.4 QUALIFICATIONS

.1 Execute the work of this Section only by a Subcontractor who has adequate plant, equipment and skilled tradesmen, and is known to have been responsible for satisfactory work similar to that specified during a period of at least five years.

1.5 SHOP DRAWINGS

.1 Submit shop drawings in accordance with Section 01 33 00 - Submittals.
.2 Indicate connections, details, dimensions, and all other data as required to accommodate installation.

1.6 PRODUCT HANDLING

.1 Deliver materials as required for erection. If storage becomes necessary stack materials on wood blocking clear of ground and tilted slightly so as to avoid water lying on the material. Storage area to be as close to the

building as is practical. Protect finished surfaces from damage or rust.

.2 Damaged materials shall be replaced by this Contractor without extra cost to the Owner.

2 Products

2.1 MATERIALS

.1 Steel Sections and Plates: to CAN/CSA-G40.21, Grade 350W.

.2 Hollow Structural Sections: to CAN/CSA-G40.21 Grade 350W.

.3 Welded Wire Fabric: WWF 50 x 50 x MW11.1 x MW11.1.

.4 Welding Materials: to CSA W48 Series.

.5 Hot rolled structural steel shapes: to CAN/CSA-G40.21, Grade 350W.

.6 Galvanizing: hot dipped galvanizing with zinc coating 600 g/m^2 to CAN/CSA-G164-18 or latest edition.

.7 Stainless Steel: bars and rods to ASI Type 316, No. 4 finish.

.8 Anchors: strap type or approved self drilling type minimum 3 per member.

.9 Fasteners: as shown on drawings and as required for secure anchorage.

3 Execution

3.1 FABRICATION

.1 The jointing in built-up sections shall be made with hairline joints in the least conspicuous location and manner. All work shall be assembled in the most substantial manner and reinforced where necessary with similar fastenings. All screws shall be countersunk unless otherwise noted.

.2 Provide positive anchorage to the building structure by means of through bolts, welding, or approved inserts cast into the building structure.

.3 Apply a coat of primer to all interior ferrous metals before leaving the factory unless noted otherwise. Touch up any galvanized surfaces damaged after erection with galvafroid paint as approved by the Consultant.

.4 All items shall be fabricated, finished and assembled in the shop as much as possible, consistent with the size and shipping problems. Assembly on the job shall be kept to a minimum.

.5 All welds, unless noted specifically otherwise, are to be continuous where exposed and ground smooth.

3.2 SCHEDULE OF FABRICATION

.1 Generally: Ensure that all Drawings and Specification Sections, including those for architectural, structural, mechanical and electrical work, are consulted to establish the limits of work included in this Section.

.2 Miscellaneous Channels and Clip Angles:
: Provide all miscellaneous fastenings required, including supports, anchor bolts and other items as required and indicated to complete all work as part of this project.

.3 Sump Pit Covers, Frames and Ladders
: As detailed on drawings.
: Finish: galvanized.

.4 Trench cover:
: Grating and plate as sized and detailed on the drawings.
: Galvanized.

.5 Railing and Guards:
: Railings and guards as sized and detailed on the drawings.
: Painted.

3.3 ERECTION

.1 Erect work in accordance with shop drawings and in coordination with trades whose work relates to this Section.

.2 Erect work plumb, straight, square and accurately fitted with tight joints at intersections.

.3 Where possible install work in one continuous piece.

.4 Anchor all components to structure, walls and floors as required with weld or other methods of anchorage approved by the Consultant.

3.4 TOUCH-UP AND REPLACEMENT

.1 Touch up adjacent primed surfaces burned, scratched or otherwise damaged during erection with prime paint, to match shopcoat, or galvafroid for galvanized when erection is completed.

.2 Paint over bare areas on galvanized surfaces and welds with zinc rich paint.

.3 Replace damaged or unacceptable materials indicated by the Consultants.

END OF SECTION 05 50 00

1 General

1.1 GENERAL REQUIREMENTS

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

1.2 WORK IN OTHER SECTIONS

.1 Related Work Specified in Other Sections
Section 03 30 00 : Cast-in-Place Concrete

1.3 REFERENCES

CSA O121-17 (r2022): Douglas Fir Plywood
CSA O141-23: Softwood Lumber
CSA O151-17 (R2022): Canadian Softwood Plywood
ASTM A325M - 14 Standard Specification for Structural Bolts, Steel, Heat Treated 830 MPa Minimum Tensile Strength
CAN/CSA G164-M92 (R2023): Hot Dip Galvanizing of Irregularly Shaped Articles

1.4 SOURCE QUALITY

.1 Lumber identification: by grade stamp of an agency certified by Canadian Lumber Standards Accreditation Board.

.2 Plywood identification: by grade mark in accordance with applicable CSA standards.

1.5 SHOP DRAWINGS

.1 Submit shop drawings in accordance with Section 01 33 00 Submittals.

.2 Submit sepia and one copy of checked Shop Drawings to the Engineer for examination, giving complete information necessary for the fabrication of the various members and components of the structure, including material specifications and the location, type and size of all connections.

.3 Erection Drawings shall show sizes and locations of all members and give complete location and details for setting anchor bolts and levelling plates. The elevations of all bearing plates shall be clearly shown.

2 Products

2.1 LUMBER MATERIAL

.1 General: Lumber shall be spruce/pine/fir number 1 and 2 grades, unless specified otherwise, softwood, S4S, moisture content 19% or less in accordance with following standards in the ratio of 67% and 33% respectively: -
.1 CSA 0141-1970.
.2 NLGA Standard Grading Rules for Canadian Lumber, 1980 edition revised according to Supplement No. 1, 1981.

.2 Plywood: Douglas Fir (DF), spruce plywood conforming to CSA 0121-M1978, standard construction, tongue and groove to thickness shown on drawings. Minimum thickness 15 mm unless noted otherwise.

.3 Fasteners: Proprietary fasteners toggle bolts, expansion shields and lag bolts, screws and lead or inorganic fibre plugs, explosive actuated fastening devices, recommended for purpose by manufacture. Use stainless steel or galvanized to CSA G164-M1981 fasteners for all exterior fastening and for any damp or moist areas.

.4 Wood Preservative: Surface-applied wood preservative: clear copper napthenate or 5% pentachlorophenol solution, water repellant preservative.

.5 Furring, blocking, nailing strips, grounds, rough bucks: Spruce, pine, douglas fir, S25 type, standard grade, nominal sizes unless noted. All material shall be pressure treated where concealed or installed exterior to the building or built into masonry, concrete or roofs.
.1 S2S is acceptable.
.2 Board sizes: "Standard" or better grade.
.3 Dimension sizes: "Standard" light framing or better grade.

.6 Floor/Roof Sheathing: Tongue and groove spruce or fir plywood to thickness shown on drawings, minimum 15mm unless noted otherwise.

.7 Material shall be straight, sawn square, true, dressed four sides properly sized, shaped to correct dimensions from nominal sizes noted on Drawings.

3 Execution

3.1 FURRING AND BLOCKING

.1 Install furring and blocking as required to all space-out and support as required for the project.

.2 Align and plumb faces of furring and blocking to tolerance of 1:600.

3.2 NAILING STRIPS, GROUNDS AND ROUGH BUCKS

.1 Install rough bucks, nailers and linings to rough openings as required to provide backing for frames and other work.

.2 Install rough bucks, nailers, framing and linings to wall supports, openings as noted for support of lockers, shelving, chalkboards, tackboards, chair rail, cabinets, millwork, washroom accessories and other accessories to be mounted on drywall partitions.

3.3 FASTENERS

.1 Frame, anchor, fasten, tie and brace members to provide necessary strength and rigidity.

.2 Countersink bolts where necessary to provide clearance for other work.

3.4 SURFACE-APPLIED WOOD PRESERVATIVE

.1 Treat all surfaces including cut ends of material with wood preservative before installation.

.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.

3.5 INSTALLATION

.1 Lay out work carefully and to accommodate work of others. Cut and fit accurately. Erect in position indicated by drawings. Align, level, square, plumb, and secure work permanently in place. Brace work temporarily as required. Join work only over solid bracing.

.2 Bore holes true to line and to same size as bolts. Drive bolts into place for snug fit, and use plates or washers for bolthead and nut bearings. Turn up bolts and lag screws tightly when installed, and again just before concealed by other work or at completion of work.

.3 Co-operate with work of other Sections to ensure that unity of actions will ensure orderly progress to meet construction schedule.

.4 Provide anchors, bolts and inserts, required for attachment of the work of this Section, to those performing the work of other Sections and who are responsible for their installation.

.5 Work shall include rough hardware such as nails, bolts, nuts, washers, screws, clips, hangers, connectors, and strap iron required for installation of work and all operating hardware required on work of this Section for temporary use.

.6 Do not attach work by wood plugs or blocking in concrete or masonry. Use lead shields, expansion shields, concrete nails, or similar methods only as approved by the Consultant.

.7 Do not regard grounds, blocking, furring, and such other fastening provisions as shown on Drawings as exact or complete. Provide required provisions for fastening, located and secured to suit site conditions, and adequate for intended support.

.8 Cut fastening work into lengths as long as practicable and with square ends. Erect work plumb, in true planes, and fastened rigidly in place.

.9 Grounds around openings in cavity wall systems, under sills and thresholds to provide continuous support shall be 50 mm (2") minimum thickness, preservative treated.

.10 All members shall be accurately cut to length, angle and be true to line to assure tight joints.

.11 Correct alignment and plumb must be maintained until specified lateral bracing is installed. Cutting and altering of trusses is not permitted except by approval by the Engineer. Heavy concentrated loads must not be placed on top of trusses until permanent bracing and decking have been installed. In any event, these temporary loads must not exceed the truss design loads.

3.6 SPECIAL PROTECTION

.1 When it is required that wood maintain dimensional stability and tolerances to ensure accurate installation of later work, store and install it only in dry areas, and where no further installation of moist materials is contemplated.

END OF SECTION 06 10 00

1 General

1.1 GENERAL REQUIREMENTS

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

1.2 WORK IN OTHER SECTIONS

.1 Related Work Specified in Other Section

Section 05 50 00	:	Miscellaneous Metal
Section 06 10 00	:	Rough Carpentry
Section 09 90 00	:	Painting
Division 150	:	Mechanical
Division 26	:	Electrical

.2 Products Supplied Under Work of OtherSections and Installed Under Work of This Section

Section 08 10 00	:	Metal Doors& Frames
Section 08 71 00	:	Door Hardware
Section 10 28 00	:	Toilet, Bath and Laundry Accessories

1.3 REFERENCE STANDARDS

CSA O121-17 (R2022): Douglas Fir Plywood
CSA O141-23: Softwood Lumber

1.4 PRODUCT HANDLING

.1 Protect materials from damage during handling, delivery, and storage.

.2 Materials shall not be delivered until required for erection and until moisture from other work has been out of the area for at least 10 days.

.3 Millwork items shall be placed in clean dry areas where not exposed to extreme changes in temperature and humidity. During shipment and storage all materials shall have protective covering.

.4 Cover plastic laminate items with heavy kraft paper.

1.5 ENVIRONMENTAL CONDITIONS

.1 Ensure that relative humidity in areas where work is stored and installed does not exceed 55%.

1.6 EXAMINATION

.1 Before commencing installation ensure that grounds, strapping and other

constructions and surfaces to which work is installed are satisfactory for fitting and adequate for securing of work.

.2 Take site measurements of construction to which work of this Section must conform, and through which access must be made, before work is delivered to site, to ensure that adaptation is not required which would result in construction delay.

2 Products

2.1 MATERIALS

.1 General: No substitution or deviation from materials shall be approved unless approval by Consultant has been obtained prior to tender closing. Work of Section shall include rough hardware required for its execution. Use non-corrosive hardware at exterior locations. Use only adhesives and fastenings that develop sufficient strength for intended use, are non-staining, and are unaffected by the environment to which exposed.

.2 Softwood lumber: to CAN/CIA-0141 or latest revision and National Lumber Grades Authority requirements, with maximum moisture content of 6% for interior work, yard lumber selected for natural finish, Oak and Red Cedar species, to AWMAC premium grade.

.3 Nails and staples: to CIA B111-1974; galvanized for exterior work, interior highly humid areas and for treated lumber; plain finish elsewhere.

.4 Douglas Fir Plywood (DFP): to CIA 0121-M1978, standard construction.

.5 Birch Veneer Plywood: to CIA 0115-M1982.

.6 Particle Board: to CAN3-0188.0-M78, CAN3-0188.1-M78 and CAN3-0188.3-M82. Smooth, dense and free from loose particles.

.7 Decorative Laminate: to CAN3-A172-M79 and ENMA LD3-1980 selected from manufacturer's standard range. Arborite, Formica, Wilsonart. Plastic laminate colours to be selected by Consultant by manufacturer's decorative range.

Arborite GP(FR) for cabinets.
Arborite Solid Grade GP-SS.

.8 Solid surfacing counter tops: to be Corian or approved equal; colours selected from manufacturer's standard range.

.9 Cabinet Hardware: Shall be supplied under Section 08 71 00 and installed under this Section.

.1 : Door Hinges: semi-concealed, pivot.
.2 : Door Catches: magnetic type.
.3 : Drawer Slides: ball bearing carrier, fully extendable, of quality to operate adequately for size and capacity of drawer.
.4 : Pilaster Strips: recessed, slotted, nickel plated steel, with shelf clips to match.

.10 Hardwood Adhesives: One part trowel applied, elastomeric waterproof setting adhesive containing no chlorinated solvents.

.11 Contact Adhesives: to CGSB 71-GP19 or CGSB 71-GP-20.

.12 Clear Urethane Finish: in accordance with Section 0990 00 shop-controlled spray painting meeting this finish is acceptable.

.13 Plastic Laminate colours to be selected from manufacturer's standard range by Consultant.

.14 Melamine composite panels: NEMA LD 3, Grade VGL decorative laminate thermofused to both sides of particle board; premium grade, maximum 2 colours as selected by Consultant.

3 Execution

3.1 FABRICATION

.1 All millwork shall be shipped assembled as far as it is practical. Assembled units shall be of such size as will not present difficulty of entry into the building and rooms where required. Where this is not possible, they shall be shipped in knock-down form with clear instructions for assembly.

.2 Shop assemblies shall be glued and nailed where possible and shall be glue blocked at concealed locations.

.3 Millwork shall comply with the requirements for Custom Grade work as specified in Quality Standards of the Architectural Woodwork Industry, published by the Architectural Woodwork Institute, Chicago, Illinois.

.4 Properly prime all parts of the work, cut all members accurately to size, closely fit, well nailed, plumb, level, square and true to dimensions. Do not prime if clear or stained finish.

.5 Exposed edges of plywood are not permitted. Edges shall be veneered with same materials as plywood face or hardwood edged, where required for hardware securement.

.6 Set and fill nailheads, countersink and fill screw on bolt head.

.7 Millwork shall be finished in one piece whenever possible, running members in largest length obtainable. Where jointed, splice or mitre to accurate fit and alignment. Match veneered surfaces for grain and general colour.

.8 Sand and remove machine marks or other scrapes from exposed or partially exposed surfaces.

.9 Thickness of all members shall be in accordance with the maximum possible dressed size from standard lumber.

.10 Millwork items shall have all surfaces sealed before leaving the mill or fabricating shop.

.11 Sealer on surfaces to be painted or concealed shall be tinted; for exposed locations, it shall be clear.

.12 Cut holes for fittings as required, seal edges with black asphalt compound. Edges around cutouts shall be chamfered.

.13 All work shall be true, level, square, smooth and without core ghosting.

.14 Arrange adjacent parts of continuous laminate work to match in colour and pattern.

.15 All joints shall be accurately fitted to provide tight, flush hairline appearance.

.16 Trim members shall be of sizes and profiles as detailed for their respective location and use. Trim members shall be slow-fed work, free from chatter and other machine faults.

.17 Trim over 75 mm (2-1/2") wide shall have backs ploughed or kerfed.

.18 Construct cabinets with 18 mm (3/4") plywood gables, shelves and doors and 12mm (1/2") drawer boxes.

3.2 INSTALLATION

.1 Fasten work with nails generally but use screws or special fasteners at critical joints where strain, usage and excessive shrinkage is anticipated, and where specified quality grade standards require.

.2 Install work plumb, level and straight and fasten it securely to backing to support itself and anticipated superimposed loads.

.3 Provide cut-outs for electrical fixtures, inserts, cables, outlet boxes, reglets for glazing.

.4 Sand wood flooring after installation to provide uniform, smooth, unmarked surface. Vacuum thoroughly prior to finishing. Do not permit traffic over floor once finished. All protection shall be the responsibility of the Contractor.

3.3 SCHEDULE OF FINISH CARPENTRY

.1 Generally: This schedule does not list all finished carpentry items incidental to work of this Section, but only those items which required specific description. Ensure that all Drawings and Specification Sections, including those for architectural, mechanical and electrical work, are consulted to establish the limits of work included in this Section.

.2 Installation of Doors, Frames and Screens

: All frames and screens which occur in masonry walls will be set up and installed as part of the work of Section 04 20 00. Verify that frames and set plumb true.
: Install wood doors supplied under work of Section 08 20 00 after finishing of walls. Ensure that top and bottom edges are primed under work of Section 09 90 00 after they are cut to fit.
: Install all hollow metal doors, supplied under work of Section 08 10 00.
: Provide clearance for intended finish flooring.
: Install all exterior hollow metal doors and frames.
: Provide clearance for intended finish flooring.

.3 Installation of Finishing Hardware: Install finishing hardware supplied under work of Section 08 70 00 including but not limited to:

: Hardware for millwork includes wood cabinet, shelving and cupboards.
: Accurately locate and adjust hardware to meet manufacturer's instructions.
: Locate door stops to strike door 76.2mm (3") from latch edge.

.4 Wood Back Board for Electrical Panel: 19.0mm (3/4") D.F. GIS plywood securely anchored to wall with nylon shields and screws. Install as required by Division 26.

3.4 SCHEDULE OF MILLWORK

.1 Generally: This schedule does not list all millwork items incidental to work of this Section, but only those items which required specific description. Ensure that all Drawings and Specifications Sections, including those for architectural, mechanical and electrical work, are consulted to establish the limits of work included in this Section.

.2 Washroom Vanities: Construct from 25 mm plywood and 38 x 89 wood framing. Install steel plate brackets along front edge and provide 25 mm plywood gables at ±800 mm o/c. Finish plastic laminate.

3.5 ADJUSTING AND CLEANING

.1 Adjust hinged doors to swing freely and easily, to remain stationary at any point of swing, to close evenly and tightly against stops without binding, and to latch positively when doors are closed with moderate force.

.2 Adjust hardware so that latches and locks operate smoothly and without binding, and closers act positively with the least possible resistance in use.

END OF SECTION 06 20 00

1 General

1.1 RELATED WORK SPECIFIED IN OTHER SECTIONS

Section 07 60 00 : Flashing and Sheet Metal Flashing

1.2 REFERENCES

.1 Roofing Application Standards Manual, (latest edition):

.2 Accepted Products Listing [date]:
"S.B.S. Modified Bituminous Membrane Systems 5 and 10 Year", November 2017 and,

.3 Accepted Inspector

.2 American Society for Testing and Materials (ASTM):

.1	ASTM D41 / D41M	Standard Specification for Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing
.2	ASTM D2178/ D2178M	Standard Specification for Asphalt Glass Felt Used in Roofing and Waterproofing
.3	ASTM D6162/ D6162M	Standard Specification for Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using a Combination of Polyester and Glass Fibre Reinforcements
.4	ASTM D6163/ D6163M	Standard Specification for Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using Glass Fibre Reinforcements
.5	ASTM D6164/ D6164M	Standard Specification for Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using Polyester Reinforcements
.6	ASTM F1667-13	Driven Fasteners: Nails, Spikes and Staples

.3 Canada Green Building Council (CaGBC):

.1	LEED v4 Rating System	LEED v 4 Building Design + Construction

.4 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	CGSB 19-GP-14M	Sealing Compound, One component, Butyl-Polyisobutylene, polymer base, solvent curing

.5 Canadian Roofing Contractors Association (CRCA)

.1 CRCA Roofing Specifications Manual, 2011

.6 Canadian Standards Association

.1	CSA-A123.21-14	Standard Test method for the Dynamic Wind Uplift Resistance of Membrane Roofing Systems
.2	CAN/CSA-A123.4-04 (R2013)	Asphalt for Constructing Built-Up Roof Coverings and Waterproofing Systems
.3	CSA-A123.23-15	Product Specification for Polymer-Modified Bitumen Sheet, Prefabricated and Reinforced

.7 Roof Consultants Institute (RCI)

.1 RCI Manual of Practice – Roof, Exterior Wall, and Waterproofing Consulting, and Quality Assurance Observation, 2010

.2 Registered Roof Observers – RRO®

.8 Underwriters Laboratories of Canada

.1	CAN/ULC S706-09	Standard for Wood Fibre Insulating Boards for Buildings
.2	CAN/ULC S704	Standard for Thermal Insulation, Polyurethane and Polyisocyanurate Boards, Faced

1.3 DEFINITIONS

.1 Roofing System" means: all materials contained within the roof assemblies installed by the Contractor, including all materials above the deck including membrane flashing up to and including 1067mm (42") above the surface of the primary membrane, and related sheet metal work.

.2 Third Party Roofing Inspector" means: an individual engaged in commercial roofing inspections as a primary business, has a minimum of 5 years experience as a roofer, has obtained a recognized Inspector Credential from either ORCA or RCI, can provide current Commercial General Liability Insurance coverage, annually inspects a minimum of 5,000 square metres of roofing systems, and is independent from roofing contractors, manufacturers, suppliers & distributors.

.3 Roofing Workmanship Warranty" means: a written guarantee of the integrity of the Roofing System installation, and provides for the repair or replacement of defects or deficiencies including all associated workmanship.

.4 Roofing Manufacturer's Warranty" means: a written guarantee of the integrity of the Roofing System materials and provides for the repair or replacement of material defects or deficiencies including installation.

.5 Roofing Warranty Period" means: a five year period of time starting on the date of Interim Acceptance of the Work.

.6 Roofing Maintenance Bond" means: a "Roofing System" specific bond supplied by a 3rd party, federally regulated, Surety Company.

.7 Warrantor" means:

.1 The 3rd party, legal entity that provides the Workmanship Warranty certificate.

.2 The manufacturer that provides the Manufacturer's Warranty certificate.

1.5 DELIVERY, STORAGE, AND HANDLING

.1 Delivery and Acceptance Requirements:

.1 Deliver materials handle and store according to manufacturers requirements with manufacturer's seals and labels intact. The manufacturer's name, brand, mass, specification number and lot number shall be shown on the labels.

.2 Storage and Handling Requirements:

.1 Do not store materials on roof in concentrations, which exceed design live loads.

.2 Do not store gravel ballast on roofs. Haul gravel ballast to roof at rate of application.

1.6 QUALITY ASSURANCE

.1 Qualifications: Engage a roofing company having documented experience with installation of specified roofing system having areas of 30,000 m² or greater, and that employ “Qualified Roofing Trades-people” that are skilled with installation of specified Products within Climate Zone 7a or colder as defined by the National Energy Code of Canada for Buildings, 2011 as follows:

.2 Qualified Roofing Trades-people” are defined as follows:

.1 The onsite roofing foreman to hold documented evidence of supervising previous successful roofing projects, from start to completion, of similar size and complexity for public institutional buildings (with a minimum of 30,000 m^2) of modified bituminous membrane roof type where construction was completed within the last 8 years;

.2 Minimum of one member of the onsite roofing crew to hold an Alberta Journeyman Certificate, or Red Seal Journeyman Certificate, with documented evidence of the journeyman roofer completing previous successful roofing projects, from start to completion, of similar size and complexity for a public building (with a minimum of 10,000 m^2) of modified bituminous membrane roof type where construction was completed within the last 8 years;

.3 Minimum of 50% of the onsite roofing persons to have completed some portion of a roofing apprenticeship program and shall have either: requested from Alberta’s Apprenticeship and Industry Training Board certification as "Roofer", or equivalent after obtaining prior written authorization from the Consultant.

.4 All roofing staff operating torch equipment shall hold a valid Torch Safety certification provided by an agency acceptable to the Consultant.

.5 All onsite roofing staff shall hold a valid Fire Extinguisher training certification provided by an agency acceptable to the Consultant.

.6 Qualifications and certifications from other jurisdictions may be acceptable provided that written authorization is granted from the Consultant prior to start of roofing activities.

.7 Submit proof of qualifications when requested by the Consultant.

1.7 WARRANTY

.1 Warranty:

.1 The Contractor shall provide a Roofing Warranty certificate with a five year Roofing Warranty Period, signed by both the Contractor and the Warrantor stating:

.1 The Roofing System has been constructed in accordance with the Contract Documents;

.2 The Roofing Warranty Period;

.3 Moisture leaks to be corrected within a time-frame determined by the Consultant.

.4 The Owner as the warrantee, and stating that roofing work will remain in place and be free of any defects in materials and workmanship for the stated Roofing Warranty Period; and either:

.2 For the 5-year Roofing Warranty Period: Warrantor shall, at no additional expense to the Owner, repair any roofing failures (of the Roofing System including: moisture penetration, installation errors, manufacturers defects) which includes the replacement of all affected components of the Roofing System, occurring between the date of Interim Acceptance of the Work and the end of the Roofing Warranty Period.

.2 In addition to other Contractual requirements, the Contractor shall provide documents ensuring the performance of the Contractor's obligations under the Roofing Warranty in a form acceptable to the Consultant either:

.1 For a 5-year Roofing Warranty Period:

.1 Ensure that the following is in place:

.1 Ensure that a Roofing Maintenance Bond is in place for the Roofing Warranty Period of five years, starting on Interim Acceptance of the Work; and

.2 Manufacturers Warranty certificate(s), signed by the Contractor and the Roofing System manufacturer includes all roofing materials and assemblies installed by the Contractor. The Roofing System manufacturer’s Warranty must be for a minimum Roofing Warranty Period of five years, starting on Interim Acceptance of the Work; and

.3 A Canadian Roofing Contractors Association (“CRCA”) membership; and

.4 Listing of 10 successfully completed low-slope roofing projects, within climate zone 7a or colder per National Energy Code of Canada 2011; and

.5 Valid Ontario Certification of Recognition (COR); and

.6 Valid Ontario Worker’s Compensation Board (WCB) coverage for contractors and subcontractors; and

.7 Valid Ontario Business License; and

.8 In force General Liability insurance coverage for the work, for minimum $5,000,000.00 and endorsed for Hot Works.

.9 Contractor to demonstrate successful installation of low slope roofing for a minimum of 5 years in climate zone 7A or colder per National Energy Code of Canada 2011.

1.8 THIRD PARTY ROOFING INSPECTION

.1 The City will engage third party roofing inspection (paid through Cash Allowance). The Inspector will provide numerous inspections and reports to the Consultant during the progress of the roofing work, in accordance with the ORCA Roofing Applications Standards, to help ensure the roofing work is provided as set out in this Contract. Upon notice from the Consultant, the Contractor shall expediently perform all steps and make changes as identified by the roofing inspector, at no cost to the Owner. The involvement of the roofing inspector does not relieve the Contractor of the responsibility to supervise, inspect and provide the roofing work as set out in this Contract.

.2 The Construction schedule shall include roofing inspections. The Consultant will provide the number of roofing inspections and the frequency. The Owner, Consultant, roofing inspector(s), and Roofing System manufacturer, at reasonable times, shall have proper and safe access to the Work, including parts of the Work in preparation at locations other than the Place of the Work, for the purposes of observation, inspection and testing.

.3 Provide copies of the manufacturer’s site reports to the Owner, Consultant, and roofing inspector, prior to Interim Acceptance of the Work.

2 Products

2.1 PRODUCTS

.1 Except as specified otherwise, provide products from the Ontario Roofing Contractors Association (“ORCA”) “Accepted Products Listing for S.B.S. Modified Bituminous Membrane Systems” or equivalent with prior written authorization from the Consultant.

2.3 VAPOUR RETARDER

.1 Provide a SBS modified bitumen pre-manufactured sheet, with manufacturer's standard internal reinforcement, compatible with substrates and adjoining membranes.

2.4 INSULATION

.1 Provide one of the following, at Contractor's option:

.1 Molded Expanded Polystyrene (MEPS) Board: certified for conformance with CAN/ULC S701, Thermal Insulation, Polystyrene, Boards and Pipe Covering, Type 2, and as follows:

.1 Thermal Conductivity (kSI): 0.036 W/m°C maximum.

.2 Board Size, Nominal: 610 mm x 1220 mm.

.3 Dimensional Stability: 0.3% max. linear change.

.4 Certification: third party, in accordance with CGSB, ULC, or other certification programs accredited by the Standards Council of Canada.

.2 Isocyanurate Insulation: conforming to CAN/ULC-S704, rigid roof insulation board consisting of a polyisocyanurate foam core bonded chemically in the manufacturing process to glass fibre and other facings which are compatible to roofing membrane, aged RSI value of 0.99 per 25.4 mm thickness; thickness as indicated. Install in maximum 50 mm thick layers and maximum board size of 1200 mm x 1200 mm, to achieve RSI value as indicated on the drawings. Ensure that insulation is date stamp on date of manufacture, and that the insulation is not installed until 3 months after it has been manufactured.

.3 Extruded-Polystyrene Board Insulation: ASTM C 578, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E 84.

1. Rigid closed cell extruded polystyrene foam insulation.

2. Comply with ASTM C 578-95, Type IV, density 1.6 lb/cu. ft. min. compressive resistance 25 psi (ASTM D 1621-94)

3. Thermal resistance: R-values of 6.0 and 5.6 min. per inch °F-ft2-h/Btu2/inch at 40 °F and 75 °F respectively (ASTM C 518-98).

4. Water absorption: Max. 0.1% by volume (ASTM C 272-91 (96)).

5. Surface Burning Characteristics (ASTM C 578-95)
   a. Flame spread 0.
   b. Smoke Developed 155.

.5 Insulation Blocking: pine or spruce to CAN/CSA-O141, construction grade, maximum 15% moisture content at time of installation, sized to match total thickness of insulation

2.6 PRIMARY MEMBRANE AND MEMBRANE FLASHING

.1 Provide two-ply SBS modified bitumen membrane, including SBS modified bitumen flashings, to manufacturer's recommendations conforming to “ORCA Accepted Products Listing for S.B.S. Modified Bituminous Membrane Systems” and as specified in this Section.

.2 For membrane component types and reinforcement, refer to Primary Membrane Schedule at end of this Section.

.3 Cap Sheet Finish: granules in colour selected by Consultant from manufacturer's standard range.

.4 Membrane Flashing Finish: granules in colour selected by Consultant from manufacturer's standard range.

3 Application

3.1 INSTALLERS

.1 Ensure a roofing foreman is onsite and supervising the roofing work at all times when roofing work is undertaken. Ensure that at least one Journeyman or Red Seal Journeyman Roofer shall be onsite when roofing work is undertaken.

Contractors Association, current version, as amended from time to time.

.2 Qualified Roofing Trades-persons necessary to receive the manufacturer warranties are appropriately trained by the manufacturer and are onsite at all relevant times.

.3 Sub-Contracting

.1 Roofing Contractor shall not sub-contract the roofing work and related sheet metal flashings. Sub-contracting of sheet metal fabrication is permitted.

3.2 APPLICATION OF INSULATION

.1 Before application of insulation, ensure vapour retarder is not damaged, repair if necessary.

.2 If Moulded Expanded Polystyrene insulation is used:
.1 Back mop the substrate receiving the insulation layer and embed insulation into asphalt to create a full bond.

.3 Trim insulation to ensure no voids occur between the insulation and the insulation substrate. Where insulation butts a sloping surface, trim the insulation to profile that change in slope.

.4 Trim insulation to ensure tight fit at all vertical uprights.

.5 Leave no insulation exposed at the end of the workday.

3.3 APPLICATION OF PRIMARY MEMBRANE

.1 Install membrane components in accordance with requirements of “ORCA Roofing Application Standards Manual”.

.2 Use installation method as indicated on Primary Membrane Schedule at end of this Section.

.3 Torch apply sheet materials for continuous fusion of sheets and adhesion to substrates.

.4 Seal seams of nailed base sheets using cold or hot applied asphalt, or with torch heat application.

.5 Limit cap sheet bleed-out at seams to 12 mm. Cover excessive bleed-out with missing mineral surfacing by embedding matching colour granules.

.6 Torch-apply cap sheet and cap sheet flashing to seaming layout indicated on reviewed shop drawings and MBM Primary Membrane Schedule.

.7 Primary membrane deficiencies may include, but not be limited to, ridges, tenting, buckles, wrinkles and voids.

3.7 MBM PRIMARY MEMBRANE SCHEDULE

Component Substrate	Installation Method	Reinforcement, Minimum, g/m^2
Base sheets on slopes up to 2:12		
Plywood, lumber and OSB	Mop or adhere or mechanically fastened*	180 polyester
Gypsum sheathing	Mop or adhere or mechanically fastened*	95 glass fibre
Concrete	Mop, adhere or torch*	95 glass fibre
Base sheets on slopes over 2:12		
All Substrates	Mop or adhere and mechanically Fasten	180 polyester
Base sheet flashing		
All substrates	Self-adhered or mechanically fastened	180 polyester
Cap sheets		
Base sheet	Torch	180 polyester
Cap sheet flashing		
Base sheet flashing	Torch	180 polyester

*Base sheet installation method shall follow manufacturer's installation best practice method.

END OF SECTION 07 52 00

1 General

1.1 GENERAL REQUIREMENTS

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

1.2 WORK IN OTHER SECTIONS

.1 Related Work Specified in Other Sections

Section 04 20 00	:	Unit Masonry
Section 05 50 00	:	Metal Fabrication
Section 06 10 00	:	Rough Carpentry
Section 07 90 00	:	Joint Protection

1.3 SCOPE OF WORK

.1 Work of this Section shall include but not be limited to all sheet metal flashings where noted on drawings.

1.4 FIELD QUALITY CONTROL

.1 The Owner will appoint an independent inspection company to review materials, methods and installation.

.2 The costs of inspections and testing will be paid from the Cash Allowance covering this work as set forth in Section 01 21 00.

1.5 SUBMITTALS

.1 Submit samples of materials and profiles to Consultant for approval prior to fabrication.

2 Products

2.1 MATERIALS

.1 Sheet Metal: 26 gauge zinc-coated steel to ASTM A-446 Grade "A" with G90 zinc coating. Prefinished metal to be used for all flashings exposed to view. Colours as specified in Section 07310 selected from Stelcolour 5000 series.

.2 Aluminum Sheets: AA-C22-AA4 anodized aluminum, 5005 alloy, prefinished.

.3 Locking strips: 22 gauge galvanized steel continuous concealed strips.

.4 Fasteners: weatherguard hex head screws with ½" dome and neoprene washers. Nails - non-ferrous compatible with materials being installed. Colour to match flashings.

.5 Special Hook Strips and Cleats: Two gauges heavier of matching materials of flashing being employed. Galvanized.

.6 Solder: Block solder 50% tin, 50% lead.

.7 Fasteners: galvanized, or stainless steel nails or screws, compatible with materials being employed. Suitable to Consultant's approval.

.8 Nails: Ardox of length to penetrate bases ½" (13mm).

.9 Exposed Fasteners: #10 hex head cadmium plated with neoprene and solid washers by Atlas Bolt or approved equal. Consult manufacturer for screw type and sizing for materials being secured. Provide caps for screw heads to match colour of flashing as specified or shown.

.10 Masonry Fasteners: Tapcon sized to penetrate concrete 38mm (1-1/2") minimum unless otherwise shown.

.11 Wedges: Rolled plumber sheet lead.

.12 Masonry Anchors: Rawl lead lags and screws as approved by Consultant.

.13 Caulking: Polysulphide compound for concealed horizontal metal joints. Polyurethane to CAN/CGSB Standard CAN/CGSB 1924 M80 for reglet and exterior applications. Use colour to match materials as approved by Consultant.

.14 Joint Filler: Extruded polyethylene, closed cell Shore A Hardness 20, tensile strength 20 to 30 psi (140 to 210 Kilopascals).

.15 Bitumen Paint: Gilsonite asphalt 910-02 by Bakelite.

.16 Fascia and Soffits: Fabricate from minimum 20 ga. prefinished aluminum sheet conforming to CGSB 93.GP-1M. Provide continuous units as required. Colour to match existing Stelcolour QC-317 - White.

.17 Eavestrough and Downspouts: Fabricate from min. 20 ga. prefinished aluminum sheet. Minimum 125m x 125m (5" x 5") for eavestrough and 100mm x 100mm (4" x 4") for downspout. Provide hangers, ferrules, spikes, end caps, outlet drops and wire strainers. Colour to match existing.

.18 Splash Pad: 600mm x 600mm x 38mm precast concrete slabs.

3 Execution

3.1 FABRICATION

.1 Fabricate all possible work in shop in min. 2400mm lengths by brake forming, bench cutting, drilling and shaping.

.2 Form bends with straight sharp lines and angles into true planes, free from twists, buckles, dents and other visual distortions. Double-back exposed metal edges at least 12mm. Raw edges will not be permitted.

.3 Supply all accessories required for installation of sheet metal work of this Section. Fabricate accessories of same material as work with which they will be used.

3.2 INSTALLATION

.1 Install sheet metal work in accordance with CRCA specifications and standards and as detailed.

.2 Use concealed fastenings except where approved before installation.

.3 Install sheet metal flashings at copings, walls, expansion joints and curbs as shown on the drawings, or as otherwise required, for building components which penetrate roofs, and for which flashings are not specified in the work of other sections.

.4 Sheet metal work shall be installed to properly cover the area to be protected and be watertight under all service and weather conditions. Install in a uniform manner, level, true to line, free of dents, warping and distortion.

.5 Back-paint at the rate of 2.25 litres per 9.29 square metres with bituminous paint, sheet metal that comes into contact with another kind of metal, masonry or concrete.

.6 Install sheet metal with concealed fasteners at lock joints. **Exposed fastening will be permitted only with the approval of the Consultant.** Space all fasteners evenly in an approved manner. Use lead plugs and screws with rubber washers where metal flashings are installed over concrete or masonry.

.7 Install membrane flashing under sheet metal, installed directly over concrete, wood or masonry surfaces. Overlap joints 50mm and turn up 75mm at edges where horizontal surfaces intersect vertical planes.

.8 Join sheet metal by "S" lock seams, to permit thermal movement. Fill all

joints with caulking as flashing is being installed. Clean off all excessive material visible subsequent to installation. Space joints evenly where exposed. Make corners by means of raised seams. Lock seam and caulk. Do not use pop rivets.

.9 Slope all metal to interior to maintain minimum 4% slope for positive drainage. Do not form open joints or pockets that fail to drain water.

.10 Caulk all open sheet metal joints.

.11 Wedge flashings into reglet joints with lead wedges at 225mm o.c. At reglets wider than 9mm and deeper than 20mm provide polyethylene rod, 25% wider than joint width. Prime and caulk all joints to ensure positive waterproof seal. Use colours to match materials as approved by Consultant. Conform to manufacturer's latest printed recommendations for use of products being employed.

3.3 TOUCH-UP AND REPAIR

.1 Prepare and touch up all scratches on prepainted finish with matching paint to the satisfaction of the Consultant.

.2 Remove flux residue completely from surfaces and crevices. Remove other deposits or protections, and wash metals left unpainted and exposed to view as specified by metal manufacturer.

END OF SECTION 07 60 00

1 General

1.1 GENERAL REQUIREMENTS

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

1.2 WORK IN OTHER SECTIONS

.1 Related Work Specified in Other Sections

Division 15 : Heating, Ventilation and Air conditioning

1.3 ENVIRONMENTAL CONDITIONS

.1 Apply sealants only to completely dry surfaces. Sealant and substrate materials to be minimum 5°C surface temperature. Should it become necessary to apply sealants below 5°C, consult sealant manufacturer and follow their recommendations.

1.4 SUBMITTALS

.1 Submit samples to the Consultant for approval of each specified type of compound to be used together with the recommended primers and joint filler or fillers proposed to be used. Provide samples of available colours for selection by the Consultant.

1.5 PROTECTION

.1 Mask adjacent surfaces with masking tape prior to priming and caulking. Remove tape after joint has been tooled.

1.6 WARRANTY

.1 Contractor hereby warrants that the work of this Section will not leak, crack, crumble, melt, shrink, run, lose adhesion or stain adjacent surfaces, and remain free from defects in material and workmanship for a period of three years from the date of the Work Certificate of Total Performance.

2 Products

2.1 MATERIALS

.1 Primers: type recommended by sealant manufacturer for the appropriate sealant and corresponding substrate.

.2 Joint fillers: Polyethylene, urethane, neoprene or vinyl: extruded closed cell foam, Shore A hardness 20, tensile strength 140 to 200 kPa.

.3 Bond breaker: pressure sensitive plastic tape, which will not bond to sealants.

.4 Joint cleaners: non-corrosive, non-staining type, recommended by sealant manufacturer and compatible with joint forming materials.

.5 Sealants: Colour of sealant as selected by Consultant.

.6 Sealants:

Type A: Multi-component, chemical cured to meet specified requirements of CAN2 192-M80, such as Dymeric, as manufactured by Tremco (Canada) Ltd. Use at all exterior building joints, floor, wall and masonry joint locations, except where another type is specified.

Type B: Acrylic solvent release, one part sealant. To meet specified requirements of CGSB 19-GP-5M, such as Mono, by Tremco (Canada) Ltd. Use at interior joints between windows, door frames and screen frames.

Type C: Silicone sealant. One part sealant; to meet specified requirements of CGSB 19-GP-9Ma, such as Proglaze, by Tremco (Canada) Ltd. Sealant for fixtures, vanity tops, and where mildew resistant is required.

3 Execution

3.1 PREPARATION

.1 Remove dust, paint, loose mortar and other foreign matter. Dry joint surfaces.

.2 Remove rust, mill scale and coatings from ferrous metals by wire brush, grinding or sandblasting.

.3 Remove oil, grease and other coatings from non-ferrous metals with joint cleaner.

.4 Prepare concrete, masonry, glazed and vitreous surfaces to sealant manufacturer's instructions.

.5 Examine joint sizes and correct to achieve depth ratio 1/2 of joint width with

minimum width and depth of 6 mm, maximum width 25 mm.

.6 Install joint filler to achieve correct joint depth. Install joint backing in joints. Joint backing shall be oversized to remain under 28% compression within the joint, 15 -6°C (20°F) and set back from the surface 9mm (3/8") to 12.5mm (1/2") to facilitate sealant bead thickness specified.

.7 Where necessary to prevent staining, mask adjacent surfaces prior to priming and caulking.

.8 Apply bond breaker tape where required to manufacturer's instructions.

.9 Prime sides of joints in accordance with sealant manufacturer's instructions immediately prior to caulking.

3.2 APPLICATION

.1 Apply sealants, primers, joint fillers and bond breakers to manufacturer's instructions. Apply sealant using gun with proper size nozzle. Use sufficient pressure to fill voids and joints solid. Superficial pointing with skin bead is not acceptable.

.2 All caulking shall be completed before adjacent surfaces, required to be painted, are painted.

.3 Form surface of sealant with full bead, smooth, free from ridges, wrinkles, sags, air pockets, embedded impurities. Neatly tool surface to a slight concave joint.

.4 Apply sealant to joints between window or door frames to adjacent building components, around perimeter of every external opening, to control joints in masonry walls and between masonry and structural steel, to fixtures and millwork and walls, and as required exterior and interior to ensure a tight building.

.5 Ensure that caulking is finished between structural members to be painted and all adjacent surfaces prior to painting.

.6 Exposed caulking compound shall be smooth, free from ridges, wrinkles, air pockets and embedded impurities.

.7 Clean adjacent surfaces immediately and leave work neat and clean. Remove excess sealant and droppings using recommended cleaners as work progresses. Remove masking after tooling of joints. Finished surfaces damaged due to this work shall be replaced to the satisfaction of the Consultant without extra cost to the Owner.

END OF SECTION 07 90 00

1 General

1.1 GENERAL REQUIREMENTS

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

1.2 WORK IN OTHER SECTIONS

.1 Related Work Specified in Other Sections

Section 03 30 00: Cast-In-Place Concrete
Section 04 20 00: Unit Masonry
Section 05 12 00: Structural Metal Framing
Section 05 50 00: Miscellaneous Metal
Section 07 90 00: Sealants
Section 08 70 00: Finish Hardware
Section 09 90 00: Painting

.2 Products Supplied Under Work of this Section and Installed Under Work of Other Sections

Section 03 30 00: To Install Frames, Anchors, Bolts, Inserts at Concrete
Section 04 20 00: To Install Frames, Anchors, Bolts, Inserts at Masonry
Section 04 20 00: To Grout Frames

.1 Products Supplied and Installed Under Work of Other Sections

Section 06 20 00: To install Finish Hardware
Section 08 71 00: To supply Finish Hardware

1.3 QUALIFICATIONS

.1 Execute work of this Section only by a Subcontractor who has adequate plant, equipment and skilled tradesmen to perform it expeditiously, and is known to have been responsible for satisfactory installations similar to that specified during a period of at least five years.

1.4 SHOP DRAWINGS

.1 Submit one PDF digital copy of shop drawings to the Consultant for examination.

.2 Show full size profiles, reinforcing for hardware, anchorage details and complete schedule of all doors, frames, screens and hardware.

1.5 REQUIREMENTS OF REGULATORY AGENCIES

.1 Construct fire-rated doors and frames of ratings indicated in accordance with CAN 4-5104, CAN4-5105, NFPA-80 and NFPA-101 as otherwise required by jurisdictional authorities.

.2 Ensure that hardware and installation meet requirements of standards.

.3 Doors and frames, indicated as labelled, shall meet all conditions of standards, and shall have attached labels.

1.6 PRODUCT HANDLING

.1 Package or crate, and brace products to prevent distortion in shipment and handling. Label packages and crates and protect surfaces by sturdy wrappings.

2 Products

2.1 MATERIALS

.1 General: All doors and frames shall be fabricated from wipe coat galvanized steel. All doors shall have welded edge seams on hinge and lock edges only and all seams shall be sealed. All frames are to be welded type throughout.

.2 Hollow Metal Doors

Face	:	16 gauge
Top and Bottom End Channels	:	: 16 gauge
Vertical Stiffeners	:	18 gauge
Insulation (exterior doors)	:	Loose fibreglass minimum density 1.5 lb/cu.ft.
Steel Top Cap (ext. Doors)	:	20 gauge
Core	:	"Honeycomb" core material, pressure laminated to face sheets
Reinforcing	:	For locks, closers, lites
Hinges:	:	min. 3 templated hinges per door

.3 Hollow Metal Frames and Screens: Welded Type

Frames	:	16 U.S. gauge
Spreaders and Anchors	:	18 U.S. gauge
Guard Boxes	:	22 U.S. gauge
Reinforcements	:	12 U.S. gauge

.4 Glazing Stops: Minimum 1mm base thickness steel, screw fixed tamperproof.

.5 Reinforcing Channel: 18 gauge bent sections 115mm wide with 38mm return lip.

.6 Corner Post Reinforcing: C4 x 7.25 galvanized steel channel or 75 x 75 x .125 HSS tubular steel sections.

.7 Door Bumpers: Black neoprene single stud, eight (8) per frame.

.8 Hardware: as specified in Section 08 71 00.

.9 Labels: Conforming to ULC Standards and where noted on the drawings.

3 Execution

3.1 FABRICATION METAL DOOR FRAMES AND SCREENS

.1 Form profiles accurately to approved Shop Drawings; neat, sharp, free from kinks, twists and warps. Fabricate profiles to details shown on drawings.

.2 Blank, reinforce, drill and tap frames to receive all hardware as specified.

.3 Spot weld reinforcing plates to the inside construction to accommodate hardware cut-outs, door closers and check to ensure rigid construction. Check hardware list for requirements.

.4 Weld guard boxes to frame at all strikes, hinges and concealed closers to completely enclose same. Include conduit for electric strikes and wiring devices.

.5 Install stiffener plates or spreaders between frame trim where required to prevent bending of trim and to maintain alignment when setting and during adjacent construction work.

.6 Mitre head and jamb joints, accurately and weld continuously and grind smooth. Where site welding or splicing is required due to size of unit, the location of field joints shall be shown on the Shop Drawings and strictly adhered to. Avoid field welding where possible.

.7 Welds shall be ground smooth, filled with paste filler and sanded to a smooth, uniform finish.

.8 Provide two welded-in channel or angle spreaders per door frame at bottom to ensure proper frame alignment.

.9 Provide adjustable 'T' anchors or 'L' type anchors for each jamb at approximately 50mm centres (minimum 4 per jamb).

.10 Provide floor anchors on frames that terminate at finished floor. Provide jamb extension anchorage on frames that terminate at slab.

.11 Provide reinforcing channels for anchorage of frames in drywall partitions to floor and structure where frames are longer than 2400mm and where required to meet labelling requirements. Channels are to be anchored to the floor, tack welded to the frame and welded or clip angled to the structure above.

.12 Provide corner post reinforcing where required to maintain labelling or stability to frames which turn corners. Anchor securely to the floor, frame and structure above.

3.2 FABRICATION HOLLOW METAL DOORS

.1 Fabricate doors to conform to details and schedules. Doors shall be flush face, seamless type. Edges of doors shall have seams filled and ground smooth. Door thickness shall be 45mm unless specifically noted.

.2 Reinforce, stiffen, sound deaden and insulate interior doors with pre expanded small cell honeycomb core. Laminate core to both faces of the panels.

.3 Doors shall be templated, mortised, reinforced, drilled and tapped to receive either surface mounted or mortised hardware.

.4 Cut out neatly for louvres where shown and as specified. Frame opening with stiffeners. Install louvres square and centred on the width of the door.

.5 Assemble all components by means of adequate spot welding or arc welding in accordance with C.S.A. Standard Specification W50 to provide a finished door, square and true and free of all distortion.

.6 Doors shall be cleaned and sanded, given a coat of air drying paste filler, and sanded to eliminate all unevenness or irregularities.

3.3 INSTALLATION OF DOORS

.1 Install hollow metal doors complete with all hardware as supplied under the work of Section 08 70 00.

.2 Install doors only when work has progressed to a stage when no damage will occur to them in place.

.3 Hang doors to swing easily and freely on their hinges, to remain stationary in any position and to close tightly and evenly on frames without binding.

.4 Provide 1.5mm clearance at head and jambs, and no more than 9mm at floor. Provide clearance for intended finish flooring.

3.4 FINISHING

.1 Doors manufactured from C.R.S. shall be chemically treated for good paint adhesion and all visible surfaces shall be finished with a corrosion resistant steel primer. Doors manufactured from wipe coated galvanized steel shall be supplied without a prime coat.

.2 All doors, frames and screens to be finish painted to match existing colours.

3.5 ADJUSTING AND CLEANING

.1 Adjust doors to move freely, without excessive play and to fit accurately.

.2 Refinish damaged and defective work before completion of project. Refinishing of exposed surfaces shall show no discernible variation in appearance.

.3 Clean work at completion of installation as specified in Section 01 70 00.

END OF SECTION 08 10 00

1 General

1.1 SECTION INCLUDES

A. Insulated steel sectional overhead doors.

B. Hardware.

C. Electric operators and controls.

1.2 RELATED SECTIONS

Section 03 30 00	:	Cast-in-Place Concrete
Section 04 20 00	:	Unit Masonry
Section 05 50 00	:	Metal Fabrications
Section 06 10 00	:	Rough Carpentry.
Section 07 90 00	:	Joint Protection.
Section 08 71 00	:	Door Hardware.
Section 09 90 00	:	Painting and Coating.
Section 26 27 16	:	Electrical Cabinets and Enclosures.

1.3 REFERENCES

A. American National Standards Institute (ANSI):
1. ANSI/DASMA 102 - Specifications for Sectional Overhead Type Doors.
2. ANSI/DASMA 105 - Test Method for Thermal Transmittance and Air Infiltration of Garage Doors.
3. ANSI/DASMA 108 - Standard Method for Testing Sectional Garage Doors, Rolling Doors, and Flexible Doors: Determination of Structural Performance Under Uniform Static Air Pressure Difference.
4. ANSI/DASMA 115 - Standard Method for Testing Sectional Doors, Rolling Doors, and Flexible Doors: Determination of Structural Performance Under Missile Impact and Cyclic Wind Pressure.

B. ASTM International (ASTM):
1. ASTM A123 - Standard Specification for Zinc (hot-dipped galvanized) coatings on iron and steel products.
2. ASTM A229 - Steel wire, oil-tempered for mechanical springs.
3. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
4. ASTM A924 - Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
5. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
6. ASTM C518 - Standard Test Method for Steady-State Thermal

Transmission Properties by Means of the Heat Flow Meter Apparatus.
7. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Element.
8. ASTM E283 - Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.
9. ASTM E330 - Structural performance of exterior windows, curtain walls, and doors by uniform static air pressure difference.
10. ASTM E413 - Classification for Rating Sound Insulation V62221

C. Underwriters Laboratories (UL):
1. UL 325 - Standard for Door, Drapery, Gate, Louver, and Window Operators and Systems Current Edition, Including All Revisions.

1.4 DESIGN / PERFORMANCE REQUIREMENTS

A. Wind Loads: Design and size components to withstand loads caused by pressure and suction of wind acting normal to plane of wall as calculated in accordance with applicable code.
1. Design pressure: Standard wind load of 60.5 mph/97 km/h (9.39 psf/0.45 kPa).

B. Wiring Connections: Requirements for electrical characteristics.
1. 115 volts, single phase, 60 Hz.

1.5 SUBMITTALS

A. Submit under provisions of Section 01 30 00.

B. 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.

C. Shop Drawings: Clearly show and describe in detail, detailed door assemblies and adjacent construction, including elevations, sections and details of door, track, hardware and operating components, dimensions, gauges, finishes and relationship of door, track, hardware, and operating components to adjacent construction.

D. Selection Samples: Colour to match existing overhead door.

E. Manufacturer's Certificates: Certify products meet or exceed specified requirements.

F. Operation and Maintenance Data.

1.6 QUALITY ASSURANCE

1. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with a minimum of five years documented experience.

2. Installer Qualifications: Authorized representative of the manufacturer with a minimum of five years documented experience.Installation shall be only by the specified manufacturer or an authorized representative for the region.

3. Single-Source Responsibility: Provide doors, tracks, motors, and accessories from one manufacturer for each type of door. Provide secondary components from source acceptable to manufacturer of primary components.

4. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories, Inc./ULC/CSA acceptable to authority having jurisdiction as suitable for purpose specified.

1.7 DELIVERY, STORAGE, AND HANDLING

1. Store products in manufacturer's unopened packaging until ready for installation.

2. Protect materials from exposure to moisture. Do not deliver until after wet work is complete and dry.

3. Store materials in a dry, warm, ventilated weathertight location.

1.8 PROJECT CONDITIONS

1. Pre-Installation Conference: Convene a pre-installation conference just prior to commencement of field operations, to establish procedures to maintain optimum working conditions and to coordinate this work with related and adjacent work.

1.9 WARRANTY

1. Manufacturer’s 2 year warranty against defects in materials and workmanship.

2. Manufacturer’s 40 year warranty for coating film integrity and 35 year warranty against chalking and fading of coating.

2 Products

1.10 MANUFACTURERS

A. Acceptable Manufacturer: Richards-Wilcox Canada, which is located at:
5100 Timberlea Blvd.
Mississauga, ON, Canada L4W 2S5

Tel: 905-625-0037
Fax: 905-625-0057
Email:marketing@rwdoors.com;Web:https://www.rwdoors.com

B. Substitutions: Not permitted.

1.11 INSULATED STEEL SECTIONAL OVERHEAD DOORS

A. Richards-Wilcox Canada Thermatite Model T200-MR / T200 2 inch.
   1. Door Assembly: Metal/foam/metal sandwich panel construction. Doors comply with:
      a. ANSI/DASMA 102 - American National Standard Specifications for Sectional Overhead Type Doors.
   2. Size: See Drawings. Door is to be 1 inch (25 mm) higher than finished door opening and extend 1 inch (25 mm) beyond jamb on either side of finished door opening width.

1.12 HARDWARE

A. Counter-Balance System:
   1. Spring assembly: Oil tempered torsion springs:
      a. Minimum 100,000 cycles
   2. Spring: Sized to suit the cycles.
   3. Shaft: 1 inch (25 mm) 1/8 inch (3 mm) galvanized tube with full length keyway, recommended for doors up to 675 lbs (305 kg).

B. Hardware: Include all the required hardware and zinc plated fasteners.
   1. Hinges: Linear style 12 gauge (2.75 mm) galvanized steel.
   2. Track 2 inches (50 mm): Rolled formed from 2 inch (50 mm) 14 gauge (2.0 mm) galvanized steel.
      a. Mounting: ADCA: Continuous adjustable track angle ADCA. Bolted type, field adjustable to ensure weather tight seal, fabricated from 14 gauge (2.0 mm) commercially galvanized steel, designed to provide continuous track support for full opening height.
      b. Mounting: Clip Angle: Pre-punched angle and clips designed for field bolting, adjustable to ensure weather tight seal and serviceability, the angles are fabricated from 0.093 inch (2.4 mm) commercially galvanized steel.
      c. Mounting: Bracket: Track brackets. Bolted type field adjustable to ensure weather tight seal, rib reinforced, stamped from 0.123 inch (3.1 mm) thick commercially galvanized steel.
      d. Horizontal Track Curve: 12 inch (305 mm).
      e. Rollers: 2 inch (50 mm) white nylon race, 10 ball bearings. Stem: zinc plated.
      f. Roller Brackets: 14 gauge (2.0 mm) thick commercially galvanized

steel. Graduated design to suit the vertical track slop to ensure weather tight seal.

3. Track 3 inches (75 mm): Rolled formed 12 gauge (2.7 mm) galvanized steel.
   a. Mounting: ADCA: Continuous adjustable track angle ADCA. Bolted type, field adjustable to ensure weather tight seal, fabricated from 13 gauge (2.4 mm) commercially galvanized steel, designed to provide continuous track support for full opening height.
   b. Mounting: Clip Angle: Pre-punched angle and clips designed for field bolting, adjustable to ensure weather tight seal and serviceability, the angles are fabricated from 0.093 inch (2.4 mm) commercially galvanized steel.
   c. Mounting: Bracket: Track brackets. Bolted type field adjustable to ensure weather tight seal, rib reinforced, stamped from 0.123 inch (3.1 mm) thick commercially galvanized steel.
   d. Track Hangers: Perforated type 1-1/4 inches by 1-1/4 inches (32 mm by 32 mm) angles, roll formed from 14 gauge (2.0 mm) thick commercially galvanized steel.
   e. Horizontal Track Curve: 16 inch (406 mm) radius.
   f. Rollers: Hardened steel outer race, 2-7/8 inch (73 mm) diameter, with ten 5/16 inch (8 mm) ball bearings, and 7/16 inch (11 mm) diameter roller axels.
   g. Roller Brackets: Fabricated from commercially galvanized steel. Graduated type design to suit the slope in the vertical track to ensure weather tight seal. Thickness as follows:
      1) 11 gauge (3.1 mm).
4. Horizontal angle: Full length.
5. Pusher springs. For standard lift doors with manual chain hoist or jackshaft electric operators.
6. Bumper leaf springs: For high lift and vertical lift door applications.
7. Across-the-door bar latch: With night lock and outside cylinder and handle for manually operated doors only.
8. Across-the-door-bar latch inside only: Complete with night lock and interior handle. Electric interlock is required on electrically operated doors.
9. Double end roller brackets and long stem rollers.
10. Double radius low headroom track: Minimum clearance required, 5 inches (127 mm) for 2 inch (50 mm) hardware and 7-1/2 inches (190 mm) for 3 inch (hardware).
11. Track guards. 3/16 inch (4.8 mm) steel, 60 inches (1520 mm high).

1.13 ELECTRIC OPERATORS AND CONTROLS

A. Pulse DC1000 Direct Drive (1 HP): DC electric motor is directly coupled to a hollow shaft (30:1 reduction) worm gear reducer designed to install over keyed door shaft.
   1. Motor: Continuous duty 1 HP, 90 V DC, 1750 rpm motor.
   2. Operator: Suitable for 110 to 240 V, 1 PH, and 60 Hz power supply with integral absolute encoder to control the door travel.
   3. Controls: Programmable wall mountable UL325 compliant NEMA 4X control panel with LCD display and OPEN-CLOSE-STOP buttons on cover, 24V DC control voltage, containing the back-up battery pack to operate the door in case of power failure, logic circuit board. Pulse with modulation programming to provide soft-start soft-stop, dynamic brake, and speed control. Cycle counter, dual upper limit for partial opening, time delay on reverse and programmable close timer, terminal blocks for external activating and reversing devices. Includes the following:
      a. Photo Cell: NEMA 4 photo cell for mounting across the opening wired to reverse the door closing in case it detects an obstruction.
      b. Remote push button station: NEMA 4, three buttons OPEN-CLOSE-STOP bush button station for remote location.
   4. Maximum Recommended Counter balance Sectional Door size: 600 sq ft.

B. Pulse DC750 Direct Drive (3/4 HP): DC electric motor directly coupled to a hollow shaft (30:1 reduction) worm gear reducer designed to install over keyed door shaft.
   1. Motor: Continuous duty 0.75 HP, 90 V DC, 1750 rpm motor.
   2. Operator: Suitable for 110 to 240 V, 1 PH, and 60 Hz power supply with integral absolute encoder to control the door travel.
   3. Controls: Programmable wall mountable UL325 compliant NEMA 4X control panel with LCD display and OPEN-CLOSE-STOP buttons on cover, 24V DC control voltage, containing the back-up battery pack to operate the door in case of power failure, logic circuit board. Pulse with modulation programming to provide soft-start soft-stop, dynamic brake, and speed control. Cycle counter, dual upper limit for partial opening, time delay on reverse and programmable close timer, terminal blocks for external activating and reversing devices. Includes the following:
      a. Photo Cell: NEMA 4 photo cell for mounting across the opening wired to reverse the door closing in case it detects an obstruction.
      b. Safety Edge: Wireless, Featheredge on leading edge of bottom section wired to reverse the door closing in case it detects an obstruction.
      c. Remote push button station: NEMA 4, three buttons OPEN-CLOSE-STOP bush button station for remote location.

4. Maximum Recommended Counter balance Sectional Door size: 400 square feet.

C. Pulse DC500 Direct Drive (1/2 HP): DC electric motor directly coupled to a hollow shaft (30:1 reduction) worm gear reducer designed to install over keyed door shaft.
   1. Motor: Continuous duty 0.5 HP, 90 V DC, 1750 rpm motor.
   2. Operator: Suitable for 110 to 240 V, 1 PH, and 60 Hz power supply and shall have integral absolute encoder to control the door travel.
   3. Controls: Programmable wall mountable UL325 compliant NEMA 4X control panel with LCD display and OPEN-CLOSE-STOP buttons on cover, 24V DC control voltage, containing the back-up battery pack to operate the door in case of power failure, logic circuit board. Pulse with modulation programming to provide soft-start soft-stop, dynamic brake, and speed control. Cycle counter, dual upper limit for partial opening, time delay on reverse and programmable close timer, terminal blocks for external activating and reversing devices. Includes the following:
      a. Photo Cell: NEMA 4 photo cell for mounting across the opening wired to reverse the door closing in case it detects an obstruction.
      b. Safety Edge: Wireless, Featheredge on leading edge of bottom section wired to reverse the door closing in case it detects an obstruction.
      c. Remote push button station: NEMA 4, three buttons OPEN-CLOSE-STOP bush button station for remote location.
   4. Maximum Recommended Counter balance Sectional Door size: 200 square feet.

D. AC Jack Shaft Hoist: Provide jack shaft type electric operators, for the doors indicated on the Drawings, to operate the doors at approximate speed of 8 inch (200 mm) per second.
   1. Standard Lift Doors: Dyna-Hoist" heavy commercial duty, logic control type operator with on board radio receiver, model "Dyna-Hoist MO-OPH" to NEMA 1, shall be equipped with an adjustable friction clutch, time delay on reverse, mechanical brake, integral enclosure containing the controls, floor level disconnect, self-engaging chain hoist with electrical cut-off for manual emergency operation, continuous duty motor __ HP minimum, suitable for ___ volts, _ Ph, 60 Hz power supply.
   2. Standard High Lift and Full Vertical Lift Doors: Dyna-Hoist" heavy industrial duty, logic control type operator with on board radio receiver, model "Dyna-Hoist MO-OSH" to NEMA 1, shall be equipped with an adjustable friction clutch, cast iron flanged bearings on input and output shafts, time delay on reverse, solenoid brake, integral enclosure containing the controls, floor level disconnect, chain hoist with electrical

cut-off for manual emergency operation, continuous duty motor 1 HP minimum, suitable for 208 volts, 3 Ph, 60 Hz power supply

3. Standard Controls:
   a. One push button station "OPEN/CLOSE/STOP" to NEMA 1, for inside wall mounting near the door jamb on the operator side.
   b. Install a "Featheredge" Reversing Safety Edge along the bottom edge of door to reverse on contact with an object as supplied by Service Door Industries. Hose type pneumatic safety edges will not be accepted. Power to the safety edge shall be supplied through reelite.

1.14 FABRICATION

A. Fabricate the work true to dimensions detailed and square, and to the reviewed shop drawings, free from distortion and defects detrimental to the appearance and performance.

B. Verify the door opening dimensions prior to the fabrication of the doors.

C. Doors shall be 1 inch (25 mm) higher than finished openings and extend 1 inch (25 mm) beyond jamb on either side of finished opening width.

D. Shop and field connections shall comply with CAN/CSA S16.1-M.

E. Accurately fit joints and intersecting members with adequate fastenings.

2 Execution

1.15 EXAMINATION

A. Do not begin installation until the openings have been properly prepared.

B. Verify wall openings are ready to receive work and opening dimensions and tolerances are within specified limits.

C. Verify electric power is available and of correct characteristics.

D. If preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

1.16 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

1.17 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install doors, tracks and operating equipment complete with necessary hardware, weather-stripping, anchors, hangers, brackets, and accessories, in accordance with manufacturer's printed instructions.

C. Assemble and erect work plumb, true, square, straight, level, and accurate as per Drawings and reviewed shop drawings.

D. Isolate metals where necessary to prevent corrosion due to contact with dissimilar metals and between metals, masonry and concrete. Use bituminous paint or butyl tape or as recommended, in writing, by the door manufacturer.

1.18 ADJUSTMENT AND DEMONSTRATION

A. Lubrication: Upon completion of erection of units and operating equipment, lubricate moving parts before operation. Grease sprockets, bearings, cables, link chains and guides. Use lubricant as recommended by the manufacturer.

B. Demonstration: Test-operate and adjust doors to perform smoothly, free from warp, twist, or distortion. Demonstrate the operation to the satisfaction of the Architect at the same time of acceptance of the completed work.

1.19 PROTECTION

A. Do not permit construction traffic through overhead door openings after adjustment and cleaning.

B. Protect installed products until completion of project.

C. Touch-up damaged coatings and finishes and repair minor damage before Substantial Completion.

END OF SECTION 08 36 13

1 General

1.1 GENERAL REQUIREMENTS

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

1.2 WORK IN OTHER SECTIONS

.1 Related Work Specified in Other Sections

Section 08 10 00 : Doors & Frames
Section 08 36 13 : Insulated Sectional Steel Doors

.2 Products Supplied Under Work of This Section

and Installed Under Work of Other Sections
Section 06 20 00 : To install all Finishing Hardware

1.3 REFERENCE STANDARDS

.1 All hardware herein specified is the Owner's standard quality for the project. No substitution or deviation will be considered unless approval has been obtained from the Consultant. The Consultant will have final decision on equality.

1.4 SCOPE OF WORK

.1 Furnish all finish hardware items as detailed in schedule herewith. Comply with all additional functions and duties as indicated and dictated by this specification. Install all hardware under this contract. Prepare doors and frames accordingly.

.2 The Hardware Consultant shall act on the behalf of the Consultant to make numerous site visits upon receipt of the finishing hardware and shall notify the Consultant in writing that all goods have been supplied exactly as per this specification.

Any deviation from the hardware schedule shall be replaced with the scheduled hardware at no additional cost to the Owner. Samples will be retained until the completion of the project.

1.5 COORDINATION

.1 The hardware supplier shall coordinate all hardware supply and installations with related trades.

.2 Immediately after awarding the finish hardware contract, it shall be the

responsibility of hardware supplier to request reviewed shop drawings from related trades for co-ordinating.

1.6 QUALIFICATIONS

.1 Personnel who will be responsible for scheduling, detailing, ordering, and co-ordinating hardware for this project, shall be experienced Architectural Hardware Consultants. Regular membership in the Door and Hardware Institute is acceptable evidence of such experience.

.2 Upon award of this contract, the successful Tenderer shall submit to the Consultant the name of the individual who shall be responsible for this project.

1.7 SUBMITTALS

.1 Hardware supplier shall prepare and submit to the Consultant for approval, one (1) PDF copy of complete detailed hardware schedule.

.3 Supply a sample of each hardware item as listed herein, to be retained by the Consultant for comparison with hardware furnished.

.4 The hardware supplier shall transmit copies of the hardware schedule and relative template information to any other contractors requiring same for fabrication of doors, frames and etc.

.5 Hardware shall be delivered to the job site in manufacturer's original packages. Each item shall be marked with the opening to identify correct location.

1.8 PRODUCT HANDLING

.1 A locked storage space shall be furnished by the General Contractor for the storage of all finishing hardware.

.2 If doors are field painted or finished, hardware shall be installed after or protected by masking, covers, etc.

1.9 GUARANTEE

.1 All products supplied will bear a manufacturer's warranty of two years in general and ten years on door closers. This warranty shall cover material, workmanship, function of, and finish. Any product which fails to fulfil these requirements will be exchanged by the hardware supplier at no cost to the Owner.

2 Products

2.1 GENERAL

.1 The work of this Section shall include the supply of all finish hardware, including but not be limited to:-

: Hardware for all hinged doors.
: Door silencers for metal door frames.
: Door stops, floor or wall types as required.
: All hardware for millwork.
: Metal thresholds, sweeps, weatherstripping.
: Electric door hold open devices.
: Electric door operators **(supply and install under base contract)**

.2 All materials to be of first quality workmanship, material and finish. Any product which is not acceptable will be removed from job site and replaced at no cost to the Owner.

2.2 MANUFACTURERS

Butts :	Monthard Ltd.
Locksets, Latchsets :	Schlage Lock Co.
Pulls, Pushes, Floorand Wall Stops, Kickplates	Canadian Builders Hardware
Door Closers :	L.C.N. Door Closers
Overhead Door Holders :	Glynn-Johnson Ltd.
Panic Bolts :	Von Duprin Ltd.
Thresholds, Sweeps :	K. N. Crowder Mfg. Co.
Key Cabinet :	Telkee Mfg.

2.3 MATERIALS

.1 Only items listed as allowable substitutions will be accepted.

.2 Hinges shall be Monthard type, size and weight as listed in the hardware schedule. Paint grade hinges are not acceptable. Substitution of standard weight hinges on doors specified with heavy weight hinges will not be accepted. Equivalent Stanley or Hager hinges in size, type, weight and finish will be accepted. NO SUBSTITUTIONS ALLOWED FOR DOORS SPECIFIED WITH ZERO CONTINUOUS HINGES.

.3 Locks and latches shall be Schlage L series mortise with 03B (lever) and 42B (Orbit) trim 626 finish. NO SUBSTITUTIONS ALLOWED.

.4 Exit devices shall be Von Duprin 55 and 88 series 626 finish. The hollow

metal supplier shall ensure that the centre rails on all doors with lites shall be located at height which allows the installation of exit devices according to Von Duprin's templating. If a conflict occurs, it shall be the hollow metal supplier's responsibility to notify the Consultant for approval of all changes. NO SUBSTITUTIONS ALLOWED.

.5 Door closers shall be LCN 4010, 4110, 4020, 4820 and 4041 series. "Cush" series is not acceptable for any doors specified with door closers and overhead stops. 1461 series is not acceptable for doors specified for the 4041 series. NO SUBSTITUTIONS ALLOWED.

.6 "Carpentry Note" - All doors specified with 4∅41 closers shall be installed with either regular (REG), parallel (PA) or top jamb (TJ) mounting. Refer to the finishing hardware schedule and LCN template information for proper installation requirements and procedures.

.7 Kick and Push Plates shall be CBH type 304 stainless steel, 0.050 inches thick. Sizes shall be specified in the hardware schedule. Hager equivalents will be accepted.

.8 Door pulls shall be CBH 7000 series, one inch diameter stainless steel. Horizontal push bars shall be CBH 7000 series, one inch diameter stainless steel mounted back-to-back with door pulls.

.9 Overhead stops shall be Glynn-Johnson 90 series Heavy-Duty, as listed in the hardware schedule. NO SUBSTITUTIONS ALLOWED.

.10 Automatic door operators shall be Horton 7000 series. Supply and installation shall be by the hardware supplier **(base bid)**.

2.4 MILLWORK

.1 Material listed below shall be used for this project.

Hinges	:	Grass
Pulls	:	CBH
Locks	:	National
Catches	:	Ives
Drawer Guides	:	Knape & Vogt
Pilasters &Clips	:	Knape & Vogt

2.5 KEYING

.1 All lock cylinders shall be subject to a new Schlage Master Key System and Construction Master Keyed. Upon building completion it shall be the responsibility of the General Contractor to remove construction key inserts.

.2 All locks to be supplied with ten keys per cylinder.

2.6 ADJUSTING TOOLS

.1 After installation, at least four (4) each of special adjusting tools furnished with hardware shall be turned over to Owner by the General Contractor.

3 Execution

3.1 PRODUCT LOCATION

.1 All mounting height locations shall conform to the Canadian Steel Door Manufacturers' Association recommended installation heights and Ontario Building Code barrier-free requirements.

3.2 EXAMINATION

.1 Before supplying materials, ensure by a check of drawings, shop drawings and details prepared for the project, that listed hardware is suitable by dimension and function for intended purposes.

3.3 INSTALLATION

.1 Provide templates required for preparation of doors and frames to the appropriate fabricators.

.2 Work of this Section shall include assistance and supervision of installation when requested, and as otherwise provided by the supplier, to ensure correct installation.

3.4 ADJUSTING

.1 Verify under Work of this Section that installed hardware functions properly, and adjust accordingly to ensure satisfactory operation.

.2 Upon occupancy of building arrange an appointment with the Owner's designated representative to instruct this person in the proper use, servicing, adjusting and maintenance of hardware.

3.5 INSPECTION

.1 Hardware supplied will be inspected after completed installation by manufacturer's representative and a written report shall be made to the Owner. Should a manufacturer's representative not be available, the Consultant will carry out the final inspection and the findings will be binding to the hardware suppliers.

END OF SECTION 08 71 00

1 General

1.1 GENERAL REQUIREMENTS

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

1.2 WORK IN OTHER SECTIONS

.1 Related Work Specified in Other Sections

Section 07 90 00	:	Sealants
Section 08 10 00	:	Metal Doors & Frames

1.3 SUBMITTALS

.1 Affidavits: In lieu of samples and inspection procedures when required by CGSB Specifications, submit affidavits that materials supplied under these requirements meet CGSB Specifications, if requested by Consultant.

1.4 ENVIRONMENTAL CONDITIONS

.1 Glaze with compounds, sealants, or tapes only when glazing surfaces are at temperatures over 5°C (40°F) and when positive that no moisture is accumulating on them from rain, mist or condensation.

2 Products

2.1 MATERIALS

.1 Clear Float Glass: to CAN2-12.1-M76min. 6mm thickness.

.2 Tempered safety glass: to CAN2-12.1-M79 Type 2, Class B 6mm thickness.

.3 Clear Wired Glass: polished Georgian wired pattern to CAN2-12.11 M76 6.4mm (1/4").

.4 Insulating Glass: to CAN2-12.10-M76 Type 2 Class A, Style 2, Garde B, Level 1 with 12.5 min. air space. 6mm Solar bronze tempered exterior lite and 6mm clear float glass interior lite.

.5 Glazing compound: oil base, to CGSB 19-GP-6M.

.6 Butt glazing sealant: silicone to CGSB 19-GP-9Ma gun grade.

.7 Sealant compound: one component acrylic base, to CGSB 19-GP-5M+Amdt-Nov.79, gun grade.

.8 Sealant compound: one component silicone rubber, to CAN2-19.13-M82, gun grade.

.9 Glazing tape: preformed butyl tape, 10-15 durometer hardness.

.10 Setting blocks: neoprene, Shore "A" durometer hardness 70 to 90 size to suit glass thickness.

.11 Spacer shims: neoprene, Shore "A" durometer hardness 40 to 50.

.12 Primer-sealers and cleaners: to glass manufacturer's standard.

.13 Laminated Glass: 14 mil, heat strengthened glass, tinted green, consisting of one (1) lite of 6mm clear, one (1) lite of 6mm tinted and 1.5mm vinyl interlayer.

3 Execution

3.1 INSTALLATION

.1 Generally: Install materials in accordance with manufacturer's specifications, and ensure that each material in a glazing system is compatible with the others. Do not set any glass without glazing beds of gaskets.

.2 Glass: Install sheet glass in thickness to comply with CGSB Specification 12-GP-2, and other specified glass as indicated in this Specification or on drawings.

.3 Glazing Preparation and Methods: Use glazing compounds and sealants without addition of thinners and from only containers with seals unbroken until opened for use. Prime all glass rebates except for aluminum, unless specified otherwise. Primer shall be suitable for materials affected.

3.2 GLAZING SCHEDULE

.1 Exterior Windows: Insulating units set with glazing gaskets, tapes and snap-on covers. Setting blocks as required.

.2 Hollow Metal Doors and Screens: Safety glass, polished plate or clear wired glass single glazing as noted in Door Schedule. Fixed stop bedding and heel head, glazing compound, removable metal stops, glazing compound. Spacer shims and setting blocks as required.

.3 Tempered Safety Glass: Install for all lights in entrance and vestibule lights (at doors and sidelights) as indicated on drawings.

.4 Clear Wired Glass: Georgian polished, for all glazing shown for rated doors and frames in fire separations.

3.3 REPLACEMENT AND CLEANING

.1 Replace scratched, etched, or defective glazing resulting from manufacture, setting, handling or storage before or during installation.

.2 Final cleaning of glass is specified as a part of the Work of Section 0170 00.

.3 Remove stains, deposits, marks or blemishes caused by the Work of this Section from surfaces of all materials exposed to view. Replace materials that cannot be cleaned to appear as new.

END OF SECTION 08 80 00

1 General

1.1 GENERAL REQUIREMENTS

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

1.2 WORK IN OTHER SECTIONS

.1 Related Work Specified in Other Sections

Section 05 41 00	:	Light Weight Framing Systems
Section 08 10 00	:	Doors and Frames
Section 09 90 00	:	Painting

1.3 QUALIFICATIONS

.1 Execute Work of this Section only by a Subcontractor who has adequate plant, equipment and skilled tradesmen to perform it expeditiously and is known to have been responsible for satisfactory applications similar to that specified during a period of at least five (5) years.

1.4 TOLERANCES

.1 Install work within 3mm (1/8") of dimensioned location unless approved otherwise, and flat to a tolerance of 3mm (1/8") maximum in 3m (10') and 1.5mm (1/16") maximum of any running length of 300mm (1').

.2 Do work in accordance with CSA A82.31-M91 except where specified otherwise.

1.5 PRODUCT HANDLING

.1 Store packaged finish materials in protected dry areas. Store gypsum board flat in piles with edges protected.

.2 Ensure that finish metal members are not bent, dented or otherwise deformed.

.3 Deliver products supplied under the work of this Section only to those who are responsible for installation, to the place they direct, and to meet installation schedules.

1.6 ENVIRONMENTAL CONDITIONS

.1 Install work only in areas closed and protected against weather, and maintained between 10°C and 20°C (50°F and 70°F). In cold weather ensure that heat is introduced in sufficient time, before work commences, to bring surrounding materials up to these temperatures; and maintained

until materials installed by this Section have cured.

1.7 EXAMINATION

.1 Before application of drywall commences ensure that services have been installed, tested and approved by relevant jurisdictional authorities; that conduit, pipes, cables and outlets are plugged, capped or covered; and that fastenings and supports installed by others are in place.

.2 Ensure that environmental conditions and work preceding that of this Section are satisfactory, and will permit compliance with the quality and dimensions required for work specified in this Section. Do not permit work of others to touch the back of wallboard.

2 Products

2.1 MATERIALS

.1 Gypsum Board
- .1 Plain: to CSA A82.27-M91 standard 12mm thick, 1200mm wide x maximum practical length, ends square cut, edges square.
- .2 Fire Code 'C' panels: to CSA A82.27-M91, 19mm thick x 1200mm wide x max. Practical length.
- .3 Rated Partitions: C.G.C. cavity shaft wall for ratings as noted.
- .4 Backing board: to CSA A82.27-M91 plain Type X 12mm thick, square edges.
- .5 Exterior Grade Sheathing: to CSA A82.27-M91 standard Type X 12mm thick, 1200mm wide x maximum practical length suitable for exterior application.
- .6 Cement Board: C.G.C. Durock, 12mm thick for exterior use and washrooms and shower walls where tile to be installed.
- .7 Spray Texture: Coloured jointing compound mix to provide medium splatterdash textured appearance.

.2 Metal Furring and Suspension Systems
- .1 Metal furring runners, hangers, tie wires, inserts, anchors: to CSA A82.30-M1980, galvanized.
- .2 Resilient Channels: Galvanized Steel Channels RC-1.
- .3 Drywall Furring Channels: 0.5mm core thickness galvanized steel channels for screw attachment of gypsum board.
- .4 Resilient clips: 0.5mm base steel thickness galvanized steel for resilient attachment of gypsum board.
- .5 Acceptable manufacturers Bailey Metal Products or Chicago Metal.

.5 Fastenings and Adhesives
- .1 Nails, screws and staples: to CSA A82.31-M91.
- .2 Stud adhesives: to CGSB 71-GP-25M.

.3 Laminating compound: to CSA A82.31-M91, asbestos-free.

.6 Accessories

.1 Casing beads, corner beads fill type: 0.5mm base thickness commercial grade sheet steel with Z275 zinc finish to ASTM A525M-80, perforated flanges; one piece length per location.

.2 Polyethylene: to CAN 2-51.33-M80, Type 2.

.3 Insulating strip: rubberized, moisture resistant, 3mm thick cork strip, 12mm wide, with self sticking permanent adhesive on one face length as required.

.4 Joint compound: to CSA A82.31-M91, asbestos-free.

3 Execution

3.1 SUSPENDED AND FURRED CEILINGS

.1 Erect hangers and runner channels for suspended gypsum board ceilings in accordance with CSA A82.31-M91 except where specified otherwise.

.2 Support light fixtures by providing additional ceiling suspension hangers within 150mm of each corner and at maximum 600mm around perimeter of fixture.

.3 Install work level to tolerance of 3mm over 3000mm.

.4 Frame with furring channels, perimeter of openings for access panels, light fixtures, diffusers and grilles.

.5 Install min. 19x64mm furring channels parallel to, and at exact locations of steel stud bulkheads unless noted.

3.2 WALL AND STRUCTURE FURRING AND BULKHEADS

.1 Install wall furring for gypsum board wall finishes and exterior sheathing in accordance with CSA A82.31-M91, except where specified otherwise.

.2 Furr steel beams, columns, joists, steel deck and exposed services where indicated, including all rated enclosures to meet ULC Standards.

.3 Install rigid acoustic wall insulation specified in Section 07220 to interior walls where noted on drawings.

3.3 GYPSUM BOARD APPLICATION

.1 Do not apply gypsum board until bucks, anchors, blocking, electrical and mechanical work are approved.

.2 Apply single and double layer gypsum board to metal furring or framing

using screw fasteners for first layer, laminating adhesive for second layer. Maximum spacing of screws 300mm oc.

.3 Secure exterior sheathing with tight fitting joints to framing.

3.4 ACCESSORIES

.1 Erect accessories straight, plumb or level, rigid and at proper plane. Use full length pieces where practical. Make joints tight, accurately aligned and rigidly secured. Mitre and fit corners accurately, free from rough edges. Secure at 150mm o.c. using contact adhesive for full length.

.2 Install casing beads around perimeter of suspended ceilings and bulkheads.

.3 Install 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 or casing beads abutting metal window or exterior door frames, to provide thermal break.

3.5 TAPING AND FILLING

.1 Finish face panel joints and internal angels with joint system consisting of joint compound, joint tape and taping compound installed according to manufacturer's directions and feathered out onto panel faces.

.2 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.

.3 Fill screw head depressions with joint and taping compounds to bring flush with adjacent surface of gypsum board so as to be invisible after painting is completed.

.4 Sand lightly to remove burred edges and other imperfections. Avoid sanding adjacent surface of board.

.5 Completed installation to be smooth, level or plumb, free from waves and other defects and ready for painting.

3.6 ACCESS DOORS

.1 Install service access doors supplied by mechanical contractor.

.2 In addition, provide and install 20 - 12 x 12 metal access doors in locations directed by Consultant.

3.7 ACOUSTIC INSULATION/SEALANT

.1 Install acoustic insulation to all walls noted on drawings. Install accurately and uniform to provide a satisfactory sound rated wall.

END OF SECTION 09 21 00

1 General

1.1 GENERAL REQUIREMENTS

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

1.2 WORK IN OTHER SECTIONS

.1 Related Work Specified in Other Sections

Section 09 22 00	:	Gypsum Board
Section 09 90 00	:	Painting
Division 15	:	Mechanical
Division 26	:	Electrical

1.3 QUALIFICATIONS

.1 Execute work of this Section only by a subcontractor who has adequate equipment and skilled mechanics to perform it expeditiously, and is known to have been responsible for satisfactory installations similar to that specified.

.2 Execute work of this Section only by a contractor who has adequate equipment and skilled mechanics to perform it expeditiously, and is known to have been responsible for satisfactory installations similar to that specified.

.3 Ensure that tradesmen have full knowledge of specified systems and requirements of jurisdictional authorities.

1.4 TOLERANCES

.1 Install ceilings within 5mm (3/16") of dimensioned height above floor unless approved otherwise by Consultant, and level within a maximum tolerance of 3mm in 3000mm (1/8" in 10').

.2 Perform work of this section to meet or exceed ASTM C635-78, ASTM C636-76 and ASTM A525-67.

.3 Submit reflected ceiling plans indicating component layout arrangement, the location of electrical items to be built into the ceiling and necessary details of closures and trim to be used around columns, edges and items to be built-in.

1.5 SUBMITTALS

.1 Samples: Submit samples of each specified acoustical board, suspension

components, and exposed grid material.

.2 Samples: Submit samples of each specified tile acoustical panels and insulation, suspension components, and exposed grid material.

.3 Affidavits: Submit to Consultant two (2) copies of affidavits in accordance with Section 01300 to verify that ceiling meets fire protection requirements.

.4 Extra Stock: Provide two (2) sealed cartons of each specified acoustical board for Owner's use. Deliver to Owner as he directs.

.5 Extra Stock: Provide one (1) percent additional tile each specified acoustical board for Owner's use. Deliver to Owner as he directs.

1.6 PRODUCT HANDLING

.1 Package finish materials.

.2 Store materials in protected dry areas.

.3 Ensure that finish metal members are not bent, dented or otherwise deformed.

.4 Deliver products supplied under the work of this Section to those who are responsible for installation, to the place they direct and to meet installation schedule.

1.7 ENVIRONMENTAL CONDITIONS

.1 Install work only in areas closed and protected against weather and maintained at no less than $10^{o}C$.

.2 Do not install in any area unless satisfied that work in place has dried out, and that no further installation of damp material is contemplated.

1.8 PROJECT CO-ORDINATION

.1 Ensure that framing provided for mechanical and electrical fixtures is co-ordinated with contractors and that all conduit, etc. is installed prior to installation of ceiling.

2 Products

2.1 MATERIALS

.1 General: Use materials specified herein or approved equal as defined in General Conditions.

.2 Acoustical Panels: to CAN/CGSB2-92.1-M89, non-combustible, mineral fibre, 600 mm x 600 mm, 16 mm thick, square edge, NRC range 0.60 – 0.70, STC range 35-39 AIMa, non-directional fissured, tegular edge.

.3 Ceiling Grid: Prefinished exposed tee system with main runners and cross tees to provide a nominal 24" x 24" pattern

.4 Hanger wire shall be #9 gauge galvanized.

.5 Refer to Division 23 and Division 26 for air diffusers and light fixtures.

3 Execution

3.1 INSTALLATION

.1 Co-ordinate work of this Section with that of other Sections. Ensure that adequate preparation is made for attachment of hangers and fasteners. Do not use through-the-roof hangers. Provide for carrying and integration of flush-mounted and recessed service components only after consultation and verification of methods and locations with those performing the work of Divisions 23 and 26.

.2 Install the entire hanger and suspension grid to adequately support the ceiling assembly, including services incorporated with a maximum deflection of 1/360 of the span of each component member, and free from horizontal movement. Provide intermediate support channels as and when required between structural building components securely wired thereto. Install hangers at no more than 50mm off vertical.

.3 Trim all openings as required for recessed lighting fixtures. Independent supports and hangers for recessed fixtures are specified as part of the work of Division 26.

.4 Lay out work to provide even spacing in each area, with grid lines symmetrical about room axes, columns and service elements and with maximum border widths of equal dimensions on opposite sides of areas.

.5 Maintain true surface planes, and component and joint lines throughout each area.

.6 Install grid system ceilings as specified by the manufacturer of the system. Ensure that methods of installation used are acceptable to the manufacturer of each system component and to Consultant.

.7 Brace system to maintain alignment of grid.

3.2 CEILING SCHEDULE

.1 Suspended ceilings in regular locations as defined in the Room Finish Schedule.

.2 Acoustic ceilings in locations as shown on the drawings and as per the schedule of finishes.

3.3 ACOUSTIC INSULATION

.1 Install acoustic insulation where shown on drawings.

3.4 CLEANING

.1 Clean soiled or discoloured surfaces of exposed work on completion of work.

.2 Replace components which are visibly damaged, marred or uncleanable.

.3 Final cleaning is specified in Section 01700.

END OF SECTION 09 51 23

1 General

1.1 GENERAL REQUIREMENTS

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

1.2 QUALITY ASSURANCE

.1 Qualifications: Execute work of this Section only by a Contractor who has adequate equipment and skilled tradesmen to perform work expeditiously, and is known to have been responsible for satisfactory work similar to that specified during a period of at least the immediate past five years.

.2 Requirements of Regulatory Agencies: Coatings shall meet fire hazard classification requirements of jurisdictional authorities for each material in each installation location as applicable.

1.3 SUBMITTALS

.1 Samples

: Submit 216mm x 280mm (8½" x 11") samples at least 30 days before materials are required; labelled to indicate finish, formula, colour name, number, sheen and gloss units.
: Each specified colour in each specified finish coat material.
: Each non-standard colour in each specified coat material.
: Each natural wood finish on each specified wood species.

.2 Extra Stock: Deliver to Owner on completion of work, and as he directs, sealed containers of each finish painting material applied, and in each colour. Label each container as for original including mixing formula. Provide one quart of extra stock when less than 45 litres (10 gallons) are used for project, 4.5 litres (1 gallon) of extra stock when 45 to 182 litres (10 to 40 gallons) are used, and 9 litres (2 gallons) of extra stock when 182 litres (40 gallons) are used.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

.1 Deliver to site each container sealed and labelled with manufacturer's name, catalogue number or brand name, colour, formulation type, reducing instructions and reference standard specification number if applicable.

.2 Store only acceptable project materials at site and in an area specifically set aside for purpose that is locked, ventilated, maintained at a temperature of over 4°C (40°F) and protected from

direct rays of sun.

.3 Ensure that health and fire regulations are complied with in storage area. Provide carbon dioxide fire extinguishers of 9 kg (20 lbs) minimum capacity in each storage area while materials are contained within.

.4 On each container, for materials requiring a fire hazard classification, attach an Underwriter's label verifying that the material is listed under their label service, and giving the hazard classification.

1.5 EXAMINATION

.1 Verify that specified environmental conditions are ensured before commencing work.

.2 Ensure that surfaces to receive finishing materials are satisfactory for specified materials; will not adversely affect execution, permanence or quality of work.

.3 Test all surfaces for moisture content with an electronic moisture meter, and concrete, masonry and plaster surfaces for acid-alkali balance.

.4 Maintain at site at all times until work is completed a moisture meter, hygrometer and thermometer to verify surface and environmental conditions.

.5 Apply finishing materials only when air and surface temperatures exceed 4^{o}C (40^{o}F), except for

7^{o}C for latex paint at interior locations
10^{o}C for latex paint at exterior locations
21^{o}C for lacquers and enamels.

.6 Do not apply exterior finishes in direct sunlight that raises surface temperatures above that for proper application and drying, nor in rainy, foggy or windy weather.

.7 Do not apply finishes when relative humidity is over 85%, when condensation has formed or is likely to form, nor immediately following rain, frost or dew.

.8 Do not paint on plaster, drywall, pipe insulation or masonry surfaces that contain over 12% moisture, nor on wood that contains over 15%.

1.6 PROTECTION

.1 Cover or mask surfaces adjacent to those receiving treatment and finishing to protect work of others from damage and soil. Mask instructions and specification plates attached to equipment being painted.

.2 Take particular care in storage and mixing areas that floors are protected by tarpaulins and metal pans.

.3 Place cloths and other disposable finishing materials that are fire hazard, in closed metal containers containing water and remove from building every night.

.4 Coordinate with the appropriate trades for the removal from finished surfaces, storage and reinstallation after finish work is completed for finish hardware, switch and receptacle plates, escutcheons, luminaire frames and similar items.

.5 Post "NO SMOKING" signs and ensure that spark-proof electrical equipment is used in areas where flammable painting materials are being applied.

.6 Post "WET PAINT" signs throughout freshly finished areas and remove when finishes are dry.

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.

Approved Products: Benjamin Moore or Sherwin Williams or CIL.

.2 Paint materials for paint systems: to be products of single manufacturer.

.3 Paints, coatings, adhesives, solvents, cleaners, lubricants, and other fluids, to be as follows:

.1 Be water-based, water clean-up.
.2 Be non-flammable 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, toxic metal pigments.

.4 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).

.5 Water-borne surface coatings must not be formulated or manufactured with aromatic solvents, formaldehyde, halogenated solvents, mercury, lead, cadmium, hexavelant chromium or their compounds.

.6 Water-borne surface coatings and recycled water-borne surface coatings must have flash point of 61.0 degrees C or greater.

.7 Recycled water-borne surface coatings must contain 50 % post-consumer material by volume.

.8 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 Hexavelant 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 five base colours and three accent colours. No more than eight 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 Where specific products are available in restricted range of colours, selection will be 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. 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 MIXING AND TINTING

.1 Paint gloss: defined as sheen rating of applied paint, in accordance with following values:

Gloss Level Units @ 60 Units @ 85 Category/ Degrees/ Degrees/
G1 - matte 0 to 5 max. 10 finish
G2 - velvet 0 to 10 10 to 35 finish
G3 - eggshell 10 to 25 10 to 35 finish
G4 - satin 20 to 35 min. 35 finish
G5 - 35 to 70 semi-gloss finish
G6 - gloss 70 to 85 finish
G7 - high > 85 gloss finish

.2 Gloss level ratings of painted surfaces as noted by Owner.

2.5 INTERIOR PAINTING SYSTEMS

.1 Wood and Metal: including doors, door and window frames, casings, mouldings, etc.

.1 High performance architectural latex semi-gloss finish.

.2 Plaster and Gypsum Board: gypsum wallboard, drywall, "sheet rock type material", etc., and textured finishes

.1 Latex eggshell finish (over latex sealer).

.3 Plaster and Gypsum Board, Concrete ceilings

.1 Latex Flat finish

.2 Mix specified paste or powder coatings or those that are field-catalysed at job, to meet specified requirements of manufacturer.

3 Execution

3.1 PREPARATION

.1 Generally

: Remove from surfaces grease, oil, dirt, dust, ridges and other soil and materials that would adversely affect the adhesion or appearance of finish coatings.
: Finish, patch and smooth surfaces to remove cracks, holes, ridges and similar blemishes.
: Touch-up damaged prime coats on shop primed metals with same priming material.
: Neutralize highly alkaline surfaces with a neutralizing wash of 4% solution of zinc sulphate. Substitute 4% solution of tetrapotassium pyrophosphate for surfaces to receive latex paints. Brush off residue before painting.
: Scrub mildewed surfaces with a solution of tri-sodium phosphate, bleach with a solution of one part sodium hyopchlorite (Javex) to three parts of water and rinse with clear water.
: Remove finishing hardware, electrical plates, accessories and similar removable fittings on surfaces to be finished. Mask any other work that is not removable.

.2 Metal Surfaces

: Unprimed Steel: Remove, weld flux and scale with scrapers, wire brushes, wire power wheels, sandblasting, chipping or grinding as may be required. Finish surfaces smooth and remove weld flux alkali contamination with phosphoric acid solution. Wash with solvent.
: Primed Steel: Before touch-up of prime paint smooth out surface irregularities; clean weld joints, bolts, nuts and damaged areas with phosphoric acid solution; and wash with solvent.
: Galvanized Steel: Wash thoroughly with mineral spirits and wipe dry with completely clean cloths. Phosphatize surfaces in accordance with CGSB Specification 31-GP-116, or apply one coat of etch specified.

.3 Concrete and Masonry

: Remove residue of form oil from concrete with xylol.
: Fill minor holes and cracks in concrete, cement plaster and concrete masonry with Portland cement grout. Match patches to texture of adjacent surfaces.
: Remove dirt, scale, loose mortar and similar foreign matter by brushing.
: Remove oil and grease with a washing of tri-sodium phosphate solution followed by a thorough rinsing with water.
: Remove efflorescence by dry brushing; or, if required, by washing with dilute muriatic solution of one part commercial muriatic acid to 20 parts water, followed by a commercial rinse with a drenching by clear water.
: Wire brush concrete generally. Etch very smooth concrete, such as floors, with application of a solution of one part commercial muriatic acid (31.45%) to three parts of water by volume. Apply at rate of one gallon solution for each 4.5 to 9.0 square metres (50 to 100 square feet) of surface. When foaming action is finished, flush surfaces clean of cement laitance with high pressure water.

.4 Wood

: Sand finish surfaces smooth with No. 00 sandpaper.
: Clean soiled surfaces with an alcohol wash.
: Wipe off dust and other loose dirt, or vacuum clean before application of coatings.
: Seal knots, pitch and sapwood with two coats of orange shellac, or an application of special sealer.
: After prime coat is dry and sanded, fill nail and screw holes and cracks with wood filler or with putty for interior work and caulking compound for exterior work. Colour fillers to match wood or stain if surfaces are given clear final coatings. Smooth, sand and prime fillers when set.
: Wash down glue-laminated members that have been sealed, with solvent.

.5 Drywall

: Fill minor holes and depressions, caused by accidental damage, with drywall joint cement and sand smooth when it is set, taking care not to raise nap of paper cover.

3.2 APPLICATION

.1 Generally

: Before commencing work, arrange for a site meeting at which conditions of surfaces and possible adaptations to suit, and use of materials and application procedures shall be discussed between Contractor, Painting Subcontractor, Consultant and representatives of materials manufacturers.
: Do not paint caulked joints.
: Remove spatters of finish materials from adjacent surfaces including glass, before they set up.

.2 Priming and Back priming

: Back prime exterior and interior woodwork, frames, fitments and similar work as soon as it is delivered and before installed. Use exterior primer compatible to finish coat for exterior work and enamel undercoat for interior work to receive paint or enamel finishes. Prevent primer from running over faces.
: Back prime exterior and interior woodwork receiving clear finishes with gloss varnish reduced 25% by mineral spirits.
: Prime tops and bottoms of painted wood doors with enamel undercoat. Remove doors to prime finish.
: Prime alkaline surfaces with alkali resistant primer.
: Brush out and force primers into grain of wood, and into crevices, cracks and joints in all materials.

.3 Painting

: Apply paint by brush or rollers. Spray paint only when requested or approved by Consultant, and in areas restricted and approved by him.
: Use only brushes for enamels and varnishes, and for painting wood.
: Touch up visible suction spots on dried primer and ensure that they are sealed before application of second coat. Repeat on second coat if still visible.
: Vary colour of intermediate coats by 10% to 25% from succeeding coat shades.

.4 Pipes, Equipment, Conduits and Ducts

: Finish all exposed pipes including insulation to match exposed piping in existing building. Provide identification/directional stickers for all pipes in sufficient quantities.

: Finish all exposed ductwork and electrical conduit to match the wall or ceiling surface to which it is installed.
: Refer to mechanical and electrical drawings for extent of work.
: Finish all pumps and all equipment which is not prefinished. Finish all equipment bases, isolators, etc.

3.3 FIELD QUALITY CONTROL

.1 Arrange for periodic visits to site by paint manufacturer's representatives while work is in progress. On each visit he shall verify that specified materials and methods are used, and that procedures agreed upon at the initial site meeting are followed.

3.4 ADJUSTMENT AND CLEANING

.1 Touch up and finish minor defective work. Refinish entire wall, ceiling or similar surfaces where finish is damaged or not acceptable.

.2 Leave storage and mixing areas clean and in same condition as equivalent spaces in project.

3.5 PAINTING AND FINISHING SCHEDULE

.1 Generally

: Work of this Section shall include finishing all surfaces for which a finish formula is specified and as called for in the Room Finish Schedule.
: Unless otherwise specified or indicated on Drawings and Schedules, finish pipes, ducts, conduit, equipment, panels, fitments, services, structure, attachments, accessories, prime coated hardware or similar appurtenances on or near finished surfaces to match finish of the surface.
: Finish edges and tops of trim, projecting ledges, fitments, cupboards and similar work to match adjacent surfaces, whether or not they are above or beyond sight lines.
: Finish interiors of alcoves, recesses, closets, cupboards, fitments and similar spaces to match adjacent surfaces unless otherwise indicated.

3.6 RESTORATION

.1 Clean and re-install all hardware items removed before undertaking 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 09 90 00

1 General

1.1 GENERAL REQUIREMENTS

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

1.2 WORK IN OTHER SECTIONS

Related Work Specified in Other Sections

Section 03 30 00	:	Cast-in-Place Concrete
Section 04 20 00	:	Unit Masonry
Section 05 50 00	:	Miscellaneous Metals
Section 06 20 00	:	Finish Carpentry
Section 07 90 00	:	Sealants
Section 08 71 00	:	Finish Hardware
Section 09 90 00	:	Painting
Section 10 28 00	:	Toilet, Bath and Laundry Accessories

1.3 QUALIFICATIONS

Execute the work of this Section only by a Contractor who has adequate plant, equipment and skilled tradesmen to perform it expeditiously and is known to have been responsible for satisfactory installations similar to that specified.

1.4 SUBMITTALS

Shop Drawings: Submit shop drawings for Consultant's approval for all items specified in this Section in accordance with Section 01 30 00, Submittals.

2 Products

2.1 MATERIALS

.1 Steel toilet partitions shall be floor-mounted, headrail, braced toilet compartments as manufactured by Hadrian Manufacturing Inc., Burlington.

.2 Partitions shall be finished in colour selected by Consultant from manufacturers standard range. Two (2) colours will be selected from the 14 standard colours in the manufacturer's standard range.

.3 Sheet steel: Zinc coated steel, A446 Grade A.

.4 Stainless Steel: A1S1 Type 302 or 304, No. 4 Finish.

.5 Honeycomb Core: Kraft paper, uniformly expanded to maximum cell size of 25.4m (1").

.6 Hinges: Bright finished chromium plated brass or stainless steel.

.7 Latches: Exposed handle of bright finished chromium plated brass or stainless steel. Latch bolt of stainless steel. Face plates, keepers, stops and housings of brass or non-ferrous alloy chrome plated where exposed or stainless steel. Rubber bumpers on stops.

.8 Coat Hook and Bumper: Bright finished chromium plated brass or stainless steel, with rubber bumper.

.9 Pilaster Cap: Stainless steel.

.10 Brackets: Stainless steel.

.11 Fastenings: Theft-proof chromium plated or stainless steel where exposed.

.12 Pilaster Anchor Devices and Bolts: Steel, galvanized, zinc coated.

.13 Prime Paint: Alkyd primer for baking to meet or exceed quality specified in CGSB specification 1-GP-81, or phosphate treatment.

.14 Baked Enamel: Alkyd enamel for baking to meet or exceed quality specified in CGSB specification 1-GP-88.

3 Execution

3.1 FABRICATION

.1 Panels, Doors and Pilasters

: Fabricate panels, doors and pilasters with two faces of steel, wipe coated galvanized, cemented under pressure to honeycomb core. Close all edges with minimum 0.914mm (20 ga.) steel, oval crown, locking strips with corners mitred and welded.

: Reinforce panels for attachment of grab bars, and toilet tissue dispensers.

: Panels and doors shall be 25.4mm (1") thick minimum, with minimum 0.711mm (22 ga.) steel facings.

: Pilasters shall be 31.8mm (1-1/4") thick with minimum 0.914mm (20 ga.) steel facings.

.2 Pilaster Anchorage and Cap

: Welded zinc coated steel anchor brackets to face plates of pilasters. Clean welds and prime paint.
: Provide for anchorage of pilaster to steel channels above ceiling by two 9.5mm (3/8") diameter zinc coated bolts or as recommended by the manufacturer.
: Provide for levelling and plumbing by anchor bolts and for their permanent securing in place by locked nuts to prevent subsequent movement.
: Fabricate anchorage assembly to transfer lateral and withdrawal forces directly to structure.
: Conceal pilaster and anchorage with 76mm (3") high stainless steel cap secured by concealed fastening.

.3 Hardware

: Toilet Compartments: hinges, non-gravity and with adjustable positioning stop for holding door partially open when unlatched, operating mechanism concealed within door, nylon or oil-less metal bearings and no vertical movement when door is operated. Latches, with mechanism concealed within door.

.4 Finishing

: Scrape and clean surfaces to remove rust, mill scale, grease or other surface deposits. Finish work by methods standard to supplier with one prime coat and one finish coat of minimum 1 mil thickness.

1.2 EXAMINATION

Take field dimensions of work upon which work of this Section depends before fabrication.

1.3 INSTALLATION

.1 Erect work straight, plumb, level and secured to prevent distortion or displacement or both.

.2 Clearance between panels and pilasters and walls shall not exceed 19mm (3/4").

.3 Clearance at vertical door edges shall be uniform and no greater than 4.8mm (3/16").

.4 Fasten panels, pilasters and screens to walls with "U" brackets. Fasten

handrails to walls and pilasters with "U" brackets.

.5 Secure brackets to walls with only

: 38.8mm (1-1/2") long expansion shields in solid masonry.
: Toggle bolts in cells of hollow masonry units.

.6 Seal flange connection to ceiling.

1.4 ADJUSTING, REFINISHING, CLEANING

Adjust operating hardware to work smoothly and without force. Adjust hinges of toilet compartment doors so that all doors remain open to the same degree when unlatched.

END OF SECTION 10 21 13

1 General

1.1 GENERAL REQUIREMENTS

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

1.2 WORK IN OTHER SECTIONS

.1 Related Work Specified in Other Sections

Section 03 30 00	:	Cast-in-Place Concrete
Section 06 10 00	:	Rough Carpentry
Section 04 20 00	:	Unit Masonry
Section 09 90 00	:	Painting and Coating

1.3 SHOP DRAWINGS

.1 Submit shop drawings and catalogue illustrations in accordance with Section 01 33 00.

.2 Clearly 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.

2 Products

2.1 MATERIALS

.1 Specified manufacturer's catalogue references are based on products manufactured by Twin-Cee to establish minimum acceptable standards for Work of this Section. Products of equal quality by Bobrick & Watrous will be acceptable on approval of Consultant.

3 Execution

3.1 FABRICATION

.1 Provide reinforcing, anchorage and mounting devices required for the installation of each product.

.2 Fit joints and junctions between components tightly and in true planes, conceal and weld joints where possible.

3.2 INSTALLATION

.1 Contractor to install of washroom accessories, including those noted as supplied by the owner. Supplier shall provide standard barrier-free mounting heights and locations, handling instructions, anchorage information, roughing-in dimensions, and templates for installation of work of this Section.

.2 Verify location and mounting heights of products with Manufacturer before roughing-in or installation.

.3 Install work plumb, level, straight, tight and secure to mounting surfaces. Provide solid wood blocking in drywall partition for anchorage purposes.

.4 Attach accessories to walls with only

: 38mm (1-1/2") long expansion shields in solid masonry or concrete
: toggle bolts in cells to hollow masonry units.

3.3 ADJUSTING, REFINISHING

.1 Adjust operating units to provide free-acting, tightly closing and properly functioning operation. Lubricate as required.

3.4 SCHEDULE OF ACCESSORIES

The following schedule is supplied for your information only. Verify actual quantity and location of each washroom accessory with the drawing.

.1 Sanitary Napkin Vendor: Watrous Model W-0468 recess equipped to dispense napkins and tampons. 25 cent coin mechanism with surface mounted stainless steel finish.

.2 Sanitary Napkin Disposal Units: Watrous Model W-1013-S recessed one.

.3 Recessed Soap Dish: Watrous Model W-7404-S.

.4 Soap Dispensers: Watrous Model W-0343. Type 304 #4 finish stainless steel.

.5 Towel Bars: Watrous Model W-0755-SS, satin finish, 760 mm long with concealed mounting hardware.

.6 Folding Shower Seats: Watrous Model W-8203.

.7 Robe Hook: Watrous Model W-7340 stainless steel single robe hook in 2 per dressing room.

.8 Paper Towel Dispenser: Watrous Model W-1105-5. Stainless steel finish. Supplied by Owner.

.9 Toilet Tissue Dispenser: Watrous Model W-0030, surface mounted, controlled delivery, twin roll type. Second roll shall not be accessible until first roll has been depleted. Frame and cabinet constructed of type 304 #4 finish stainless steel. One for each water closet. Supplied by Owner

.10 Deodorizer: Watrous Model W-1601. One for each washroom.

.11 Hand Dryers: Refer to Electrical Specifications.

.12 Mop and Broom Holder: Watrous Model W-8215. Stainless steel finish type 304 complete with rubber cam holders. One for each custodian sink.

.13 Handicapped Grab Bars – Flip-Up:

.1 Model: Flip-up by Dunleavy Cordun Associates (Tel: 905-470-6685) 18 gauge stainless steel, 32 mm diameter, 800 mm long flip-up grab bar with white wall mounting bracket and automatic locking system.

.14 Handicapped Grab Bars: Watrous Model W-3100 24P (610 mm) and W-3100 30 x 30 P (760 mm x 760 mm). Grab bars stainless steel with concealed mounting hardware and peened surface. All bars installed in conformance with OBC requirements capable of withstanding horizontal and vertical pull of 2.2 kN. W-3100 24P and W-3100 30 x 30P
Refer to drawings for location and orientation.

.15 Mirrors (Tile Angle): Watrous Model W-0600TA, stainless steel finish, 6 mm polished float glass.
Size: 410 mm x 760 mm

.16 Mirrors (Standard): Watrous Model W-0620, stainless steel finish, 6 mm polished glass, concealed tamperproof fasteners.
Size: 460 mm x 610 mm

END OF SECTION 10 28 00

1 General

1.1 GENERAL REQUIREMENTS

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

.2 The work required under this section consists of all labour, materials and services required for the complete installation (including operational verification) of all the equipment required for the elevator(s) as herein specified.

.3 All work shall be performed in a first class, safe and workmanlike manner.

.4 In all cases where a device or part of the equipment is herein referred to in the singular, it is intended that such reference shall apply to as many of such devices or parts as are required to make complete installation.

1.2 WORK IN OTHER SECTIONS

Related work not specified herein: The following sections contain requirements that relate to this section and are performed by trades other than the elevator manufacturer/installer.

.1 <u>Related Work Specified in Other Sections</u>

Section 08 10 00	:	Doors & Frames
Section 08 36 00	:	Insulated Sectional Steel Doors
Section 01 50 00	:	Construction Facilities and Temporary Controls: protection of floor openings and personnel barriers; temporary power and lighting.
Section 03 30 00	:	Cast-In-Place Concrete: elevator pit, and elevator machine foundation.
Section 04 20 00	:	Unit Masonry: masonry hoistway enclosure, building-in and grouting hoistway doorframes, and grouting of sills.
Section 05 50 00	:	Metal Fabrications: pit ladder, divider beams, and supports for entrances, rails and hoisting beam at top of elevator hoistway.
Section 31 01 00	:	Earthwork: excavation for elevator pit.
Division 15	:	Heating, Ventilating, and Air Conditioning: ventilation and temperature control of elevator equipment areas.
Division 26	:	Electrical: a. Main disconnects for each elevator.

b. Electrical power for elevator installation and testing.
c. Disconnecting device to elevator equipment prior to activation of sprinkler system.
d. The installation of dedicated GFCI receptacles in the pit and overhead.
e. Lighting in controller area, machine area and pit.
f. Wiring for telephone service to controller.

Division 26 : Emergency (Standby) Power Supply Systems: emergency generator for elevator operation.

Division 26 : Fire Alarm Systems: The installation of fire and smoke detectors at required locations and interconnecting devices; fire alarm signal lines to contacts in the machine area.

Division 26 : Telephone Systems: ADAAG-required emergency communications equipment.

1.3 REFERENCE STANDARDS

Applicable Codes: Comply with applicable building and elevator codes at the project site, including but not limited to the following:

1. ANSI A117.1, Buildings and Facilities, Providing Accessibility and Usability for Physically Handicapped People.
2. ADAAG, Americans with Disabilities Act Accessibility Guidelines.
3. ANSI/NFPA 70, National Electrical Code.
4. ANSI/NFPA 80, Fire Doors and Windows.
5. ASME/ANSI A17.7, Safety Code for Elevators and Escalators.
6. ANSI/UL 10B, Fire Tests of Door Assemblies.
7. CAN/CSA C22.1, Canadian Electrical Code.
8. CAN/CSA-B44, Safety Code for Elevators and Escalators.
9. EN 12016 (May 1998): “EMC Product Family Standards for lifts, escalators, and passenger conveyors Part 2 – immunity”
10. Local Building Codes
11. All other local applicable codes.

1.4 SCOPE OF WORK

1. Equipment Description: Monospace 300 DX by Kone (or approved equal) gearless machine-room-less elevator where all components fit inside the hoistway.

2. Equipment Control: Elevonic® Control System.

3. Drive: Regenerative

4. Quantity of Elevators: 1
5. Elevator Stop Designations: 2
6. Stops :2-13 (150 fpm)
7. Openings: Front opening (side).
8. Travel (maximum): 100 ft (30 m) (150 fpm)
9. Rated Capacity: 3500 lb.
10. Rated Speed: 150 fpm.
11. Platform Size: 2500 front & rear: 2055mm x 1332mm
12. Clear Inside Dimensions: 2540mm x 2108mm
13. Cab Height: 7'-9"
14. Clear Cab Height: 7'-6" with 5/16" floor recess and 4 LED ceiling
15. Entrance Type and Width:: Single-Slide Door 42" (1067 mm)
16. Entrance Height: 7'-0" (2134 mm)
17. Main Power Supply: 208, 220-240, 440-480 or 600 Volts + or - 5% of normal, three-Phase, with a separate equipment grounding conductor. Transformer (by others) required for voltages other than 208, 220-240, 440-480 volts.
18. Car Lighting Power Supply: 120 Volts, Single-phase, 15 Amp, 60 Hz.
19. Machine Location: Inside the hoistway at the top of the hoistway.
20. Signal Fixtures: Manufacturer's standard with metal button targets (exc. CA).
21. Controller Location: Machine-Roomless Controller(s) must be in the front wall on the same side as the counterweight, located at the top landing. Optional Machine Room/Space.
22. Performance:
    1. Car Speed: + 3 % of contract speed under any loading condition or direction of travel.
    2. Car Capacity: Safely lower, stop and hold up to 120% of rated load. (code required).
    3. Ride Quality:
       a. Vertical Vibration (maximum): 20 milli-g
       b. Horizontal Vibration (maximum): 12 milli-g
       c. Vertical Jerk (maximum): 4.59 ± 1.0 ft./ sec^3 (1.4 ± 0.3 m/ sec^3)
       d. Acceleration/Deceleration (maximum): 2.62 ft./ sec^2 (0.8 m/ sec^2)

e. In Car Noise: 55 – 60 dB(A)
f. Stopping Accuracy: ± 0.375 in. (± 10 mm) max, ± 0.25 in. (± 6 mm) Typical
g. Re-levelling Distance: ± 0.5 in. (± 12 mm)

23. Operation: Simplex Collective Operation: Using a microprocessor-based controller, operation shall be automatic by means of the car and hall buttons. If all calls in the system have been answered, the car shall park at the last landing served.

24. Operating Features – Standard

1. Full Collective Operation
2. Anti-nuisance.
3. Fan and Light Protection.
4. Load Weighing Bypass.
5. Independent Service.
6. Full Collective Operation.
7. Firelighter's Service: Special Emergency Service Phase I and II – Emergency Recall and In-Car Emergency Operation.
8. Top of Car Inspection.

25. Operation Features – Optional

1. Zoned Access at Bottom Landing.
2. Automatic Standby Power Operation with Manual Override.

26. Door Control Features:

1. Door control to open doors automatically when car arrives at a landing in response to a normal hall or car call.
2. Elevator doors shall be provided with a reopening device that will stop and reopen the car door(s) and hoistway door(s) automatically should the door(s) become obstructed by an object or person.
   Door protection shall consist of a two dimensional, multi-beam array projecting across the car door opening.
3. Door nudging operation to occur if doors are prevented from closing for an adjustable period of time.

27. Provide equipment according to seismic zone: 2

1.5 SUBMITTALS

.1 Product Data: Submit manufacturer's product data for each system proposed for use. Include the following:

1. Signal and operating fixtures, operating panels and indicators.

2. Cab design, dimensions and layout.
3. Hoistway-door and frame details.
4. Electrical characteristics and connection requirements.
5. Expected heat dissipation of elevator equipment in hoistway (BTU).
6. Colour selection chart for Cab and Entrances.

.2 Shop Drawings: Submit approval layout drawings. Include the following:

1. Car, guide rails, buffers and other components in hoistway.
2. Maximum rail bracket spacing.
3. Maximum loads imposed on guide rails requiring load transfer to building structure.
4. Clearances and travel of car.
5. Clear inside hoistway and pit dimensions.
6. Location and sizes of access doors, hoistway entrances and frames.

.3 Operations and Maintenance Manuals: Provide manufacturer's standard operations and maintenance manual.

1.6 QUALITY ASSURANCE

.1 Manufacturer: Elevator manufacturer shall be ISO 9001 certified.

.2 Installer: Elevators shall be installed by the manufacturer.

.3 Permits, Inspections and Certificates: The Elevator Contractor shall obtain and pay for necessary Municipal or State Inspection and permit as required by the elevator inspection authority, and make such tests as are called for by the regulations or such authorities. These tests shall be made in the presence of such authorities or their authorized representatives.

1.7 PRODUCT HANDLING

.1 Should the building or the site not be prepared to receive the elevator equipment at the agreed upon date, the General Contractor will be responsible to provide a proper and suitable storage area on or off the premises.

.2 Should the storage area be off-site and the equipment not yet delivered, then the elevator contractor, upon notification from the General Contractor, will divert the elevator equipment to the storage area. If the equipment has already been delivered to the site, then the General Contractor shall transport the elevator equipment to the storage area. The cost of elevator equipment taken to storage by either party, storage, and redeliver to the job site shall not be at the expense of the elevator contractor.

1.8 GUARANTEE

.1 The elevator contractor's acceptance is conditional on the understanding that their warranty covers defective material and workmanship. The warranty period shall not extend longer than one (1) year from the date of completion or acceptance thereof by beneficial use, whichever is earlier, of each elevator. The warranty excludes: ordinary wear and tear, improper use, vandalism, abuse, misuse, or neglect or any other causes beyond the control of the elevator contractor and this express warranty is in lieu of all other warranties, express or implied, including any warranty of merchantability or fitness for a particular purpose.

1.9 MAINTENANCE AND SERVICE

.1 Maintenance service consisting of regular examinations and adjustments of the elevator equipment shall be provided by the elevator contractor for a period oftwelve (12) months after the elevator has been turned over for the customer's use. This service shall not be subcontracted but shall be performed by the elevator contractor. All work shall be performed by competent employees during regular working hours of regular working days. This service shall not cover adjustments, repairs or replacement of parts due to negligence, misuse, abuse or accidents caused by persons other than the elevator contractor. Only genuine parts and supplies as used in the manufacture and installation of the original equipment shall be provided.

.2 The periodic lubrication of elevator components shall not be required, including: Sheaves, Rails, Belts, Ropes, Car and CWT guides, etc

.3 The elevator control system must:

1. Provide in the controller the necessary devices to run the elevator on inspection operation.
2. Provide on top of the car the necessary devices to run the elevator in inspection operation.
3. Provide in the controller an emergency stop switch. This emergency stop switch when opened disconnects power from the brake and prevents the motor from running.
4. Provide in the event of a power outage, means from the controller to electrically lift and control the elevator brake to safely bring the elevator to the nearest available landing.
5. Provide the means from the controller to reset the governor over speed switch and also trip the governor.
6. Provide the means from the controller to reset the emergency brake when set because of an unintended car movement or ascending car over speed.

7. Provide the means from the controller to reset elevator earthquake operation.

.4 Provide system capabilities to enable a remote expert to create a live, interactive connection with the elevator system to enable the following functions:

1. Remotely diagnose elevator issues with a remote team of experts
2. Remotely return an elevator to service
3. Provide real-time status updates via email
4. Remotely make changes to selected elevator functions including:
   a. Control building traffic: Restrict floor access, remove car from group operation, shut down elevator, select up peak/down peak mode, activate independent service
   b. Conserve energy: Activate cab light energy save mode, activate fan energy save mode, shut down car(s)
   c. Improve passenger experience: Extend door open times, change parking floor, activate auto car full, activate anti-nuisance, advance door opening, door nudging, extend specific floor extended opening time, release trapped passengers.

2 Products

2.1 DESIGN AND SPECIFICATIONS

1. Provide machine-roomless Monospace 300 DX™ traction passenger elevators from Kone Elevator Company. The control system and car design based on materials and systems manufactured by Kone Elevator Company. Specifically, the system shall consist of the following components:

   1. Controller located entirely inside the hoistway. No extra machine room or control closet space required.
   2. An AC gearless machine using embedded permanent magnets mounted at the top of the hoistway.
   3. Polyurethane Coated-Steel Belts for elevator hoisting purposes.
   4. Regenerative drive that captures normally wasted energy and feeds clean power back into the building’s power grid.
   5. LED lighting standard in ceiling lights and elevator fixtures.
   6. Sleep mode operation for LED ceiling lights and car fan.

2. Approved Installer: Kone Elevator Company

2.2 EQUIPMENT: CONTROLLER COMPONENTS

1. Controller: A microcomputer based control system shall be provided to perform all of the functions of safe elevator operation. The system shall also perform car and group operational control.

    1. Controller located entirely inside the hoistway. No extra machine room or control closet space required.
    2. All high voltage (110V or above) contact points inside the controller shall be protected from accidental contact when the controller doors are open.
    3. Controller shall be separated into two distinct halves; Motor Drive side and Control side. High voltage motor power conductors shall be routed so as to be physically segregated from the rest of the controller.
    4. Field conductor terminations points shall be segregated; high voltage (>30 volts DC and 110 VAC,) and low voltage (< 30 volts DC)
    5. Controllers shall be designed and tested for Electromagnetic Interference (EMI) immunity according to the EN 12016 (May 1998): “EMC Product Family Standards for lifts, escalators, and passenger conveyors Part 2 – immunity”
    6. Controller shall be located inside the wall next to the top landing entrance frame. Emergency access shall be provided through an access panel in the entrance frame secured by a key lock.
    7. A separate control room or cabinet should not be required.

2. Drive: A Variable Voltage Variable Frequency AC drive system shall be provided. The drive shall be set up for regeneration of AC power back to the building grid.

2.3 EQUIPMENT: MACHINE AND GOVERNOR

1. Machine: AC gearless machine, with a synchronous permanent-magnet motor, dual solenoid service and emergency disc brakes, mounted at the top of the hoistway.

2. Governor: The governor shall be a tension type car-mounted governor.

3. Buffers, Car and Counterweight: Polyurethane type buffers shall be used.

4. Hoistway Operating Devices:
    1. Emergency stop switch in the pit
    2. Terminal stopping switches.

5. Positioning System: Consists of an encoder, reader box, and door zone vanes.

6. Guide Rails and Attachments: Guide rails shall be Tee-section steel rails with brackets and fasteners. Side counterweight arrangements shall have a dual-purpose bracket that combines both counterweight guide rails, and one of the car guide rails to building fastening.

7. Coated-Steel Belts: Polyurethane coated belts with high-tensile-grade, zinc-plated steel cords and a flat profile on the running surface and the backside of the belt. All driving sheaves and deflector sheaves should have a crowned profile to ensure centre tracking of the belts. A continuous 24/7 monitoring system using resistance based technology has to be installed to continuously monitor the integrity of the coated steel belts and provide advanced notice of belt wear.

8. Governor Rope: Governor rope shall be steel and shall consist of at least eight strands wound about a sisal core centre.
Fascia: Galvanized sheet steel shall be provided at the front of the hoistway.

9. Hoistway Entrances:

    1. Frames: Entrance frames shall be of bolted construction for complete one-piece unit assembly. All frames shall be securely fastened to fixing angles mounted in the hoistway and shall be of UL fire rated steel.
    2. Sills shall be extruded aluminum, or bronze finish, or nickel silver finish.
    3. Doors: Entrance doors shall be of metal construction with vertical channel reinforcements.
    4. Fire Rating: Entrance and doors shall be UL fire rated for 1-1/2 hour
    5. Entrance Finish: Lobby - satin finish stainless steel, both levels
    6. Entrance marking plates: Entrance jambs shall be marked with 4” x 4” (102 mm x 102 mm) plates having raised floor markings with Braille located adjacent to the floor marking. Marking plates shall be provided on both sides of the entrance.
    7. Sight Guards: sight guards will be furnished with all doors painted to match with painted doors, painted black for stainless steel and gold satin doors.

2.4 EQUIPMENT: CAR COMPONENTS

1. Car frame and Safety: A car frame fabricated from formed or structural steel members shall be provided with adequate bracing to support the platform and car enclosures. The car safety shall be integral to the car frame and shall be Type "B", flexible guide clamp type.

2. Cab: Steel Shell Cab with laminated vertical panels. Paints and laminate to be selected from manufacturer’s catalogue of choices. Brushed Stainless Steel finished base plate located at top and bottom. Laminate to

be selected from manufacturer's catalogue of choices. Brushed Stainless Steel finished base plate located at top and bottom

3. Car Front Finish: Satin Stainless Steel.

4. Car Door Finish: Satin Stainless Steel.

5. Ceiling Type:

6. Dropped flat steel ceiling Real White (EWO) with 4 LED lights.

7. Emergency Car Lighting: An emergency power unit employing a 6-volt sealed rechargeable battery and totally static circuits shall be provided to illuminate the elevator car in the event of building power failure.

8. Fan: A one-speed 120 VAC fan will be mounted to the ceiling to facilitate in-car air circulation, meeting A17.1 code requirements. The fan shall be rubber mounted to prevent the transmission of structural vibration and will include a baffle to diffuse audible noise. A switch shall be provided in the car-operating panel to control the fan.

9. Handrail: Handrails shall be provided on side wallsof the car enclosure. 1½" diameter (38.1 mm) Round bar handrail with a Brushed Steel.

10. Threshold: Extruded Aluminum or Bronze Finish or Nickel-Silver Finish.

11. Emergency Exit Contact: An electrical contact shall be provided on the car-top exit.

12. Guides: The car shall have 3" diameter roller guides at top and bottom and the counterweight shall have slide type guides at the top and the bottom.

13. Platform: The car platform shall be constructed of metal. Load weighing device shall be mounted on the belts at the top of the hoistway.

14. The LED ceiling lights and the fan should automatically shut off when the system is not in use and be powered back up after a passenger calls the elevator and pushes a hall button.

2.5 EQUIPMENT: SIGNAL DEVICES AND FIXTURES

1. Car Operating Panel: A car operating panel shall be provided which contains all push buttons, key switches, and message indicators for elevator operation. The car operating panel shall have a satin stainless steel. A car operating panel shall be furnished. It shall contain a bank of round stainless steel, mechanical LED illuminated buttons. Flush mounted to the panel and marked to correspond to the landings served. All buttons to have raised numerals and Braille markings with:

   - Flat Flush Mounted satin stainless steel button with blue or white LED

illuminating halo or gold satin button with white LED illuminating halo
- 1/8" (3mm) satin stainless steel projecting button with blue or white illuminating halo button with white illuminating halo.

- Vandal-Resistant, Flush satin stainless steel button with blue LED illuminating centre jewel.
- Lexan 1/8" (3mm) projecting fully illuminated button with white LED.

The car operating panel shall be equipped with the following features:

1. Raised markings and Braille to the left hand side of each push-button.
2. Car Position Indicator at the top of and integral to the car operating panel.
3. Door open and door close buttons.
4. Inspection key-switch.
5. Elevator Data Plate marked with elevator capacity and car number.
6. Help Button: The help button shall initiate two-way communication between the car and a location inside the building, switching over to another location if the call is unanswered, where personnel are available who can take the appropriate action. Visual indicators are provided for call initiation and call acknowledgement.
7. Landing Passing Signal: A chime bell shall sound in the car to signal that the car is either stopping at or passing a floor served by the elevator.
8. In car stop switch (toggle or key unless local code prohibits use)
9. Call Cancel Button.

2. Car Position Indicator: A digital, LED car position indicator shall be integral to the car operating panel.

3. Hall Fixtures: Hall fixtures shall be provided with necessary push buttons and key switches for elevator operation. Clearly indicate landing/opening designations for each finish. Integral Hall fixtures shall feature round stainless steel, mechanical buttons marked to correspond to the landings. Hall fixtures to be located in the entrance frame face. Buttons shall be in vertically mounted fixture. Fixture shall be satin stainless steel finish.

Button Options:
- Flat Flush Mounted satin stainless steel button with blue or white LED illuminating halo or gold satin button with white LED illuminating halo,
- 1/8" (3mm) satin stainless steel projecting button with blue or white illuminating halo or gold satin button with white illuminating halo,
- Vandal-Resistant, Flush satin stainless steel button with blue LED illuminating centre jewel,
- Lexan 1/8" (3mm) projecting fully illuminated button with white LED.

4. Car Lantern and Chime: A directional lantern visible from the corridor shall be provided in the car entrance. When the car stops and the doors are opening, the lantern shall indicate the direction in which the car is to travel and a chime will sound.

5. Access key-switch at lowest floor in entrance jamb.

6. Emergency (standby) Power key-switch: Manual selection of each elevator in normal operation after automatic return in standby power operation has been initiated.

3 Execution

3.1 PRODUCT LOCATION

1. Take field dimensions and examine conditions of substrates, supports, and other conditions under which this work is to be performed. Do not proceed with work until unsatisfactory conditions are corrected.

3.2 INSTALLATION

1. Installation of all elevator components except as specifically provided for elsewhere by others.

3.3 DEMONSTRATION

1. The elevator contractor shall make a final check of each elevator operation with the Owner or Owner’s representative present prior to turning each elevator over for use. The elevator contractor shall determine that control systems and operating devices are functioning properly.

END OF SECTION 14 21 00

Filer Engineering Ltd.

1046 Botanical Drive
Burlington, Ontario L7T 1V1

Tele: (905) 526-7411
Fax: (905) 526-8899

SPECIFICATIONS
FOR

Liburdi Engineering Limited
45 Innovation Drive
Dundas, Ontario
L9H 7L8

Building Addition

August 2026

F1500
Ver. T1.0

Project Number and Name: **F1500 Liburdi Proposed Manufacturing Addition**

The table below indicates the specification sections that are part of this Contract.

The table indicates if the appropriate *Standard Specification Sections* apply or if modified or additional specification section(s) apply to this project. Modified or additional specification sections are attached as part of the Documents.

LIST OF SPECIFICATION SECTIONS

DIVISION 15		
Section 15005	Mechanical Supplemental Form	3 Pages
Section 15010	Mechanical General	15 Pages
Section 15060	Identification	4 Pages
Section 15072	Vibration Isolation	3 Pages
Section 15081	Thermal Insulation – Piping	4 Pages
Section 15082	Thermal Insulation – Ducting	3 Pages
Section 15084	Acoustic Duct Lining	2 Pages
Section 15086	Mechanical Systems Fire Stopping	2 Pages
Section 15100	Site Services	5 Pages
Section 15125	Flexible Connections and Expansion Joints	3 Pages
Section 15140	Pipe Hangers and Supports	4 Pages
Section 15142	Domestic Water Supply Piping – Copper	6 Pages
Section 15153	Drainage and Vent Piping	3 Pages
Section 15154	Sewage Pumping Systems	2 Pages
Section 15192	Steel Piping, Valves and Fittings – Gas	4 Pages
Section 15401	Plumbing Specialties	4 Pages
Section 15410	Plumbing Fixtures and Trim	1 Page
Section 15732	Packaged High Efficiency Rooftop Air Conditioning Units	10 Pages
Section 15769	Vantage Infra-Red Heaters	5 Pages
Section 15779	Rooftop Air Make-Up Units	13 Pages
Section 15809	HVAC Duct Cleaning	1 Page
Section 15811	Ductwork – Low Pressure – Metallic	8 Pages
Section 15812	Ductwork – High Pressure – Metallic	5 Pages
Section 15820	Ductwork Accessories	3 Pages
Section 15821	Balancing Dampers	2 Pages
Section 15823	Fire Dampers	2 Pages
Section 15831	Commercial Fans	2 Pages
Section 15832	Welding Extraction Arms	1 Page
Section 15834	Insulated Dampers	2 Pages
Section 15851	Louvres, Intakes and Vents	2 Pages
Section 15852	Grilles, Registers and Diffusers	1 Page
Section 15856	Variable Frequency Drives	4 Pages
Section 15877	Inspection and Testing of Mechanical Systems	7 Pages
Section 15878	Commissioning	23 Pages
Section 15900	Building Automation System	27 Pages

The table below indicates the drawings that are part of this Contract.

LIST OF DRAWINGS

DRAWING NUMBER	DRAWING TITLE
M0.01	**Site Plan and Legends**
M0.02	**Schedules**
M0.03	**Schedules**
M1.01	**Existing Building Drainage Plan**
M1.02	**Existing Building HVAC Plan**
M1.03	**Existing Building Roof Plan**
M1.04	**Addition Drainage Plan**
M1.05	**Addition HVAC Plan**
M1.06	**Addition Roof Plan**
M1.07	**Addition Compressed Air, Argon Gas Plan**
P1.01	**Washroom Plumbing Plans**
M3.01	**Mechanical Details**
M3.02	**Mechanical Details**

END OF SECTION 00000

Mechanical Supplemental Tender Form

1.1 Instructions to Bidders:

.1 The Mechanical Supplemental Tender Form **must be submitted to the Architect and General Contractor within 2 hours of tender closing**. Mechanical contractor shall identify all sub-contractors he/she intends to use and must complete all information requested or tenders may be considered null and void. Should any uncertainty arise as to the proper manner of submitting tenders, the requisite information will be given at the office of the Consultant. Contractor shall sign and date this page and initial and date each page thereafter.

1.2 Contractor:

.1 I / We certify that I / We have the authority to bind the company.

_____	_____
Company Name	Authorized Signature
_____	_____
Address	Printed Signature
_____	_____
City	Title
_____	_____
Telephone Number	Date
_____	
Fax	

Sub-Contractors

The contractor shall state below the name of the Insulation, Fire Protection, Sheet Metal, Refrigeration Firm, and Controls Sub-contractor he/she intends to use, which shall not be changed without the consent of the Consultant.

Insulation: _____

Fire Protection: _____

Sheet Metal: _____

Refrigeration Firm: _____

Controls: _____

_____

1.3 The Stipulated Bid Sum shall be for the base bid or equal manufacturer or supplier equipment only unless otherwise indicated. Where a choice of this equipment is given, this Contractor shall indicate the supplier or manufacturer he/she intends to use. Where no choice is indicated, the base bid supplier or equipment shall be used.

1.4 Equipment or materials manufactured by firms named in the following listing only shall be deemed equal to the equipment or material specified, provided the equipment or material will have capacity, performance, rating, construction, physical dimensions, accessories and features which, in the opinion of the Consultant, are equal to those of the specified equipment or material. The Mechanical Contractor shall not indicate equipment, materials or suppliers which are not listed.

1.5 Where modifications to the work of other trades are required as a result or part of alternative offered, include the cost of said modifications in the work.

1.6 Submit the following list of Base Bid , Equal and alterative suppliers in accordance with the Bid requirements:

Spec. Reference Section	Equipment	Base Bid or Equal	Acceptable Alternate Manufacturer or Supplier (Indicate By Circling)	Acceptable Alternative Cost Savings($)
Section 15072	Vibration Isolation	Vibro-Acoustics Vibron Telcoustics Anvil		
Section 15081	Thermal Insulation – Piping	Knauf Manson Owens-Corning		
Section 15082	Thermal Insulation - Ductwork	Fiberglass Canada Schuller Knauf		
Section 15086	Mechanical Fire Stopping	3M Hilti		
Section 15125	Flexible Connections and Expansion Joints	Metraflex		
Section 15154	Sewage Pumping Systems	Myers	Gould ITT Bell and Gossett	
Section 15410	Plumbing Fixtures and Trim	As per Plumbing fixture schedule on the drawings	As per Plumbing fixture schedule on the drawings	
Section 15732	Packaged Roof Top Conditioning Units	Trane		
Section 15769	Vantage Infra-Red Heaters	Roberts Gordon		

Spec. Reference Section	Equipment	Base Bid or Equal	Acceptable Alternate Manufacturer or Supplier (Indicate By Circling)	Acceptable Alternative Cost Savings($)
Section 15732	Roof Top Air Make-Up Units	Engineered Air		
Section 15809	HVAC Duct Cleaning	PowerVac Ontario Duct Cleaning Ventcare D.D.K		
Section 15823	Fire Dampers	Ruskin Controlled Air Nailor Ventex Price		
Section 15831	Commercial Fans	Greenheck, Penn, Loren Cook Airex, Trane Carnes		
Section 15832	Extractor Arms	Plymovent		
Section 15834	Insulated Dampers	Tamco Ventex Alumavent Nailor Ruskin		
Section 15851	Louvres, Intakes and Vents	Airolite Ventex E.H. Price Ruskin		
Section 15852	Grilles, Registers and Diffusers	E.H.Price Titus	Nailor Metalaire Krueger	
Section 15877	Inspection and Testing of Mechanical Systems	Dynamic Flow Balancing Air Audit Air Velocities		
Section 15878	Commissioning	Separate Contract under Cash Allowance to General Trades	NA	
Section 15900	Building Automation System	Trane		

END OF SECTION 15005

Mechanical General

1.0 **Contents Index**

2.0	Scope of Work	22.0	Protection
3.0	Standard of Acceptance	23.0	Pipe Systems
4.0	Codes, Regulations and Permits	24.0	Pipe Grades and Slopes
5.0	Record of Drawings	25.0	Pipe Expansion and Contraction
6.0	Site Visit	26.0	Pipe Hangers and Supports
7.0	Cutting and Patching	27.0	Sleeves and Escutcheons
8.0	Shop Drawings	28.0	Firestopping
9.0	Spare Parts	29.0	Dielectric Couplings
10.0	Excavation and Backfilling	30.0	Pressure System Registration
11.0	Arrangement of Piping and Ductwork	31.0	Layout
12.0	Testing	32.0	Co-ordination
13.0	Electric Equipment and Controls	33.0	Co-ordination Drawings
14.0	Thermometers and Pressure Gauges	34.0	Guarantee / Warranty
15.0	V-Belt Drive	35.0	Construction Period - Mechanical Systems Operation
16.0	Guards		
17.0	Painting	36.0	Trial Systems Usage
18.0	Access Doors	37.0	Commissioning
19.0	Operating and Maintenance Instructions	38.0	Energy Efficiency
20.0	Building Structure / Equipment Supports		
21.0	Vibration Isolation		

2.0 **Scope of Work**

.1 Division 15 shall furnish all labour, materials and equipment necessary for the proper and timely completion of the mechanical systems as shown on the drawings and/or as specified.

.2 The Specifications shall be considered as an integral part of the Plans, which accompany them, neither the Plans nor the Specifications shall be used alone. Any items or subject omitted from one, but which is mentioned or reasonably implied in the other, shall be considered as properly and sufficiently specified, and must, therefore, be provided. Misinterpretations of either the Plans or the Specifications shall not relieve this Division of responsibility.

.3 It is the intent that the drawings and specifications describe complete mechanical systems. All materials and equipment and the furnishing of all labour reasonably implied by these drawings and/or the specifications shall be included to provide systems ready for satisfactory operation. Refer to all other trade drawings and specifications to fully co-ordinate the installation of the work.

.4 Furnish all required labour and materials, machinery, scaffolding tools, implements, or other appliances together with all proper and required facilities for moving and transporting same, so that the Contract and all Work to be done under it, can and will be carried on in a workmanlike manner, properly, satisfactorily, continuously, and expeditiously, to completion, in all respects to the satisfaction of the Owner.

.5 Mechanical Contractor to be aware that any Work required to be performed in the building is to be carefully and closely coordinated. The areas to be affected by the new piping Work and demolition Work shall be identified prior to commencing construction as soon as possible after award of Contract. The drawings show piping in a general arrangement. The actual pipe and

duct layout is to be determined prior to fabrication only after close examination of obstructions such as structural systems, ceiling systems, light fixtures, fan coil units, piping, and ductwork. Refer also to Division 1 for additional details concerning coordination in these areas.

.6 All sections of this specification must read and be covered by conditions of the Contract and the requirements of Division 1.

3.0 **Standard of Acceptance**

.1 Items on the drawings and subsequent divisions of these specifications are listed with the names of specific manufacturers, the first of which have been used in the design and is the equipment shown on the drawings. Differences in equipment physical dimensions from the design basis equipment shall be accommodated by the Mechanical Contractor at the Contractor's cost. Any equal equipment submitted must not exceed space or servicing requirements (including electrical and controls and weight) allocated on the drawings.

.2 The use of alternate equipment such as heating / cooling units, or fans will require the submission of detailed scale shop drawings of proposed installation details including ductwork, piping, electrical, structural connections, loads and service clearances. Any alternate names listed in this Division have been selected because of the similarity of quality and performance. If this subcontractor wishes to submit equipment or material of a manufacturer listed as an "Alternate", cost savings must be indicated on the tender form at the time of closing. Any costs caused by the installation of an alternate will be borne by the Contractor. Any equipment submitted must not exceed space or servicing requirements (including electrical and controls and weight) allocated on the drawings.

.3 All of the materials required for the performance of the Work shall be new and the best of their respective kind and of a uniform pattern throughout the Work.

4.0 **Codes, Regulations And Permits**

.1 All mechanical work shall be installed, inspected and tested in accordance with governing codes, rules and regulations of the municipality in which the work is performed and also of provincial and federal authorities having jurisdiction.

.2 The Division 15 Contractor shall obtain all permits required for the installation of mechanical work, arrange for inspections and tests and pay all fees and costs for the permits and inspections. All necessary permits shall be obtained immediately after notification of award of contract.

.3 In addition to the foregoing, the Division 15 Contractor shall perform such other inspections and tests as may be deemed necessary by the Prime Consultant.

.4 The Ontario Building Code and the applicable requirements of C.S.A., A.S.T.M. ANSI, U.L.C., and NFPA Standards including their latest amendments, as well as Provincial and Municipal By-laws and Regulations shall be considered part of this specification. Lack of possession of knowledge of any code or standard required for proper completion of the work shall not constitute sufficient reason for deviation therefrom.

.5 Upon completion of the Contract, issue to the Owner a formal certification of completion of Work before final payment for Work may be considered due.

5.0 **Record Drawings**

.1 Clearly record all contract changes and deviations from the contract drawings on a set of drawings available from the General Contractor for this purpose and forwarded to the General Contractor at the completion of the project. All buried services shall be located on the drawings with accurate reference dimensions to building walls. Retain a competent mechanical designer to transcribe all construction alterations onto AutoCAD electronic files. Submit a C.D. of the as builts at substantial performance of the project.

.2 The final Certificate of Acceptance will not be issued until satisfactory record drawings are filed with the consultant.

6.0 **Site Visit**

.1 This contractor shall visit the site and evaluate all existing site conditions as they may affect this work. No extras will be allowed for any effects from failing to complete a comprehensive site tour to understand and account for the impact of existing site conditions on the contract scope of work.

7.0 **Cutting And Patching**

.1 The General Contractor shall be responsible for and pay for all cutting and patching required in the scope of work as defined in the General Conditions. All new finishes shall be equal to those of surrounding surfaces for materials, colour, texture and workmanship. This Division shall clearly mark out all openings required and review with the General Contractor before cutting proceeds. This Division shall install all opening frames, sleeves, ductwork and piping, louvres, etc., into the building structure as construction progresses. Any items missed during construction that must be added will be the responsibility of this Division and be co-ordinated with the General Trades.

.2 In each case, tradesmen qualified in the Work being cut and patched shall be employed to ensure that it is correctly and neatly done.

.3 The section requiring cuts, holes, sleeves or anchors for his Work shall locate them.

.4 To completely prevent the passage of air, tightly fit all construction to pipes, ducts, and conduit which pass through construction. Pay particular attention where fire separations are penetrated with such objects. Build separations tightly to materials penetrating separations, or provide other materials for packing around perimeters, which are specifically manufactured for such conditions. Packing materials shall be of the equivalent fire resistance rating of the penetrated construction. Obtain Consultant's approval prior to the use of packing materials.

8.0 **Shop Drawings**

.1 Shop drawings and data sheets for equipment intended for installation under this contract shall be submitted for review. After checking and when reviewed, copies will be returned to the contractor. Comply with all requirements of Division 1.

.2 Samples, drawings, catalogues, specifications, etc. submitted for approval, shall be properly labelled indicating specified services for which material or equipment is to be used. The drawings and information shall indicate the project name and the article number of specifications relating to shop drawings. The Contractor's name and contractor's signature shall appear on all copies indicating that the drawings have been checked by the contractor. Drawings not so designated will be returned for correction. 'FAX' or electronic copies of shop drawings are not acceptable.

Provide complete, detailed wiring and control diagrams for all mechanical equipment for this project. These drawings shall be submitted at the time of shop drawing review. Equipment shop drawings will be rejected unless complete wiring and controls information is submitted.

.3 Incorporate only dimensional system utilized for Drawings. Make soft conversions from metric system to imperial, or vice versa, when required for incorporation of units of one dimensional system into construction in the other.

.4 Show on shop drawings all pertinent information required for materials and installation, and for proper integration of this installation with Work of others.

.5 Do not proceed with Work dependent on shop drawings information until final reviewed shop drawings have been returned by the Consultant.

.6 Fabricate Work exactly as shown on the shop drawings. If any revisions to shop drawings are required, revise drawings and resubmit.

.7 The contractor is responsible for the detail design intent and errors / omissions, dimensions, installation methods, co-ordination, etc.

.8 Submit shop drawings for the components listed but not limited to the following:

.1 Fans
.2 Coils
.3 Pumps
.4 Heat exchangers
.5 Control systems
.6 Fan coils
.7 Terminal units
.8 Ductwork accessories
.9 Fire protection equipment
.10 Silencers
.11 Vibration isolators
. .12 Fire dampers - low and high pressure
.13 Variable frequency drives
.14 Valves
.15 Victaulic
. .16 Plumbing fixtures
.17 Plumbing specialities
.18 Fire stopping
.19 Glass lab piping
.20 Fume hoods
.21 Compressed air components
.22 Dust collectors and Dust Control Systems
.23 HVAC equipment
.24 Sprinkler systems
.25 Seismic restraints
.26 Controls
.27 Sheet metal systems

.28 Cisterns
.29 Pump Controls
.30 Chillers
.31 Roof Drains

9.0 **Spare Parts**

.1 Division 15 shall furnish spare parts as follows:
.1 One (1) set of V-belts for each piece of machinery.
.2 Three (3) sets of filters for each filter bank installed.

.2 Identify spare parts containers as to contents matching equipment number and replacement part number.

.3 Provide one set of special tools required to service equipment as recommended by manufacturers.

.4 Prior to fan systems start-up, install one complete set of throwaway roughing construction filters in all air handlers in front of permanent filter set. During commissioning process, retain roughing construction filters. Remove and dispose of construction filters at instruction of the consultant.

.5 Upon completion of the project and immediately before hand-over replace all air handler filters. Turn remaining two (2) sets of filters over to the owner.

10.0 **Excavation And Backfilling**

.1 This Division shall complete all excavating and backfilling work required to install the mechanical systems. All such work shall conform strictly to the requirements of municipal standpipe and provincial codes and regulations. Strictly conform to the requirements of the General Conditions.

.2 Where pipes are located near or below footings, the pipes shall be sleeved, and 1500 lb. concrete backfill shall be installed to underside of footings.

.3 Excavations shall be maintained free of water while underground piping is being installed and until backfill work is completed. All tests for underground piping shall be conducted and accepted before joints on such piping are backfilled.

.4 Protect all excavations with safety fencing, signage, shoring or bracing. Provide traffic control personnel when required by the municipality. Restore all pavement, sodding and landscaping to pre-construction condition to meet the municipality standards.

.5 Trenches shall be excavated to a depth which shall allow for a minimum of 150mm of hand placed bedding material, thoroughly compacted. The bedding shall be removed at pipe hubs or couplings to provide continuous support over each length of pipe.

.6 Backfill to 300 mm above the piping shall be hand placed in 100 mm layers and compacted simultaneously on both sides of the piping. All additional backfill shall be placed in approximately 150 mm layers and may be mechanically placed.

.7 Bedding and backfill materials to 300 mm above top of pipe shall be clean granular type “A” material of non-organic nature. This applies to areas both inside and outside of building lines. Backfill material for trenches within the building from 300 mm above top of pipe to grade shall be new granular material conforming to M.T.C. granular “A" material. Backfill material for trenches outside of the building but under roadways, paved or concrete parking areas, ramps, walkways, etc. from 300 mm above top of pipe to grade shall be new granular material conforming to M.T.C. granular "A" material.

.8 All bedding and backfilling shall be mechanical tamped in the specified layer and thoroughly compacted. Use a standard Proctor of 95% outside of the building and 98% for interior trenches for testing density. All bedding and haunching to the centreline of P.V.C. piping shall be compacted to 95% Proctor Density.

.9 Coordinate all subgrade pipe routing with general trades and structural for caissons and grade beams.

11.0 **Arrangement of Piping and Ductwork**

.1 Conceal piping and ductwork wherever possible by running it in pipe spaces, duct shafts, chases, ceiling spaces and furred out sections of walls and columns. Do not run piping or ductwork exposed in finished areas without obtaining permission of the Engineer.

.2 Do not scale the drawings for exact pipe or duct locations. Coordinate diffuser and grille locations with light fixtures and other fixtures shown. The piping, ductwork and equipment layout as shown on the drawings is a guide to the general method of installation. Modify as necessary without changing the intent of the design to avoid other equipment, structural elements or work installed by other trades.

12.0 **Testing**

.1 Division 15 shall perform tests on all piping and equipment systems as outlined in various sections of these Specifications and shall provide all necessary pumps, compressors, gauges, recorders and temporary connections to the piping and equipment.

.2 All tests on piping and equipment shall be conducted before concealment and before the application of paint and insulation. Ample notice of the scheduling of such tests shall be given. Tests shall be conducted in the presence of the authorities having jurisdiction and the Owner’s representative.

.3 Equipment not designed to withstand specified test pressures shall be disconnected from the system during the performance of the tests. Notwithstanding the requirements outlined herein, all services shall be subjected to the requirements of testing as outlined by local Utilities or by jurisdictions having authority.

.4 When the mechanical systems are ready to be turned over, the contractor shall conduct at his own expense, performance tests on all equipment, materials, and systems for a continuous period of not less than 24 hours. These tests shall confirm that all mechanical systems are operating properly, are properly balanced and adjusted, and meet specific engineering design requirements for this project.

13.0 **Electric Equipment And Controls**

.1 Electrical work shall conform to Division l6 requirements including the following:
- .1 Supplier and installer responsibility is indicated in the Equipment Schedule on mechanical drawings.
- .2 Control wiring: all control devices, conduit and connections below 50V which are related to control systems, are a necessary component of the control system specified in Division 15 or shown on mechanical drawings shall be installed by Division 15.

14.0 **Thermometers And Pressure Gauges**

.1 Pressure Gauges
- .1 115 mm, dial type: having 0.5% accuracy unless otherwise stated. Full scale no more than 200% of working pressure range.
- .2 Standard of Acceptance: Weiser, Trerice, Marshall Town.
- .3 Provide bronze stop cock on all gauges.
- .4 Use materials compatible with system requirements.
- .5 Install across all pumps, strainers and coils.
- .6 Siphon for steam service.
- .7 Shubber for pulsating operation

.2 Thermometers
- .1 Industrial, variable angle type, liquid filled, 225 mm scale length to CAN/CGSB14.4.
- .2 Install thermometer wells in all locations as indicated on the drawings, as well as across all coils, pumps and water heaters.
- .3 Standard of Acceptance: Trerice style A427, Winters 9IT, Wiess.

.3 Remote Reading Thermometers
- .1 100 mm (4”) diameter liquid filled activated dial type: to CAN/CGSB-14.5, accuracy within one scale division, brass movement, stainless steel capillary, stainless steel spiral armour, stainless steel bulb and polished stainless steel case for wall mounting.
  - .1 Acceptable materials:
    Trerice
    Winters Contractor
    Wiess

.4 Thermometer Wells
- .1 Copper pipe: copper or bronze.
- .2 Steel pipe: brass or stainless steel.

15.0 **V-Belt Drives**

.1 Tension belts to manufacturer's recommendations before start-up and after first l00 hours of operation using calibrated belt tensioning gauge.

.2 For motors from l/2 hp to 20 hp use standard adjustable pitch drive sheaves, having l0% range. Use mid-position of sheave for specified RPM. For motors over 20 hp sheave with split tapered bushing and keyway having fixed pitch unless specifically required for items concerned. Provide sheave of correct size to suit final balancing. Minimum drive rating: l.5 times nameplate rating on motor. Sheave size and type to match manufacturer's design requirements.

16.0 **Guards**

.1 Provide guards for exposed drives to conform to O.H.S.A.

.2 38mm dia. holes on both shaft centres for insertion of tachometers. Provide means to permit lubrication and use of test instruments with guards in place.

.3 Guards for drives shall have:
- .1 Expanded metal screen welded to 32mm steel angle frame.
- .2 l.4 mm thick galvanized sheet metal tops and bottoms.
- .3 Removable sides for servicing.

17.0 **Painting**

.1 Apply two (2) coats of corrosion resistant no V.O.C. primer paint to all mechanical equipment supports, equipment fabricated from ferrous metals and bare piping.

.2 Provide repair paint to all damaged equipment to match the factory finish.

18.0 **Access Doors**

.1 Supply access doors for furred ceilings or spaces for servicing equipment and duct accessories or for inspection of life safety or operating devices. Supply stainless steel access doors for tiled, marble, terrazzo or special surfaces. Standard of Acceptance: Acudor, Zurn, Ancon.

.2 Access doors shall be flush mounted 600 x 600 mm for body entry and 450 x 450 mm for service entry unless otherwise noted. Doors shall open 180° have rounded safety corners, concealed hinges, screwdriver latches and anchor straps. Steel shall be prime coated. Any access doors in fire rated assemblies or separations shall be U.L.C. rated for appropriate separation rating.

19.0 **Operating And Maintenance Instructions**

.1 Supply certified personnel to instruct Owners operating staff on operation of mechanical equipment. Supply maintenance specialist personnel to instruct operating staff on maintenance and adjustment of mechanical equipment and any changes or modifications in equipment made under the terms of the guarantee. Provide instruction to Owners staff during regular work hours prior to acceptance of the systems for regular operation.

.2 Prior to final acceptance of the work of the Contractor provide to the Testing and Balancing Contractor copies of complete operating and maintenance instructions for the equipment furnished under this Contract.

.3 Utilize the Operation and Maintenance data manual for instruction purposes. On completion of instructions, turn one manual over to the Engineer for review and acceptance. Provide three (3) copies of operation and maintenance manuals to Owner. The maintenance manuals shall include a comprehensive operating section, which will include a detailed description of all mechanical equipment operation included within this contract. The maintenance and operating instructions will be assembled by the Contractor into three (3) volumes using suitable looseleaf binders and including a complete index of contents. The index shall be organized into sections according to the numerical specification sections.

.4 The operating instructions shall include but not be limited to the following information which shall be included in the manuals.
- .1 List of recommended spare parts and quantities to be stocked.
- .2 Complete parts list giving manufacturer's name and catalogue number.
- .3 Operating instructions and procedures, including start up and shut down procedure.
- .4 Maintenance procedure including preventative maintenance instructions.
- .5 Lubricating instructions and schedules for all major equipment.
- .6 Wiring diagram of control panels.

.5 Operation data to include:
- .1 Control schematics for each system including environmental controls.
- .2 Description of each system and its controls.
- .3 Description of operation of each system at various loads together with reset schedules and seasonal variances.
- .4 Operation instruction for each system and each component.
- .5 Description of actions to be taken in event of equipment failure.
- .6 Valves schedule and flow diagram.
- .7 Colour coding chart.

.6 Performance data to include:
- .1 Equipment manufacturer's performance data sheets with point of operation as left after commissioning is complete.
- .2 Equipment performance verification test results.
- .3 Special performance data as specified elsewhere.
- .4 Testing, adjusting and balancing reports as specified in Section 15950 - Balancing.

20.0 **Building Structure / Equipment Supports**

.1 Initiate no drilling, cutting or welding of the building steel or concrete construction for the purpose of supporting materials or equipment without prior approval of the Prime Consultant.

.2 Hangers to steel shall be beam clamps or flange hangers where possible. Where attachment is permitted, welding studs of a size not larger than 13mm diameter may be used. If larger size bolts are required to support the equipment, these shall be attached by steel clips or brackets, secured to the building steel by welding or bolting as approved by the Engineer.

.3 Equipment Supports supplied by equipment manufacturer: specified elsewhere in Division 15.

.4 Equipment Supports not supplied by equipment manufacturer: fabricate from structural grade steel to CSA standard reference in G40.21.

.5 Welding to be in accordance with CSA Standard W59. Use E70XX low hydrogen welding rod. Welds to be continuous, 3/16" (5 mm) minimum fillet size.

.6 In carrying out field welding operations provide protective fire blankets within the Work area and a fire watch with fire extinguishers.

.7 After welding is complete clean welds of all splatter and touch-up paint with a prime coat of paint.

.8 Refer to “Seismic Restraint Systems” specification, section 15070 for mechanical trades scope of work.

21.0 **Vibration Isolation**

.1 Vibration isolation systems and equipment shall be furnished as part of the mechanical work and shall be supplied by one manufacturer for both piping and equipment. Shop drawings and application information shall be submitted to the Engineer for approval for the isolators for each specific item of equipment. Information shall include methods of installation, efficiencies and static deflections.

22.0 **Protection**

.1 All mechanical items and equipment on site during and following installation shall be protected from weather and other hazards and maintained in an orderly manner. All equipment including plumbing fixtures or equipment with a baked enamel finish shall be protected by special means such as polyethylene sheets and tarpaulins. Protect pipe ends, valves and other parts of the systems from damage and from the intrusion of foreign matter by means of caps, plugs, blind flanges, etc.

23.0 **Pipe Systems**

.1 All piping systems shall be installed in accordance with the ANSI/ASME B31-1, unless otherwise specified herein. Provide inserts, sleeves and anchors where necessary and coordinate with other trades to the fullest extent in the provision of openings, chases, etc. to accommodate the piping systems.

.2 All piping shall be installed in a neat and workmanlike manner with straight and direct runs. Unless otherwise shown, horizontal lines shall be installed parallel to building lines and as close as possible to ceilings, walls, partitions. Vertical lines shall be plumb. Adequate space shall be provided in all circumstances for the application of pipe insulation and for the operation and servicing of valves, etc.

24.0 **Pipe Grades and Slopes**

.1 Drains and waste piping shall slope down in the direction of flow at the rate of 2% per foot for 80 size and under and 1% per foot for 100 size and larger. Where slopes for piping services indicated herein are less than those established by applicable codes and regulations, the latter shall govern.

.2 All water supply piping shall be graded so that the system may be completely drained through risers, drips and fixtures. For this purpose, drain cocks shall be provided at all low points of the system. Domestic hot and cold water piping shall grade up in the direction of flow at the rate of 2%. Circulation piping shall grade down in the direction of flow at 2%

25.0 **Pipe Expansion and Contraction**

.1 All piping shall be installed in such a manner as to avoid undue stress and distortion due to expansion and contraction. Provide for expansion and contraction by the use of expansion loops for offsets. Expansion loops shall be installed in the line in a cold sprung position with proper anchors and guides.

.2 Provision for expansion and contraction shall be made on the basis of 25 mm per 30 m of pipe per 38 deg. C. temperature rise for steel pipe and 40 mm per 30 m of pipe per 38 deg. C. temperature rise for brass or copper pipe.

.3 The use of expansion type joints will be permitted only after acceptance by the engineer for the service, location and type of materials.

26.0 **Pipe Hangers and Supports**

.1 Fabricate hangers, supports and sway braces in accordance with ANSI/ASME B31.1. Support from structural members. Where structural bearings do not exist or inserts are not in suitable locations, suspend hangers from steel channels or angles. Division 15 shall provide supplementary structural members. Do not suspend from metal deck. Anchoring of piping and equipment shall be to manufacturer's recommendations. Submit anchorage system, arrangement and type of hangers supports with calculations for review. Refer to Section 21.0

.2 Provide saddles for insulated pipe and prefabricated insulation shields with high density insulation with vapour barriers for cold and chilled water piping.
Standard of Acceptance: Myatt, Grinnell

.3 Refer to Section 15140 - Pipe Hangers and Supports.

27.0 **Sleeves And Escutcheons**

.1 Pipe sleeves: at points where pipes pass through masonry or concrete. ASTM A53 Grade B Schedule 40 steel pipe. Use cast iron sleeve or steel pipe sleeves with annular fin continuously welded at midpoint:
.1 Through foundation walls.
.2 Where sleeve extends above finished floor; extend up 80 mm, caulk and seal when pipe is installed.

.2 Provide sleeves through all:
.1 Masonry walls.
.2 Concrete walls or floors
.3 Fire rated assemblies.

.3 Sizes: minimum 1/4" (6 mm) clearance all around, between sleeve and uninsulated pipe, or between sleeve and insulation.

.4 Terminate sleeves flush with surface of concrete and masonry walls, concrete floors on grade, or 100 mm A.F.F. for sleeves through Mechanical Room floors, Janitor Closets, and similar areas where a water dam is required.

.5 Fill voids around pipes:
.1 Caulk between sleeve and pipe in foundation walls and below grade floors with waterproof fire retardant non-hardening mastic.
.2 Where sleeves pass through walls or floors, provide space for firestopping. Where pipes/ducts pass through fire-rated walls, floors and partitions, maintain fire-rating integrity.
.3 Ensure no contact between copper tube or pipe and ferrous sleeve.
.4 Coat exposed exterior surfaces of ferrous sleeves with heavy application of zinc rich paint

.6 For pipes passing through roofs, use "Thaler Roofing Products" insulated aluminium cone flashings and flashing clamp device with tamper proof vent top. Anchor sleeves in roof construction; fasten roof flashing to clamp device; make water-tight durable joint. Confirm flashing model and height for appropriate roofing construction.

.7 Escutcheon plates:

.1 Provide on pipes passing through finished walls, partitions, floors and ceilings. Use SS No. 302 with set screws for ceiling or wall mounting. Inside diameter shall fit around finished pipe. Outside diameter shall completely cover opening or sleeve.

28.0 **Firestopping**

.1 Where pipes and ducts pass through fire rated walls, floors and partitions, pack space with materials having approval of authorities having jurisdiction.

.2 Division 15 to provide all materials and labour to complete U.L.C. firestopping for Division 15 work.

.3 Refer to Section 15086.

29.0 **Dielectric Couplings**

.1 Provide wherever pipes of dissimilar metals are joined. Provide insulating unions for pipe sizes NPS 2 and under and flanges for pipe sizes over NPS 2. Standard of Acceptance: Watts

30.0 **Pressure Systems Registration**

.1 When design pressures exceed 15 psi, piping systems and vessels shall be governed by the Boilers and Pressure Vessels Act of Ontario.

.2 All pressure piping systems, and pressure vessels within the scope of the Ontario Boiler and Pressure Vessel Act shall be registered with the Technical Standards and Safety Authority (TSSA). The Contractor shall register the piping systems and make all submission of data and pay all fees required to the Ministry. Maintain one copy of approved drawings on the site. Ensure that all purchased pressure vessels are approved by the Ministry and properly registered with all supporting documentation before the equipment is shipped to the site.

.3 The Contractor must comply with CSA Standard B51, the Boiler Pressure Vessel and Pressure Piping Code for Public Safety, and other applicable piping codes such as ANSI B31.1.

.4 For a Pressure Piping System to be registered with the TSSA, the Contractor must, in general, do the following:

.1 Perform the following work and other TSA requirements in a manner so as not to interfere with the scheduling of the project.

.2 Submit to the TSSA , three (3) copies of piping system drawings which indicate:

.1 Code of construction.

.2 Design pressures.

.3 Design temperatures.

.4 Material specifications.

Project drawings may be obtained at cost from the Consulting Engineer.

.3 Maintain a set of approved drawings on site available for review by the TSSA inspectors.

.4 Ensure that all Pressure Vessels are registered.

.5 Ensure that all welding and brazing is done by qualified operators certified by the TSSA, using appropriate procedures registered by the TSSA. All qualified operators shall be required to provide a copy of their Certificate of Qualification for record to be kept on site.

.6 Obtain all required permits and pay all permit and inspection fees for the complete pressure system installations.

31.0 **Layout**

.1 The drawings show the arrangements, general design, and extent of the duct and piping and other systems, suitably outlined with regard to sizes, locations, general arrangements, and installation details. The mains and connections thereto are shown more or less in diagram, except where in certain cases the drawings may include details giving the exact locations and arrangements required. Make necessary changes or additions to the runs to accommodate structural or other physical conditions, to provide proper access to equipment, or to provide minimum 8'-6" head clearance over walkway without additional charge or expense to the Owner. Notify the Consultant immediately and secure his authority in writing for such revisions before proceeding with the Work.

32.0 **Co-ordination**

.1 Start Work and proceed as soon as possible after the Contract has been let and in accordance with the construction of the building.

.2 Confer and cooperate with other trades in order to eliminate any unnecessary delays to the construction schedule. Where doubt exists regarding other trades, confer with the Superintendent without delay for detailed instructions concerning how to proceed with the Work. Expedite delivery of all equipment and materials to meet the construction schedule.

.3 Identify and resolve interference problems prior to prefabrication and installation of equipment. Submit interference drawings for review by Consultant.

.4 Examine the site and all Contract Documents prior to bid submission. No allowance will be made by any difficulties encountered due to any features of the building, methods of construction, site or surrounding public and private property which existed up to the bid close.

33.0 **Co-ordination Drawings**

.1 Prior to commencement of Work, submit for Consultant review, pipe, duct and equipment interference and sleeving drawings for each floor level and for all Division 15 Work. Drawings must be coordinated and certified correct for review.

.2 Coordination drawings shall be to a scale sufficient to show the necessary details. Submit for review, using the same procedures as specified for Shop Drawings.

.3 Prepare drawings in conjunction with other Divisions, wherever possible conflict due to the positioning of Division 15 equipment, piping or ductwork exists.

.4 Dimension proposed location of Division 15 Work with respect to building elevations and established grid lines.

.5 Prepare fully dimensioned detail drawings of all shafts, duct spaces and pipe spaces. Show sleeving, recessed and formed holes required in concrete for Division 15 Work. Include information pertaining to access, clearances, tappings, housekeeping pads, drains and electrical connections.

.6 Base information used to prepare drawings on reviewed Shop Drawings.

.7 Provide field drawings with position of various services when required by Consultant.

.8 Submit a list of access doors and panels showing proposed type, size and location. Coordinate drawings with Architectural detail drawings and reflected ceiling plans prior to submission.

34.0 **Guarantee / Warranty**

.1 Refer to General Conditions. Any extended warranties for equipment / work on this Division shall be noted in subsequent sections.

35.0 **Construction Period - Mechanical Systems Operation**

.1 Equipment warranties and guarantees are not relaxed or permitted early startup.

.2 Before substantial completion, the entire mechanical systems are to be refurbished, internally and externally cleaned and restored to “as new” condition.

.3 Regular preventive and all other manufacturer’s recommended maintenance routines are performed by the Contractor at his own expense and under supervision of the manufacturer’s representative.

.4 Supply ventilation systems are protected by 75% filters, shall be inspected daily and changed every week.

.5 Return systems shall have 40% Tacified approved filters over all ventilation system openings.

.6 There is no possibility of equipment or systems damage from any cause.

.7 Building has been closed in - all drywall and masonry work is completed. Areas are cleaned and will not be subjected to dusty processes during systems operation.

.8 Water treatment system has been commissioned and systems water treatment is being continuously monitored.

.9 All operating mechanical systems will be operated as per manufacturer’s recommendations or ins and operated and continuously monitored by the Contractor.

.10 Replace all filters.

36.0 **Trial Systems Usage**

.1 Owner may use equipment and systems for test purposes prior to acceptance. Supply all labour and material required for testing of the mechanical systems.

.2 Trial usage to apply to the following equipment and systems:
- .1 Air Handling Ventilation Systems
- .2 Exhaust Ventilation Systems
- .3 Plumbing Systems
- .4 Hot Water Heating Systems
- .5 Chilled Water Systems
- .6 Piping Systems

37.0 **Commissioning**

.1 Ensure that all equipment and systems are operable and safe for normal operation. All testing, adjusting, balancing Work and record keeping shall be performed prior to commissioning. Operational tests on equipment, ductwork, piping and control systems shall be performed prior to commissioning to verify that pressure and flow rates meet design requirements.

.2 A separate contractor **Commissioning Authority** shall be retained under separate contract to commission mechanical equipment and systems:
- .1 Mechanical equipment shall be operated in specified modes of control and sequences of operation, and emergency conditions.
- .2 Mechanical systems shall be operated in all modes of system operation (seasonal, occupied/unoccupied, etc.) including all individual interlock and conditional control logic, all control sequences, both full and abnormal conditions for which there is a specified system or control response.
- .3 If verification of functional performance cannot be completed due to seasonal reasons, lack of occupancy, deficiencies beyond the scope of the Mechanical Work, or any other reason, this shall be noted and this work shall be completed at a date and time to be determined.
- .4 Tests which fail to verify acceptable performance of equipment and systems shall be repeated after corrective measures are carried out, and this process shall continue until acceptable performance is achieved.
- .5 Ensure participation and cooperation of specialty trades
- .6 Functional performance tests shall be witnessed by the Owner. Submit test report which shall include space for remarks and Owner's acceptance signature.

.3 Ensure and certify the following documents are complete and correct:
- .1 Shop drawings and product data.
- .2 Test reports.
- .3 Operation and maintenance manuals.
- .4 As-built drawings.

.4 Fully instruct and train operating and maintenance personnel in care, adjustment and operation of mechanical systems.

.5 Refer to the Commissioning Specification Section for additional requirements.

38.0 **Energy Efficiency**

.1 All equipment supplied for this contract shall meet or exceed the 2012 energy efficiency targets stated within the following:
- .1 ASHRAE 90.1-2010 and
- .2 Ontario Building Code 2006 as amended January 1st, 2012 with supplementary standard SB-10 and SB-12

END OF SECTION 15010

Identification

1.0 **Equipment**

.1 Manufacturer's nameplates:

.1 Provide metal nameplate on each piece of equipment, mechanically fastened with raised or recessed letters.

.2 Provide Underwriters' Laboratories and CSA registration plates, as required by respective agency.

.3 Manufacturer's nameplate to indicate size, equipment model, manufacturer's name, serial number, voltage, cycle, phase and power of motors.

.4 Locate nameplates so that they are easily read. Do not insulate or paint over plates.

.2 System nameplates:

.1 Provide laminated plastic plates.

.2 Fasten nameplates securely in conspicuous place. Where nameplates cannot be mounted on cool surface, provide standoffs.

.3 Identify equipment type and number (eg. Pump No. 2) and service or areas or zone of building served, eg. South Zone Chilled Water Primary as per equipment schedule.

.4 Submit list of nameplates for review prior to engraving.

.3 System Nameplates

.1 Colour:

.1 Hazardous - red letters, white background.

.2 Elsewhere: black letters, white background (except where required by applicable codes).

.2 Construction: (1/8") 3 mm thick, laminated plastic or white anodized aluminum, matte finish, square corners, letters accurately aligned and machine engraved into core.

.3 Sizes:

.1 Conform to the following table:

Size #	Dimensions Inches x inches (mm x mm)	No. of Lines	Letter Height inches (mm)
1	3/8 x 2 (10 x 50)	1	1/8 (3)
2	1/2 x 3 (13 x 75)	1	3/16 (5)
3	1/2 x 3 (13 x 75)	2	1/8 (3)
4	3/4 x 4 (20 x 100)	1	5/16 (8)
5	3/4 x 4 (20 x 100)	2	1/4 (6)
6	3/4 x 4 (20 x 100)	2	3/16 (5)
7	1 x 5 (25 x 125)	1	1/2 (12)
8	1 x 5 (25 x 125)	2	5/16 (8)
9	1 3/8 x 8 (35 x 200)	1	3/4 (20)

.2 Use average of 25 letters / numbers (maximum) per nameplate.

.3 Use size #6 for terminal cabinets and control panels.

.4 Use size #9 for equipment in mechanical rooms.

2.0 **Piping**

.1 Comply with standard detail drawing plate "Identification of Piping Systems" number 15020.101.

.2 Identify medium in piping with markers showing name and service including temperature, pressure and directional flow arrows in accordance with CGSB 24-GP3a.

.3 Apply primary colours and secondary colour bands on finished piping surfaces, in exposed areas only to indicate type and degree of hazard.

.4 Use existing coding system for building additions and alterations. Colour coding System Schedule for new buildings as follows:

Pipe and Valve Identification Table

Pipe Marker Legend	Valve Tag Legend	Primary Colour	Secondary Colour
Domestic Cold Water Supply	D.W.S.	Green	None
Domestic Hot Water Supply	D.H.W.S.	Green	None
Domestic Hot Water Return	D.H.W.R.	Green	None
Heating Hot Water Supply	H.W.S.	Yellow	Black
Heating Hot Water Return	H.W.R.	Yellow	Black
Glycol HVAC Water Supply	G.S.	Green	None
Glycol HVAC Water Return	G.R.,	Green	None
Chilled Water Supply	C.W.S.	Green	None
Chilled Water Return	C.W.R.	Green	None
Dual Temp Supply	D.T.S.	Green	None
Dual Temp Return	D.T.R.	Green	None
Steam	STM (psi)	Yellow	Black
Condensate Return	Cond. (psi)	Yellow	Black
Storm Drain	Storm	Green	None
Sanitary Drain	SAN	Green	None
Vent (plumbing)	V.P.	Green	None
Compressed Air	Comp.Air	Green	None
Steam Vent	Vent	Yellow	Black
R.O. Water	R.O.	Green	None

Pipe Marker Legend	Valve Tag Legend	Primary Colour	Secondary Colour
Non-Potable – Tag as “Warning – Non-Potable Water – Do Not Drink”	NPW	Purple	None

.5 Primary colour paint to conform to CGSB 1-GP-60M.

.6 Manufactured pipe markers and colour bands:

.1 Plastic coated cloth material with protective overcoating and waterproof contact adhesive undercoating, suitable for continuous operating temperature of l50° C and intermittent temperature of 200o C. Apply to prepared surfaces.

.2 50 mm wide tape single wrap around pipe or pipe covering with ends overlapping one pipe diameter but not less than 25 mm for colour bands.

.3 Block capital letters 50 mm high for pipes of 75 mm nominal and larger OD (including insulation) and not less than 20 mm high for smaller diameters.

.4 Direction arrows 150 mm long by 50 mm wide for piping of 75 mm nominal or larger OD including insulation and 100 mm long by 20 mm wide for smaller diameters. Use double headed arrows where direction of flow is reversible.

.5 Waterproof and heat resistant plastic marker tags for pipes and tubing 20 mm nominal and smaller.

.6 Black pipe marker letters and direction arrows, white on red background for fire protection pipe parkers.

.7 Standard of Acceptance: Bradey Identification Tapes, Marking Services Canada Ltd.

.8 Note: Piping markers to be securely adhered to pipe covering with a layer of contact cement applied evenly under marker.

.7 Location:

.1 Locate markers and classifying colours on piping systems so they can be seen from the floor or platform.

.2 Piping runs at least once in each room.

.3 Maximum 15 m between identifications in open areas.

.4 Both sides where piping passes through walls, partitions and floors.

.5 At point of entry and leaving, where piping is concealed in pipe chase or other confirmed space, and at each access opening.

.6 At start and end points of runs and at each piece of equipment.

.7 At major manual and automatic valves immediately upstream of valves.

.8 Identify branch, equipment or building served after valve.

.9 Non-potable water piping markings shall have a continuous purple stripe and pipe tags not more than 1.5 m (5 feet) separation.

3.0 **Ductwork**

.1 Use 50 mm high black stencilled letters, eg. "Cold", "Hot", "Return" with directional flow arrow.

.2 Maintain maximum 15 m distance between markings.

.3 Identify ducts each side of dividing walls or partitions and beside each access door.

.4 Stencil over final finish only.

4.0 **Valves and Controllers**

.1 Provide lamacoid tags with 12 mm engraved code lettering and numbers secured with poly tie wraps for valves and operating controllers except at plain sight of equipment they serve.

.2 Provide Engineer with six (6) identification flow diagrams for each system. Include tag schedule, designating number, service, functions and location of each tagged item and normal operating position of valves.

.3 Install where directed one copy of flow diagram and valve schedule mounted in a glazed frame. Provide one copy in each operating and maintenance instruction manual.

.4 Consecutively number valves in systems.

.5 On "as built" drawings and schematics mark on all valve numbers at proper locations.

END OF SECTION 15060

Vibration Isolation

PART 1 - GENERAL

1.0 General Instructions

.1 Read and be governed by Conditions of the Contract and Sections of Division 1.
.2 Comply with Mechanical General Requirements, Section 15010.

1.1 Shop Drawings

.1 Submit shop drawings in accordance with general conditions.
.2 Provide separate shop drawings for each isolated system complete with performance and product data.

1.2 Maintenance Data

.1 Provide maintenance data for incorporation into manual specified in the General Conditions.

PART 2 - PRODUCTS

2.1 Refer to the drawings for tagged types of isolators.

2.2 Base Bid: Vibro-Acoustics
Vibron
Telcoustics
Anvil

2.3 Elastomeric Pads

Type	Description	Thickness
Type P1	neoprene waffle or ribbed; 50 durometer; maximum loading 350 kPa.	9 mm minimum thick
Type P2	rubber waffle or ribbed; ; 30 durometer natural rubber; maximum loading 4l5 kPa	13m minimum thick
Type P3	neoprene-steel-neoprene; neoprene bonded to 1.71 mm steel plate; 50 durometer neoprene, waffle or ribbed; holes sleeved with isolation washers.	9 mm minimum thick
Type P4	rubber-steel-rubber; rubber bonded to 1.71 mm steel plate; 30 durometer natural rubber, waffle or ribbed; holes sleeved with isolation washers.	9 mm minimum thick

2.4 **Spring Mount**

All with Zinc or Cadmium plated hardware; housings coated with rust resistant paint.

Type	Description
Type M2	stable open spring; support on bonded 6 mm minimum thick ribbed neoprene or rubber friction and acoustic pad.
Type M3	stable open spring; 6 mm minimum thick ribbed neoprene or rubber friction and acoustic pad, bonded under isolator and on isolator top plate; internal adjustment; equipment bolting not necessary.
Type M4	restrained stable open spring; supported on bonded 6 mm minimum thick ribbed neoprene or rubber friction and acoustic pad; built-in resilient limit stops, removable spacer plates.
Type M5	enclosed spring mounts with snubbers for isolation up to 23 kg maximum.

2.5 **Hangers**

All colour coded springs, rust resistant, painted box type hangers. Swivel arrangement to permit hanger box or rod to move through a 20 deg. arc without metal to metal contact.

Type	Description
Type H1	neoprene-in-shear.
Type H2	stable spring, elastomeric washer.
Type H3	stable spring, elastomeric element.
Type H4	stable spring, elastomeric element with lockout plate and indicator.

PART 3 - EXECUTION

3.1 **Installation**

.1 Install vibration isolation equipment in accordance with manufacturers instructions and adjust mountings to level equipment.

.2 Where isolation is bolted to floor avoid short circuiting of sound pads by using vibration isolation rubber washers.

.3 Block and shim level all bases so that ductwork and piping connections can be made to a rigid system at the operating level, before isolator adjustment is made. Ensure that there is no physical contact between isolated equipment and building structure.

.4 Ensure piping, ducting and electrical connections to isolated equipment do not reduce system flexibility and that piping and ducting passage through walls and floors do not transmit vibrations.

.5 Unless indicated otherwise, support piping connected to isolated equipment with spring mounts or spring hangers with 25 mm minimum static deflection as follows:

.1 Up to NPS 4: first 3 points of support. NPS 5 to NPS 8: first 4 points of support. NPS 10 and over: first 6 points of support.

.2 First point of support shall have a static deflection of twice deflection of isolated equipment, but not more than 50 mm.

3.2 **Site Visit**

.1 Arrange for manufacturer's representative to visit site to ensure installation is accordance with manufacturer's instructions and make adjustments and corrections in accordance with written report.

.2 Provide engineer with notice 24 hours in advance of manufacturer's representative visit.

END OF SECTION 15072

Thermal Insulation – Piping

PART 1 - GENERAL

1.0 General Instructions

.1 Read and be governed by Conditions of the Contract and Sections of Division 1.
.2 Comply with Mechanical General Requirements, Section 15010.

1.1 Reference Standards

.1 Complete thermal insulation in accordance with measures for Energy Conservation in New Buildings, Associate Committee of the National Building Code (ACNBC).

.2 Fire resistance:
- .l Meet NFPA 90A. Maximum flame spread rating of 25 and maximum smoke developed rating of 50.
- .2 Materials specified which have been approved by authorities having jurisdiction for special applications are acceptable.
- .3 Materials tested in accordance with ASTM C411-82 shall not flame, smolder, glow or smoke at temperatures to which exposed in service.

1.2 Definitions

.1 For purposes of this section:
- .1 "CONCEALED' - insulated mechanical services and equipment in hung ceilings and non-accessible chases and furred spaces.
- .2 'EXPOSED' - will mean 'not concealed' as defined herein.

1.3 Shop Drawings

.1 Submit shop drawings in accordance with the General Conditions.

1.4 Maintenance Data

.1 Provide maintenance data for incorporation into manual specified in the General Conditions.

PART 2 - PRODUCTS

2.0 Scope

.1 Provide new thermal insulation on all new services.

2.1 P-1 Formed Mineral Fibre to 400 Deg. F (200 Deg. C.)

.1 Application: for piping valves and fittings on:
- .1 domestic hot and recirculating water, temperature 140 deg. F (60 deg. C.),

.2 Materials - CGSB 51-GP-9M, rigid mineral fibre sleeving for piping.

.3 Thermal conductivity 'K' shall not exceed 0.30 BTU-in/hr-FT²-°F complete with a mean ambient temperature 24 deg. C.

Thickness:

Fluid Temperature Deg. F. (Deg. C)	Nominal Pipe Sizes (NPS) Thickness Inches (mm)			
	1¼ in. (32 mm.) and Under	1½ in. - 2 in. (40 mm - 52mm)	2½ in. - 4 in. (65 mm. - 102 mm.)	6 in. & over (152 mm. & over)
120-200 (51-95)	1 (25)	1 (25)	1 (25)	1 ½ (38)
201-250 (96-120)	1 ½ (38)	2 (50)	2 (50)	2 (50)
251-300 (121-150)	2 (50)	2 ½ (64)	2 ½ (64)	3 (75)
301-400 (151-200)	2 (50)	2 ½ (64)	3 (75)	3 ½ (89)

.4 Acceptable manufacturers: Knauf, Manson, Owens-Corning

2.2 **P-2 Formed Mineral Fibre with Vapour Barrier to 185 Deg. F. (85 Deg. c)**

.1 Application: for piping, valves and fittings on:
- .1 Domestic cold water.
- .2 All horizontal above ground drain piping.
- .3 Chilled, Chilled Glycol and Dual Temperature HVAC loop water supply and return.
- .4 Drains from outside air plenums.
- .5 Exposed domestic hot water piping.
- .6 Condensate drains.
- .7 Rain water leaders.
- .8 Non-potable piping.

.2 Material - CGSB 51-GP-9M, rigid mineral fibre sleeving for piping and CGSB 51-GP-52M, vapour barrier jacket and facing material.

.3 Thermal conductivity not to exceed 0.30 BTU – in/hr-FT²-°F, complete with ambient temperature 15 to 32 deg. C.,

Thickness

Nominal Pipe Sizes (NPS) Thickness Inches (mm)			
1 in. (32 mm) and under	1½ in. - 2 in. (32 mm. - 52 mm.)	2 ½ in. - 4 in. (65 mm. - 102 mm.)	4 in. - 8 in. (102 mm. - 2 mm.)
1¼ (25)	1 (25)	1 (25)	1 ½ (38)

.4 Acceptable manufactures: Knauf, Manson, Owens-Corning.

2.3 **P-3 Flexible Mineral Fiber with Vapour Barrier 185 deg. F. (85 deg. C.)**

.1 Applications: Roof drain bodies.

.2 Material:
- .1 CAN/CGSB-51.11, mineral fiber blanket for piping and CGSB 51-GP-52Ma, vapour barrier jacket and facing material.
- .2 Acceptable material - Knauf, Manson, Owens-Corning,
- .3 Thickness: All sizes, 1" (25 mm)

2.4 **Fastenings**

.1 For insulation systems P-1, P-2.
- .1 Tape - self adhesive
- .2 Lap seal adhesive - quick setting for joints and lap sealing of vapour barriers. Acceptable material - Foster 87-75 asbestos free at 6 m^2 / L.
- .3 Lagging adhesive - fire retardant coating. Acceptable material – Non-V.O.C. containing Foster 30-36 asbestos free at 1.25 m^2 / L.

2.5 **Insulation Cement**

.1 To CAN/CGSB-51.12.

2.6 **Jackets**

.1 Canvas:
- .1 Apply in exposed areas: ULC listed plain weave cotton fabric at 220 g/ m^2.
- .2 PVC jacket with pre-formed shapes as required
- .3 Acceptable material: S. Fattal Thermocanvas; Alpha Maritex 3451-RW; Clairmont Diplag 60.

.2 PVC
- .1 Apply in exposed areas.
- .2 Apply in accordance with CGSB51-GP-53M: 0.38 mm thick minimum with 25 flame spread and 50 smoke developed ratings.
- .3 Colours: white.
- .4 Minimum service temperatures: -20°C (-4°F).
- .5 Maximum service temperature: 65°C (150°F).
- .6 Moisture vapour transmission: 0.02 perm.
- .7 Fastenings:
  - .1 Use solvent weld adhesive compatible with insulation to seal laps and Joints.
  - .2 Tacks
  - .3 Pressure sensitive vinyl tape of matching colour.
- .8 Fitting, valve and strainer covers: one piece, pre-molded to match.
- .9 Fastenings standard to manufacturer - for outdoor applications, PVC jackets to contain UV inhibitors.
- .10 Acceptable material - Zeston.

PART 3 - EXECUTION

3.1 Application

.1 Work shall be performed by insulation journeymen.

.2 Apply insulation and coverings on hot piping while surface is between 50 to 60 degrees C.

.3 Vapour barriers and insulation to be complete over full length of piping or surface without penetration for hangers, and without interruption of sleeves, pipes and fittings.

.4 Install insulation with smooth and even surface.

.5 Install all piping drops in partition and masonry walls.

.6 Apply insulation after required tests have been completed and approved by Engineer. Insulation and surfaces shall be clean and dry when installed and during application of any finish. Apply insulation materials, accessories, and finishes in accordance with manufacturer's recommendations and as specified.

3.2 Installation

.1 Performed: sectional up to NPS 4, sectional or curved segmented above NPS 12.

.2 Multi-layered: staggered butt joint construction. Terminate insulation with insulation cement

.3 Valves: performed insulation sections on cold systems only.

.4 Vertical pipe over NPS 3: insulation supports welded or bolted to pipe directly above lowest pipe fitting.

.5 Bevel away from studs and nuts to permit their removal without damage to insulation, and seal with insulating cement.

END OF SECTION 15081

Thermal Insulation – Ducting

PART 1 - GENERAL

1.0 General Instructions

.1 Read and be governed by Conditions of the Contract and Sections of Division 1.
.2 Comply with Mechanical General Requirements, Section 15010.

1.1 Reference Standards

.1 Complete thermal insulation in accordance with Measure for Energy Conservation in New Buildings, Associate Committee of the National Building Code (ACNBC).

.2 Materials specified which have been approved by Fire Commissioner of Canada (FCC) for special applications are acceptable.

.3 Fire resistance:
  .1 Meet NFPA 90A. Maximum flame spread rating of 25 and maximum smoke developed rating of 50 in accordance with NFPA 255 and CAN4-S10220 for all components of insulation system. materials tested in accordance with ASTM C411 shall not flame, smolder, glow or smoke at temperatures to which exposed in service.

1.2 Definitions

.1 For purposes of this section:
  .1 'CONCEALED' - insulated mechanical services and equipment in hung ceilings and non-accessible chases and furred spaces.
  .2 'EXPOSED' - will mean 'not concealed' as defined herein.

1.3 Shop Drawings

.1 Submit shop drawings in accordance with the General Conditions.

1.4 Maintenance Data

.1 Provide maintenance data for incorporation into manual specified in the General Conditions.

PART 2 - PRODUCTS

2.1 Scope of Work

		Type	Thickness
.1	Exhaust ductwork within 1.5 meters of exterior of the building.	Board	25 mm
.2	Supply air ductwork where ducts are not soundlined.	Board	25 mm
.3	Make-up Air systems supply air ductwork	Board	25mm
.4	Round supply air ductwork.	Flexible	25 mm
.5	Supply air silencers	Board	25 mm
.6	Intake and exhaust plenums.	Board	50 mm
.7	Outdoor air intakes and plenums.	Board	50 mm

2.2 **Fibrous Glass Board Vapour Barrier Flat Surfaces**

.1 Application: insulation system for flat surfaces on rectangular ducts.

.2 Material
- .1 GSB51-GP-10M, Board, CGSB 51-GP-52M vapour barrier.
- .2 Acceptable Material: Fibreglass Canada AF530 with RFFRK vapour barrier. Equal - Schuller. Knauf.

2.3 **Fibrous glass flexible blanket with vapour barrier for curved surfaces.**

.1 Material:
- .1 CGSB 51-GP-11M blanket with CGSB-51-52M vapour barrier. Fibreglass Type 2 or Schuller.
- .2 Nominal 40 mm thick, taped joints.

2.4 **Fastenings**

.1 Tape: self adhesive, l00 mm wide rated under 25 for flame spread and under 50 for smoke development.

.2 Contact adhesive: quick-setting, non-flammable fire resistive adhesive to adhere fibrous glass to equipment. Flame spread 15, smoke development 0.

.3 Lap seal adhesive: quick-setting for joints and lap sealing of vapour barriers. Flame spread 10, smoke development 0.
- .1 Standard of Acceptance: Foster 85 -75, Childers.

.4 Pins:
- .1 Weld pins 5/32" (4 mm diameter, with 1 3/8" (35mm) diameter head for installation through the insulation. Length to suit thickness of insulation. Acceptable material Duro Dyne, Clip-Pin,
- .2 Weld pins 5/64" (2mm) diameter, for installation prior to applying insulation. Length to suit thickness of insulation. Nylon retain clips 1 1/4" (32 mm) square. Acceptable material: Duro Dyne spotter pins with spotter clips or stop clips as required.

.5 For Canvas:
- .1 Washable adhesive for cementing canvas lagging cloth to equipment insulation.
- .2 Standard of Acceptance; Foster 30 -36, Childers.

2.5 **Jackets**

.1 Canvas:
- .1 Apply in exposed area: ULC listed plain weave, cotton fabric at 8 oz./sq.yd.
- .2 Standard of Acceptance: S. Fattal Thermo Canvas, c/w childers U.L.C. lagging.

Notes: .1 Non-U.L.C. listed canvas will not be accepted on this project.
.2 Fan coil closets are considered exposed areas.

PART 3 - EXECUTION

3.1 Application

.1 Work shall be performed by insulation journeymen.

.2 Apply insulation and coverings on hot equipment while surface is between 50 to 60 deg. C.

.3 Vapour barriers and insulation to be completed over full surface without penetration.

.4 Install insulation with smooth and even surfaces.

.5 Apply insulation after required tests have been completed and approved by Engineer. Insulation and surfaces shall be clean and dry when installed and during application of any finish. Apply insulation materials, accessories and finishes to manufacturer's recommendations and as specified.

.6 Mechanical fastenings: on rectangular ducts, use 50% coverage of adhesive and weld pins at not more than 12" (3009 mm) centres, but not less than 2 rows per side and bottom.

END OF SECTION 15082

Acoustic Duct Lining

PART 1 - GENERAL

1.0 General Instructions

.1 Read and be governed by Conditions of the Contract and Sections of Division 1.
.2 Comply with Mechanical General Requirements, Section 15010.

1.1 Reference Standards

.1 Do work in accordance with recommendations of SMACNA Duct Liner Application Standard.

1.2 Product Data

.1 Submit product data in accordance with the General Conditions.

1.3 Shop Drawings

.1 Submit shop drawings in accordance with the General Conditions.

1.4 Maintenance Data

.1 Provide maintenance data for incorporation into manual specified in the General Conditions.

PART 2 - PRODUCTS

2.1 Material

.1 25 mm thick rigid board fibrous glass duct liner ASTM C-1071 Type II, density to 3.0 lb/ft^{3,} fibrous glass coated on one side with acrylic polymer coated surface.

.2 Flame spread rating on interior lining shall not exceed 25. Smoke developed rating shall not exceed 50.

.3 Adhesive: ULC and NFPA approved fire resistant with flame spread rating not exceeding 25 and smoke developed rating not exceeding 50.

.4 Standard of acceptance: Schuller, Permacote Linacoustic H.P. 25 mm thick.

PART 3 - EXECUTION

3.1 Installation

.1 Acoustically line inside of ducts where indicated with cross hatching or by notation on the drawings.

.2 Install lining in accordance with manufacturer's recommendations and in accordance with recommendation of SMACNA.

.3 Fasten to interior sheet metal surfaces with l00% coverage of adhesive and metal pins and washers.

.4 Seal edges, pin penetrations and joints with adhesive.

.5 Protect leading and trailing edges with sheet metal edging adhesive.

.6 Increase indicated duct sizes to accommodate the thickness of acoustic lining leaving the indicated free area.

END OF SECTION 15084

Mechanical Systems Fire Stopping

PART 1 - GENERAL

1.0 Related Work

.1 Fire stopping and smoke seals within mechanical assemblies.

1.1 References

.1 CAN4-S115- Standard Method of Fire Tests of Firestop Systems.

1.2 Samples

.1 Submit samples in accordance with the General Conditions.

1.3 Shop Drawings

.1 Submit shop drawings and product data in accordance with the General Conditions.

.2 Submit shop drawings to show proposed material, reinforcement, anchorage, fastenings and method of installation. Construction details should accurately reflect actual job conditions.

.3 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.

PART 2 - PRODUCTS

2.1 Materials

.1 Fire stopping and smoke seal systems in accordance with CAN4-S115.

.1 Asbestos-free materials and systems capable of maintaining an effective barrier against flame, smoke and gases in compliance with requirements of CAN4-S115 and not to exceed opening sizes for which they are intended.

.2 Service penetration assemblies certified by ULC in accordance with CAN4-S115 and listed in ULC Guide No. 40 U19.

.3 Service penetration fire stop components certified by ULC in accordance with CAN4-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 NB.

.5 Fire stopping and smoke seals at openings intended for ease of re-entry such as cables: elastromeric seal.

.6 Fire stopping and smoke seals at openings around penetrations for pipes, ductwork and other mechanical items requiring sound and vibration control; elastromeric seal.

.7 Water (if applicable) potable, clean and free from injurious amounts of deleterious substances.

.8 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.

.9 Sealants for vertical joins: non-sagging.

.10 Standard of Acceptance: (1) 3M and (2) Hilti.

PART 3 - EXECUTION

3.1 Preparation

.1 Examine sizes and conditions of voids to be filled to establish correct thicknesses and installation of materials. Ensure that substrates and surfaces are clean, dry and frost free.

.2 Prepare surfaces in contact with fire stopping materials and smoke seals to manufacturer's instructions.

.3 Maintain insulation around pipes and ducts penetrating fire separation without interruption to a vapour barrier.

.4 Mask where necessary to avid spillage and over coating onto adjoining surfaces; remove stains on adjacent surfaces.

3.2 Installation

.1 Provide temporary forming as required and remove forming only after materials have gained sufficient strength and after initial curing.

.2 Remove excess compound promptly as work progresses upon completion.

3.3 Inspection

.1 Notify the Engineer when ready for inspection and prior to concealing or enclosing fire stopping materials and service penetration assemblies.

3.4 Schedule

.1 Fire stop and smoke seal at:
- .1 Penetrations through fire resistance rated masonry, concrete, and gypsum board partitions and walls.
- .2 Penetrations through fire resistance rated floor slabs, ceilings and roofs.
- .3 Openings and sleeves installed for future use through fire separations.
- .4 Around mechanical and electrical assemblies penetrating fire separations.
- .5 Rigid ducts, greater than 129 cm^2 ; 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.

3.5 Clean up

.1 Remove excess materials and debris and clean adjacent surfaces immediately after application.
.2 Remove temporary dams after initial set of fire stopping and smoke seal materials.

END OF SECTION 15086

Site Services

PART 1 - GENERAL

1.0 General Instructions

.1 Read and be governed by Conditions of the Contract and Sections of Division 1.
.2 Comply with Mechanical General Requirements, Section 15010.

1.1 Shop Drawings

.1 Submit shop drawings in accordance with the General Conditions.

1.2 Maintenance Data

.1 Provide maintenance data for incorporation into manual specified in the General Conditions.

1.3 Work in Other Sections

.1 Related work specified in other sections:
.1 General Division

1.4 Qualifications

.1 Execute the work of this Section by a subcontractor who has equipment adequate for project, and skilled tradesmen supervised by foremen experienced in the type of work specified.

.2 All work shall be completed by a bonded contractor familiar with the City of Hamilton regional standards.

1.5 Requirements of Regulatory Agencies

.1 Work of this Section shall be in accordance with the following documents, latest revisions:
- Ontario Provincial Standard drawings and specifications
- The Ontario Building Code - Reg. 419/97
- The Canadian Plumbing Code
- City of Hamilton Engineering Specifications

1.6 Inspection and Testing

.1 The General Contractor shall employ an independent inspection and testing company to carry out all testing and inspection as required.

1.7 Warranty

.1 The Contractor hereby warrants that the works shall remain in such condition as will meet the approval of the Engineer for a period of one (1) year from the date of substantial performance for the project.

1.8 **Scope of Work**

.1 It is the intent of these Specifications to furnish and install all materials and equipment as hereinafter specified and/or as shown on the drawings in such a manner as to leave each of the services complete and in satisfactory operating conditions.

.2 All material required to complete the work under the Contract shall be supplied by the Contractor and compensation therefore shall be deemed to be included in the prices bid for the items of work for which it is to be used.

.3 The Contractor shall pay for the costs of all of the service connections as specified and as indicated.

.4 Excavation, backfill and bedding of all services as specified in this Section and as shown on the drawings is a part of this section and shall apply as if repeated here.

.5 It is the intent that the drawings and specifications describe complete systems. All materials and equipment and the furnishing of all labour reasonably implied by these drawings and/or the specifications shall be included to provide systems ready for satisfactory operation.

.6 The full scope of the work shall be determined by an examination of architectural, electrical, mechanical and other related drawings in order to avoid interferences with the work of other trades and to ensure proper completion of the work as a whole.

.7 The Specifications shall be considered as an integral part of the Plans which accompany them, neither the Plans nor the Specifications shall be used alone. Any items or subject omitted from one, but which is mentioned or reasonably implied in the other, shall be considered as properly and sufficiently specified, and must, therefore, be provided. Misinterpretations of either the Plans or the Specifications shall not relieve this Division of responsibility.

1.9 **Installation**

.1 Lay pipes on prepared bed, true to line and grade with pipe inverts smooth and free of sags or high points. Ensure pipe is in contact with shaped bed throughout its full length.

.2 Lay and join in accordance with manufacturer's recommendations.

.3 Installation of all site services to be in accordance with Ontario Provincial Standard Specifications, City of Hamilton Engineering Standards.

1.10 **Codes, Regulations and Permits**

.1 All work shall be installed, inspected and tested in accordance with governing codes, rules and regulations of the municipality in which the work is performed and also of provincial and federal authorities having jurisdiction.

.2 The Contractor shall obtain all permits required for the installation of work, arrange for inspections and tests therewith and pay all fees and costs for the permits and inspections. All necessary permits shall be obtained immediately after notification of award of contract.

.3 In addition to the foregoing, the Contractor shall perform such other inspections and tests as may be deemed necessary by the Architect.

.4 The Ontario Building Code and the applicable requirements of C.S.A. and A.S.T.M. Standards including their later amendments, as well as Provincial and Municipal By-laws and Regulations shall be considered part of this specification. Lack of possession of knowledge of any code or standard referred to herein shall not constitute sufficient reason for deviation there from.

1.11 **Record Drawings**

.1 Clearly record all changes and deviations from contract drawings on a set of white prints available from the Architect for this purpose and forwarded to him at the completion of the project. All buried services shall be located on the drawings with dimensions to property lines. All invert elevations shall be indicated.

1.12 **Site Visit**

.1 This contractor shall visit the site and evaluate all existing site conditions as they may affect this work. No extras will be allowed for any effects from failing to do so.

1.13 **Excavation and Backfilling**

.1 This Division shall do all excavating and backfilling work required to install the specified systems. All such work shall conform strictly to the requirements of local and provincial codes and regulations. Refer to Division 02200 Earthwork.

.2 Trenches shall be excavated to a depth which shall allow for a minimum of 150 mm of hand placed bedding material, thoroughly compacted. The bedding shall be removed at pipe hubs or couplings to provide continuous support over each length of pipe.

.3 Excavations shall be maintained free of water while underground piping is being installed and until backfill work is completed.

.4 All tests for underground piping shall be conducted and accepted before joints on such piping are backfilled.

.5 Backfill to 300 mm above the piping shall be hand placed in 100 mm layers and compacted simultaneously on both sides of the piping. All additional backfill shall be placed in approximately 150 mm layers and may be mechanically placed.

.6 Where pipes are located near or below footings, the pipes shall be sleeved, and 1500 lb. concrete backfill shall be installed to underside of footings.

.7 Bedding and backfill materials to 300 mm above top of pipe shall be sand of a non-organic nature.

.8 Backfill material for trenches within the building from 300 mm above top of pipe to grade shall be new granular material conforming to M.T.C. granular “A” material.

.9 Backfill material for trenches outside of the building but under roadways, paved or concrete parking areas, ramps, walkways, etc. from 300 mm above top of pipe to grade shall be new granular material conforming to M.T.C. granular "A" material.

.10 Frozen materials will not be acceptable for bedding or backfilling.

.11 All bedding and backfilling shall be mechanical tamped in the layer specified and thoroughly compacted. Use a standard Proctor of 95% outside of the building. All bedding and haunching to the centreline of P.V.C. piping shall be compacted to 95% Proctor Density.

.12 Protect all excavations with safety fencing, signage, shoring or bracing. Provide traffic control personnel when required by the municipality.

.13 Restore all pavement, sodding and landscaping to pre-construction condition.

1.14 **Sleeves**

.1 Pipe sleeves: at points where pipes pass through masonry or concrete.

.2 Sleeves of: minimum 3.5 mm thick galvanized sheet steel.

.3 Use cast iron sleeve or steel pipe sleeves with annular fin continuously welded at midpoint:
- .1 Through foundation walls protruding 300 each side of foundation walls.
- .2 Where sleeve extends above finished floor; extend up 50 mm, caulk and seal when pipe is installed.

.4 Sizes:
- .1 6 mm clearance all around, between sleeve and pipes or between sleeve and insulation.

1.15 **Protection**

.1 All mechanical items and equipment on site during and following installation shall be protected from weather and other hazards and maintained in an orderly manner.

.2 Protect pipe ends, valves and other parts of the systems from damage and from the intrusion of foreign matter by means of caps, plugs, blind flanges, etc.

PART 2 - PRODUCTS

2.1 **Water Mains**

.1 The pipe and fittings shall conform to the latest revised American Water Works Association Standard. All buried water piping must have a 5'6" (1700 mm) minimum cover.

.2 Pipe Material - Sizes 100mm to 300 mm
- .1 Class 52 cement lined ductile iron AWWA C-151. Mechanical or Tyton joints to AWWA - C-111 shall be used.

.3 Fittings
- .1 For ductile iron pipe standard cast iron or ductile iron mechanical rubber gasket joints to AWWA C-111, rubber gasket seal, cement mortar-lined to AWWA C-104, pressure rated 250 psig (1725 kPa) to AWWA C-110.

2.2 **Tapping, Sleeves and Tapping Valves**

.1 Water mains 100 mm to 300 mm full circle mechanical joint type for ductile iron and P.V.C.

.2 Acceptable Products:
.1 Sleeves:
.1 Canada Valve
.2 Mueller

.2 Valves:
.1 Canada Valve
.2 Mueller

.3 All sleeves and pressure taps to be tested to 150 psig (1035 kPa) before tapping.

2.3 **Gate Valves**

.1 Acceptable products:
.1 Canada Valve and Hydrant
.2 Mueller

.2 Design features to AWWA C-500 sizes 4" to 12{" (100 mm to 300 mm)
.1 Iron body, bronze-mounted, double disc or solid wedge gate non-rising stem, 175 psig (1205 kPa) W.P.; hydrostatic test 300 psig (2070 kPa) mechanical joint.
.2 Bituminous non-toxic coating.
.3 2" (50 mm) tapered square top x 1 1/2" (45 mm) high.

PART 3 - EXECUTION

3.1 **Final Inspection**

.1 At substantial completion of the project, review the condition of all piping, to ensure all devices are clean and in working order.

.2 Clean and flush any debris in the systems if any is found upon inspection after completion.

END OF SECTION 15100

Flexible Connections and Expansion Joints

PART 1 - GENERAL

1.0 General Instructions

.1 Read and be governed by Conditions of the Contract and Sections of Division 1.
.2 Comply with Mechanical General Requirements, Section 15010.

1.2 Shop Drawings

.1 Submit shop drawings in accordance with the General Conditions.

1.3 Product Data

.1 Submit product data in accordance with the General Conditions.

.2 Indicate for each item as applicable:
- .1 Manufacturer, model number, line content, pressure and temperature rating.
- .2 Movement handled: axial, lateral, angular and the amounts of each.
- .3 Nominal size and dimensions including details of construction and assembly.
- .4 Compliance with ANSI/ASME B31.1 pressure ratings.

1.4 Maintenance Data

.1 Provide maintenance data for incorporation into maintenance manual specified.

.2 Data to include:
- .1 Servicing requirements, including stuffing box packing, lubrication and recommended procedures.

PART 2 - PRODUCTS

2.1 Expansion Joints

.1 Slip Type:
- .1 For axial pipe movement: complete with packing chamber, limit stops, lubrication fittings or lubricant impregnated packing rings.
- .2 Packing material: as recommended by manufacturer with fixed packing gland arrangement with a packing injection assembly.
- .3 Slip pipe: hard chrome plated to ASTM A53-82, carbon steel.
- .4 Acceptable Material: Metraflex

.2 Bellows Type:
- .1 For axial, lateral or angular movements with stainless steel bellows, guides, control rings, travel stops, flanged.
- .2 Standard of Acceptance: Metraflex.

2.2 Flexible Connections

.1 Inner hose: SS corrugated.

.2 Braided wire mesh SS outer jacket.

.3 Size and end connection: as indicated.

.4 Complete unit suitable for working pressure of 1360 kPa and working temperature of 205 deg. C.

.5 Capacity to absorb 150 mm transverse movement with length across flexible portion not less than six (6) diameters. Maximum length of hose 600 mm.

.6 Standard of Acceptance: Metraflex

2.3 **Bellows Type Expansion Joints**

.1 For axial, lateral and angular movements, as indicated.

.2 Maximum operating pressure 300 psig.

.3 Maximum operating temperature 450 deg. F.

.4 Externally pressurized, constant volume, pressure balanced, designed to eliminate pressure thrust, factory tested to 1.5 times maximum working pressure. Furnish test certificates.

.5 Bellows: Multiple bellows, austenitic stainless steel for specified fluid, pressure and temperature, water treatment and pipeline cleaning procedures.

.6 Reinforcing rings - 2 piece nickel iron.

.7 Ends - Raised face pipe.

.8 Liner - Austenitic stainless steel in direction of flow.

.9 Shroud - carbon steel, painted.

2.4 **Anchors and Guides**

.1 Anchors
- .1 Provide as indicated.
- .2 Concrete to Section 03300 Cast in Place Concrete
- .3 Reinforcement - Section 03200 Concrete Reinforcement.

.2 Alignment guides
- .1 Provide as indicated.
- .2 To accommodate specified thickness of insulation.
- .3 Vapour barriers, jackets to remain uninterrupted.
- .4 Install expansion joints with cold setting as indicated. Make record of cold settings.
- .5 Install expansion joints and flexible connections in accordance with manufacturer's instructions.
- .6 Install pipe anchors and guides as indicated. Anchors to withstand 150% of axial thrust.

PART 3 - EXECUTION

3.1 **Installation**

.1 Provide all piping guides, anchors, hangers etc. as required by the expansion joint manufacturer and as recommended under T.S.S.A. review.

.2 Properly align the piping system as the working pressure and temperature.

.3 Submit shop drawings for all expansion loops / joints.

.4 Install expansion joints with cold setting, as indicated. Make record of cold settings.

.5 Install expansion joints and flexible connections in accordance with manufacturer's instructions.

.6 Install pipe anchors and guides as indicated. Anchors to withstand 150% of axial thrust.

END OF SECTION 15125

Pipe Hangers and Supports

PART 1 - GENERAL

1.0 General Instructions

.1 Read and be governed by Conditions of the Contract and Sections of Division 1.
.2 Comply with Mechanical General Requirement's -Section 15010.

1.1 Shop Drawings and Product Data

.1 Submit shop drawings and product data in accordance with Section 15010.

.2 Indicate on manufacturer's catalogue literature the following:
- .1 Upper attachment.
- .2 Middle attachment.
- .3 Pipe attachment.
- .4 Riser clamps.
- .5 Shields and saddles.

1.2 Maintenance Data

.1 Provide maintenance data for incorporation into the manual specified in the General Conditions.

PART 2 - PRODUCTS

2.1. General

.1 Fabricate hangers, supports, and sway braces in accordance with ANSI B31.1 and MSS-SP58. Fabricate hangers, supports, and sway braces in accordance with ANSI B31.1 and MSS-SP58.

.2 Support from top of structural members. Where structural bearing does not exist or inserts are not suitable locations, provide supplementary structural steel members.

.3 Mechanical Contractor shall study the pipe routing in coordination with other trades. Mechanical Contractor must drill and use expansion bolts for all supports.

.4 Coordinate with Electrical Trades where common support brackets are to be used to carry both conduit and piping to ensure adequate load bearing capacity.

2.2 Upper Attachments

.1 Concrete
- .1 Inserts for cast-in-place concrete: galvanized steel wedge to MSS-SP58, type 18. ULC listed for pipe NPS 3/4 (19mm) through NPS 8 (203 mm). Acceptable Material: Grinnell Fig. 281.
- .2 Carbon steel plate with clevis, for surface mount: malleable iron socket and expansion case and bolt. Minimum two expansion cases and bolts for each hanger. Acceptable Material: Grinnell, Plate Fig.49, Eye Nut Fig.290, Expansion Case Fig.117.

.2 Steel Beam (bottom flange):
- .1 Cold piping NPS2 (50mm) and under: malleable iron C clamp to MSS-SP58, type 19. ULC listed. Acceptable Material: Grinnell Fig.61.

.2 Cold piping NPS 2-1/2 (63 mm) and larger and all hot piping: malleable iron beam clamp to MSS-SP58, type 28 or 29. ULC listed. Acceptable Material: Grinnell Fig. 229.

.3 Steel Beam (top):
- .1 Cold piping NPS2 (50mm) and under: malleable iron "top of beam" clamp to MSS-SP58, type 19. ULC listed. Acceptable Material: Grinnell Fig. 61.
- .2 Cold piping NPS 2-1/2 (63 mm) and larger and all hot piping: steel jaw, hook rod with nut, spring washer and plain washer, to MSS-SP58, type 25. ULC listed. Acceptable Material: Grinnell Fig. 227.

.4 Steel Joist:
- .1 Cold piping NPS 2 (50 mm) and under: steel washer plate with double locking nuts. Acceptable Material: Grinnell Fig. 60.
- .2 Cold piping NPS 2-1/2 (63 mm) and larger and all hot piping: steel washer plates with double locking nut, carbon steel clevis, and malleable iron socket. Acceptable Material: Grinnell Washer Plate, Fig. 60; Clevis, Fig. 66; Socket, Fig. 290.

.5 Steel Channel or Angle (bottom):
- .1 Cold piping NPS 2 (50 mm) and under; malleable iron C clamp to MSS-SP58, type 23. ULC listed. Acceptable Material: Grinnell Fig. 86.
- .2 Cold piping NPS 2-1/2 (63 mm) and larger and all hot piping: universal channel clamp. ULC listed. Acceptable Material: Grinnell Fig. 226.

.6 Steel Channel or Angle (top):
- .1 Cold piping NPS 2 (50 mm) and under; malleable iron "top of beam" C clamp to MSS-SP58, type 19. ULC listed. Acceptable Material: Grinnell Fig. 61.
- .2 Cold piping NPS 2-1/2 (63 mm) and larger and all hot piping: steel jaw, hook rod with nut, spring washer and plain washer, to MSS-SP58, type 25. ULC listed. Acceptable Material: Grinnell Fig. 227.

2.3. **Middle Attachment (rod)**

.1 Carbon steel threaded rod black and electro-galvanized for mechanical room's finish. Acceptable Material: Grinnell Fig. 146; Myatt.

2.4 **Pipe Attachment**

.1 Cold piping, steel or cast iron: hot piping steel, with less than 1" (25 mm) horizontal movement; hot piping steel, with more than 12" (30 cm) middle attachment rod length: adjustable clevis to MSS-SP58, type 1, ULC listed. Acceptable Material: Grinnell Fig. 260; Myatt.

.2 Cold copper piping; hot copper piping with less than 1" (25 mm) horizontal movement; hot copper piping with more than 12" (30 cm) middle attachment rod length: adjustable clevis to MSS-SP58, type 1, copper plated. Acceptable Material: Grinnell Fig. CT-65; Myatt.

.3 Suspended hot piping, steel and copper, with horizontal movement in excess of 1" (25 mm); hot steel piping with middle attachment rod 12" (30 cm) or less; pipe roller to MSS-SP58-1983, type 43. Acceptable Material: Grinnell Fig. 174; Myatt.

2.5 **Riser Clamps**

.1 Steel or cast iron pipe: black carbon steel to MSS-SP58, type 42, ULC listed. Acceptable Material: Grinnell Fig. 261; Myatt; Capital Pipe Supports.

.2 Copper pipe: carbon steel copper finished to MSS-SP58, type 42. Acceptable Material: Grinnell Fig. CT-121; Myatt.

2.6 **Saddles and Shields**

.1 Cold piping NPS 1-1/4 (32 mm) and over: protection shield with high-density insulation under shield with uninterrupted vapour barrier. Acceptable Material: Grinnell Fig. 167; Myatt.

2.7 **Pipe Guides**

.1 Pipe guide sleeves for steel piping shall be fabricated from steel pipe having an inside diameter approximately 4" (100 mm) greater than the outside diameter of the pipe being guided, at least two pipe diameters long and anchored to the building structure. The pipe shall be held concentric to the sleeve by means of four steel plate fins of thickness at least equal to the pipe wall thickness. Weld fins to the pipe along the full length of the sleeve with minimum clearance to provide the sliding motion. Alternatively, provide guide sleeves as manufactured by Myatt, or Grinnell

PART 3 - EXECUTION

3.1. **Hanger Spacing**

.1 Spacing and middle attachment rod diameter as specified in paragraphs below or as in table below, whichever is more stringent:
- .1 Plumbing piping: most stringent requirements of Ontario Plumbing Code, or authority having jurisdiction.
- .2 Fire Protection: to applicable Fire Code.
- .3 Within 12" (300 mm) of each horizontal elbow.

Pipe Size NPS	Rod Diameter	Maximum Spacing - Steel	Maximum Spacing - Copper
Up to 1-1/4 (32 mm)	3/8" (10 mm)	7' (2.1m)	6' (1.8m)
1 ½ (38 mm)	3/8" (10 mm)	9' (2.7m)	8' (2.4m)
2 (50 mm)	3/8" (10 mm)	10' (3.0m)	9' (2.7m)
2 ½ (63mm)	3/8" (10mm)	12' (3.6m)	10' (3.0m)
3 (76mm)	3/8" (12mm)	12' (3.6m)	10' (3.0m)
4 (102mm)	5/8" (16mm)	14' (4.2m)	12' (3.6m)
6 (152mm)	7/8" (22mm)	16' (4.8m)	–
8 (203mm)	7/8" (22mm)	17' (5.1m)	–
10 (254mm)	1" (25mm)	21'-6" (6.6m)	–

Pipe Size NPS	Rod Diameter	Maximum Spacing - Steel	Maximum Spacing - Copper
12 (305mm)	1" (25mm)	21'-6" (6.6m)	--

3.2 **Hanger Installation**

.1 Offset hanger so that rod is vertical in operating position.

.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.

END OF SECTION 15140

Domestic Water Supply Piping – Copper

PART 1 - GENERAL

1.0 General Instructions

.1 Read and be governed by Conditions of the Contract and Sections of Division 1.
.2 Comply with Mechanical General Requirements, Section 15010.

1.1 Reference Standards

.1 Complete the work in accordance with Ontario Plumbing Code and local authority having jurisdiction except where specified otherwise.

.2 All plumbing fittings and accessories shall comply with ASME A112-18.1 for a limit of weighted average lead content of less than or equal to 0.25% when tested in accordance with NSF/ANSI 372.

1.2 Shop Drawings

.1 Submit shop drawings in accordance with the General Conditions.

1.3 Maintenance Data

.1 Provide maintenance data for incorporation into manual specified in the General Conditions.

PART 2 - PRODUCTS

2.1 Piping

.1 Domestic hot, cold and recirculating piping within the building:
  .1 Sizes 75 (3") and under, above ground: copper tube, hard drawn type L; ASTM B88M. Sizes 50 (2") and larger, above ground: provide Victaulic roll grooved copper, hard drawn type L to ASTM B88M with grooved copper fittings to ASTM B-75 alloy and Victaulic #607 couplings and #641 flange adapters.
  .2 Buried: copper tube, soft annealed, type K: to ASTM B88M or polyethylene CSA labelled piping for 120 psi rating where indicated.

2.2 Fittings

.1 Brass or bronze flanges and flanged fittings: To ANSI B16.24.
.2 Brass or bronze threaded fittings: to ANSI B 16
.3 Cast bronze to ANSI B 16-18 or wrought copper and bronze to ANSI B16.22-1980.

2.3 Joints

.1 Rubber gaskets 1.6 mm thick: to ANSI A21.11.
.2 Bolts, nuts, hex head and washers: to ASTM A307, heavy series.
.3 Solder on joints NPS 2 and over NPS 2.
.4 Solder to be "water safe".

.5 Equal Manufacturers:

.1 Copper Press-Connect Fittings:

.1 Viega LLC; ProPress

.2 Viega ProPress Bronze, or copper shall conform to ASTM F3226, ICC LC 1002, ASME B16.51, IAPMO PS 117, NSF 61, and NSF 61-G or NSF 372. ProPress fittings ½-inch thru 4-inch for use with ASTM B88 copper tube type K, L, or M and ½-inch up to include 1-1/4-inch annealed copper tube

.3 Cast copper alloy fittings

.1 Alloy: Copper alloy - UNS C12200

.2 Zero Lead silicon bronze alloy - C87710 (cast) or C87700 (machined)

.3 Shall not be bismuth bronze or yellow brass

.4 EPDM elastomeric sealing element shall be peroxide cured for resistance to chloramines

.5 Press Connect fitting shall have Viega Smart Connect technology to detect unpressed fittings shall be integrated into the body of the fitting

.6 2-1/2 inch thru 4-inch fittings shall have stainless-steel grip ring with bidirectional teeth, PBT separator ring, and EPDM sealing element at each press connection.

.7 There shall be no mixing of manufacturers.

.8 The manufacturer's installation instructions shall be strictly adhered to.

.9 Special attention shall be given to the required two step pressure test.

.1 Initial test for unpressed fitting detection per manufacturer's installation manual

.2 Full pressure test in accordance with code requirements

.10 Approved manufacturer: Viega (no exceptions)

.2 Stainless Press-Connect Fittings

.1 Viega LLC; MegaPress Stainless 316

.2 Viega MegaPress Stainless 316 shall conform to ASTM F3226, ICC LC 1002, IAPMO PS 117, ASME B31.1, B31.3, or B31.9, NSF 61, and NSF 61-G or NSF 372. MegaPress Stainless 316 fittings ½-inch thru 2-inch for use with schedule 5 thru 40 ASTM A 312 stainless steel pipe. MegaPress Stainless 316 fittings 2½-inch thru 4-inch for use with schedule 10 thru 40 ASTM A 312 stainless steel pipe

.3 EPDM elastomeric sealing element shall be peroxide cured for resistance to chloramines

.4 Press Connect fitting shall have Viega Smart Connect technology to detect unpressed fittings shall be integrated into the body of the fitting

.5 1/2 inch thru 2-inch fittings shall have stainless-steel grip ring with bidirectional teeth, 304 stainless separator ring, and EPDM sealing element at each press connection. 2-1/2 inch thru 4 inch shall have stainless-steel grip ring with bidirectional teeth, PBT separator ring, and EPDM sealing element at each press connection

.6 There shall be no mixing of manufacturers.

.7 The manufacturer's installation instructions shall be strictly adhered to.

.8 Special attention shall be given to the required two step pressure test.

.1 Initial test for unpressed fitting detection per manufacturer's installation manual

.2 Full pressure test in accordance with code requirements

.9 Approved manufacturer: Viega (no exceptions)

.3 Source Quality Control:

.1 All fittings in contact with drinking water shall be listed by a third party agency to NSF 61.

.2 Each fitting will be pressure tested by the manufacturer during the manufacturing process.

2.4 **Ball Valves**

.1 BALL VALVES – for isolation and balancing service. 100% lead free, 2" and under, rated 1380kpa, 600WOG, brass body to ASTM C49300 **(Lead free brass)**, full port, PTFE seats, double O-ring packing, TEA plated forged brass C49300 vented solid ball, blow-out proof stem, lever handle.
.1 KITZ 858 screwed ends – **100% lead free**
.2 KITZ 859 solder ends – **100% lead free**

.2 BALL VALVES – for isolation and balancing service. 2" to 10", rated class 125/200WOG, cast iron ASTM A126 class B body, **epoxy coated** to NSF.61, 316 SS stem, solid fused Teflon ball, RPTFE seats, seals, and packing, full port up to 6", lever or gear operated, flanged ends.
.1 AMERICAN VALVE 4000

2.5 **Butterfly Valves**

.1 BUTTERFLY VALVES – for isolation and balancing. 2.5" and over, rated 1380kpa/200WOG, ductile iron lug body, aluminium bronze disc, moulded EPDM liner, stainless steel stem. Valve shall be rated for full dead-end service to 200psi with down stream flange removed, lever or gear operated.
.1 KITZ 6122EL lever operated
.2 KITZ 6122EG gear operated

2.6 **Gate Valves**

.1 100% Lead Free only, 200 W.O.G.

2.7 **Globe Valves**

.1 100% Lead Free only, 200 W.O.G.

2.8 **Swing Check Valves – Back Flow Prevention**

.1 Swing "Y" Pattern
.1 Screwed Ends – Kitz 822T
.2 Solder Ends – Kitz 823T

.2 Swing Check Flanged
.1 Kitz 150 UOAM

.3 Wafer Checks
.1 Single flapper – Moygro W15A-666
Stainless Steel A351 CF8M Body, Class 150, 316 SS Trim

.2 Silent Check – Spring Loaded
Stainless Steel A351 CF8M Body, Class 150, 316 SS Trim, Centre Guided
Mueller 101MHT
Mueller 105MHT (Globe Style)

2.9 **Equal Suppliers** - Kitz, Toyo and Crane

2.10 **Solenoid Valves**

.1 150 psi lead free brass body, threaded
.2 120 volt normally closed valve solenoids
.3 Acceptable material: ASCO

2.11 **Circuit Balancing Valves**

.1 Non-lead Armstong CBV's
.2 On domestic hot water recirculation lines, CBV's shall be 3/8" pipe size.

PART 3 - EXECUTION

3.1 **Installation**

.1 Before building is occupied and portable water systems are placed into service, all piping shall be chlorinated and flushed to ensure all contaminants are removed from the system.

Liquid chlorine shall be introduced into the system, circulated for a period of 24 hours (using temporary piping connections if required).

All cold water, hot water and recirculation piping shall be flushed.

All fixtures are to be operated and the system drained of residual chlorine, then flushed thoroughly with fresh water for a period of four (4) hours. Refer to the requirements in Section 15188 for assistance in developing the methodology for this work.

The General Contractor shall be present for all of the above tests. Submit a final Public Health water test report indicating acceptance of the water test results.

.2 Install shut-off valves in line to each group of fixtures and on main lines as shown. Valves shall be full pipe size with no reducing bushings. Install access doors in walls or ceilings for each isolation valve.

.3 Connect to fixtures and equipment in accordance with manufacturer's instructions unless otherwise indicated.

.4 Install tubing close to building structure to minimize furring, conserve headroom and space. Group piping and run parallel to walls.

.5 Cut square, ream and clean tubing and tube ends, clean recesses of fittings and assemble without binding.

.6 Lay buried tubing in accordance with AWWA class 'B' bedding.

.7 Isolate equipment, fixtures and branches with gate valves.

.8 No piping shall be run on exposed surfaces without the permission of the Architect.

.9 .1 Grooved joints shall be installed in accordance with the manufacturer's latest published installation instructions.
.2 Grooved ends shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove.
.3 Gaskets shall be of an elastomer grade suitable for the intended service, and shall be molded and produced by the coupling manufacturer.
.4 Victaulic's factory trained representative shall provide on-site training for contractor's field personnel in the use of grooving tools and installation of grooved joint products. The representative shall periodically visit the jobsite and review contractor is following best recommended practices in grooved product installation. (A distributor's representative is not considered qualified to conduct the training or jobsite visit(s).)

3.2 **ProPress Execution**

.1 Examination:
.1 The installing contractor shall examine the copper tubing and fittings for defects, sand holes or cracks. There shall be no defects of the tubing or fittings. Any damaged tubing or fittings shall be rejected.
.2 The installing contractor shall insure that sealing elements are properly in place and free from damage. For sizes 2 ½" to 4", installer should insure that the stainless steel grip ring is in place.

.2 Preparation:
.1 Copper tubing shall be cut with a wheeled tubing cutter or approved copper tubing cutting tool. The tubing shall be cut square to permit proper joining with the fittings.
.2 Remove scale, slag, dirt and debris from inside and outside of tubing and fittings before assembly. The tubing end shall be wiped clean and dry. The burrs on the tubing shall be reamed with a deburring or reaming tool.

.3 Installation General Locations:
.1 Plans indicate general location and arrangement of piping systems. Identified locations and arrangements are used to size tubing and calculate friction loss, expansion, pump sizing and other design considerations. Install piping as indicated, except where deviations to layout are approved on coordination drawings.

.4 Installation:
.1 Pressure Rating: Install components having a pressure rating equal to or greater than the system operating pressure.
.2 Install piping free of sags bends and kinks.
.3 Change in Direction: Install fittings for changes in direction and branch connections. Where approved, changes in direction may also be made by bending of Types K and L tube.
.4 Solder Joints: Solder joints shall be made in accordance with ASTM B 828. The temperature of the joint during soldering shall not be raised above the maximum temperature limitation of the flux. Solder joints are not to be made within 3 x the pipe diameter of a pressed connection.
.5 Threaded Joints: Threaded joints shall have pipe joint compound or Teflon tape applied to the male threads only. Tighten joint with a wrench and backup wrench as required.
.6 Flared Joints: Flared copper tube joints shall be made by the appropriate use of cast copper alloy fittings. Flared ends of copper tube shall be of the 45-degree flare type and shall only be made with a flaring tool designed specifically for that purpose.

.7 Press Connections: Copper and copper alloy press connections shall be made in accordance with the manufacturer's installation instructions. The tubing shall be fully inserted into the fitting and the tubing marked at the shoulder of the fitting. The fitting alignment shall be checked against the mark on the tubing to assure the tubing is fully engaged (inserted) in the fitting. The joints shall be pressed using the tool(s) approved by the manufacturer.

.8 Pipe Protection: Provide protection against abrasion where copper tubing is in contact with other building members by wrapping with and approved tape, pipe insulation or otherwise suitable method of isolation.

.9 Penetration Protection: Provide allowance for thermal expansion and contraction of copper tubing passing through a wall, floor, ceiling or partition by wrapping with an approved tape or pipe insulation or by installing through an appropriately sized sleeve. Penetrations for fire resistant rated assemblies shall maintain the rating of the assembly.

.10 Backfill Material: Backfill material shall not include any ashes, cinders, refuse, stones, boulders or other materials which can damage or break the tubing or promote corrosive action in any trench or excavation in which tubing is installed.

.11 Horizontal Support: Install hangers for horizontal piping in accordance with SS-SP-69 or the following maximum spacing and minimum rod sizes.

.12 Vertical Support: Vertical copper tubing shall be supported at each floor.

.13 Galvanic Corrosion: Hangers and supports shall be either copper or vinyl coated to prevent galvanic corrosion between the tubing and the supporting member.

.14 Seismic Restraint: In seismic areas, copper tubing shall be installed to withstand all seismic forces.

.1 Piping Identification: Copper tubing systems shall be identified in accordance with the requirements of ASME A13.1.

END OF SECTION 15142

Drainage and Vent Piping

PART 1 – GENERAL

1.0 **General Instructions**

.1 Read and be governed by Conditions of the Contract and Sections of Division 1.
.2 Comply with Mechanical General Requirements, Section 15010.

1.1 **Reference Standards**

.1 Complete the work in accordance with Ontario Plumbing Code and local authority having jurisdiction except where specified otherwise.

1.2 **Shop Drawings**

.1 Submit shop drawings in accordance with the General Conditions.

1.3 **Maintenance Data**

.1 Provide maintenance data for incorporation into manual specified in the General Conditions.

PART 2 - PRODUCTS

2.1 **Copper Tube and Fittings**

.1 For above ground sanitary and vent piping, type DWV to:
  .1 ASTMB306 for copper tube.
  .2 CSA Bl58.l for cast brass fittings.
  .3 ANSI Bl6.29 for wrought copper fittings.
  .4 Solder: Lead Free – “Water Safe”

2.2 **Cast Iron Piping and Fittings**

.1 For buried sanitary, storm and vent piping, minimum NPS 3, to CSA B70 with heavy bituminous coating.

.2 For above ground sanitary, storm, and vent piping joints for all non-laboratory services.
  .1 Mechanical joints.
    .1 Neoprene or butyl rubber compression gaskets: to ASTM C564.
    .2 SS clamps.

2.3 **Plastic Piping and Fittings**

.1 For buried sanitary, and storm piping to:
  .1 CSA B181.1 for ABS DWV,
  .2 CSA B181.2 for PVC DWV, or
  .3 CSA B182.1.

2.4 **Piping Materials** Ext - Exterior - 1800 from building Buried - Buried Piping
Int - Interior of building A.G. - Above Grade

		Ext.	Int.	Buried	A.G	Mat'l	Code	Description
Sanitary Sewers -	All sizes	X X		X X		Cast iron Ipex PSM	CSA B70 CSA B182-1	Mech. joints. Tarred Gasket ring joints
			X	X		Copper DWV ABS PVC Cast iron	ASTM B42 CSA B181 CSA B182-1 CSA B70	Soldered joints Solvent weld joints Solvent weld joints Mech. joints
	to 65 dia.		X		X	Copper DWV	ASTM B42	Soldered joints
	80 and up		X		X	Cast iron	CSA B70	Mech. joints
Storm Sewers		X		X		Reinf. Concrete	CSA A257	T & G., rubber gaskets
			X	X		IPEX PSM	CSA B182-1	Gasket ring joints
			X	X		Cast iron ABS IPEX PSM	CSA B70 CSA B181 CSA B182-1	Mech. joint Solvent weld joints Solvent weld joints
			X		X	Cast iron	CSA B70	Mech. joints
Venting All sizes			X	X		Type L copper Cast iron ABS	ASTM B88 CSA B70 CSA B181	Seamless Soldered joints Mech. joints Solvent weld joints
			X		X	Copper DWV Cast iron	ASTM B206 CSA B70	Seamless, soldered joints Mech. joints

PART 3 - EXECUTION

3.1 **Installation**

.1 All buried sanitary piping shall be a minimum of NPS 3 in size. Increase smaller drains to minimum NPS 3 at floor line.

.2 Install buried pipe on 150 mm bed of Granular 'A' to line and grade as indicated. Backfill with Granular 'A'. Compact as described in the General Provisions, 15010.

.3 Install piping parallel and close to walls and ceilings to conserve headroom and space, and to grade indicated.

.4 Provide tamper proof roof flashings for all plumbing vents. Flashings shall be Thaler Roofing Specialities Products Inc. Model SJ-24 insulated (insulated 2" high) with Thaler SJ-33 stainless steel vandal proof vent stack cap.

.5 Place Cleanouts (O.B.C. Minimums To Be Met)
- .1 Where shown on Drawings and near bottom of each stack and riser.
- .2 At every 90 degree change of direction for horizontal lines.
- .3 Every 15 m of horizontal run on piping ≤ 100 mm drain size.
- .4 Extend clean out to accessible surface. Do not place cleanouts in carpeted floors; use wall type cleanouts.

.6 Each fixture discharging water into sanitary sewer or building sewer lines shall have a seal trap in connection with a complete venting system to allow gases to pass freely to atmosphere with no pressure or siphon condition on fixture water seal.

.7 Discharge vents 600 mm (24") above roof. Join lines together in fewest practicable number before projecting above roof.

.8 The **drawings indicate the drainage systems only**. The associated Ontario Building Code mandated venting system is **considered to be integral with the required drainage**. Provide a complete fixture system, venting system as per the Ontario Building Code.

.9 Test venting system by filling with water to roof line and hold without leaks for 3 hours.

.10 The General Trades shall provide compaction testing for the bedding and backfill for all buried piping systems.

END OF SECTION 15153

Sewage Pumping Systems

PART 1 - GENERAL

.1 General - Furnish and install a complete pump system consisting of submersible pump, valves, controls, access cover and all other appurtenances to make a complete system.

.2 Components - each system shall consist of: a ductile iron discharge base. All exposed nuts, bolts, and fasteners shall be of 300 series stainless steel.

.3 Lifting Chain - an adequate length of galvanized steel lifting chain shall be supplied for removing the pump. The chain shall be of sufficient length and shall include an adequate number of lifting rings for easy removal.

.4 Pump Model - pump shall be of the centrifugal type equal with an integrally built-in and submersible type motor. Discharge shall be standard 2 1/2" flange.

.5 Operating Conditions - pump shall have a capacity as noted on the drawing schedules.

.6 Motor - pump motor shall be of the totally enclosed, submersible, squirrel cage induction type at 3450 rpm, 60 Hz.

.7 Stator winding shall be of the open type with Class H insulation good for 180 deg. C. (356 deg. F.) maximum operating temperature. Winding housing shall be filled with a clean high dielectric oil that lubricates bearings and seals and transfers heat from windings and rotor to outer shell. Air-filled motors which do not have the superior heat dissipating capabilities of oil-filled motors shall not be considered equal.

.8 Motor shall have two heavy duty ball bearings to support pump shaft and take radial and thrust loads and a sleeve guide bushing directly above the lower seal to take radial load and act as flame path for seal chamber. Ball bearings shall be designed for 50,000 hours B-10 life. Stator shall be heat shrunk into motor housing.

.9 A heat sensor thermostat shall be attached to top end of motor winding and shall be connected in series with the magnetic contactor coil in control box to stop motor if motor winding temperature reaches 221 deg. F. Thermostat to reset automatically when motor cools. Three heat sensors shall be used on three phase motors.

.10 The common motor pump and grinder shaft shall be of #416 stainless steel threaded to take pump impeller.

.11 Seals - motor shall be protected by two mechanical seals mounted in tandem with a seal chamber between the seals. Seal chamber shall be oil filled to lubricate seal face and to transmit heat from shaft to outer shell. Seal face shall be carbon and ceramic and lapped to a flatness of one light band. A double electrode shall be mounted in the seal chamber to detect any water entering the chamber through the lower seal. Water in the chamber shall cause a red light to turn on at the control box. This signal shall not stop motor but shall act as a warning only, indicating service is required.

.12 Pump Impeller - the pump impeller shall be of the recessed Myers type to provide an open unobstructed passage through the volute for the ground solids. Impeller shall be of 85-5-5-5 bronze and shall be threaded onto stainless steel shaft. Enclosed or semi-open pump impellers which might become obstructed during grinding or add excessive radial loads shall not be considered as equal.

.13 Corrosion Protection - all iron castings shall be pre-treated with phosphate and chromic rinse and to be painted before machining and all machined surfaces exposed to the sewage water to be re-painted. All fasteners to be 302 stainless steel.

.14 Bearing End Cap - upper motor bearing cap shall be a separate casting for easy mounting and replacement.

.15 Power Cables - power cord and control cord shall be double sealed. The power and control conductor shall be single strand sealed with epoxy potting compound and then clamped in place with rubber seal bushing to seal outer jacket against leakage and to provide for strain pull. Cords shall withstand a pull of 300 pounds to meet U.L. requirements. Insulation of power and control cords shall be type SOW / SOW-A. Both control and power cords shall have a green carrier ground conductor that attaches to motor frame.

.16 Tests - the pump shall be tested for proper operation at rated power supply valves and for electrical and mechanical integrity prior to shipment.

.17 System Accessories
- .1 Mechanical float switches:
  - .1 High level alarm
  - .2 Pumps on
  - .3 High high level c/w Cabtire cables, length to suit, type SJOW neoprene.
- .2 CB-200 ball check valves.
- .3 2" dia. gate valves.

.18 Base Bid: Myers
Alternate: I.T.T Bell and Gossett, Gould

.19 Controller and Panel
- .1 Controller for pumps, 1 phase, 60 hertz, for float input operation complete as follows:
  - .1 interlocked main disconnect on door, fused
  - .2 magnetic starters
  - .3 EEMAC 1 enclosure
  - .4 panel mounted high level alarm
  - .5 run lights for each pump
  - .6 hand-off-auto switch for each pump
  - .7 reset buttons for pumps
  - .8 alarm silence reset button
- .2 The control shall be equipped with a terminal board relaying alarms, power supply, pump wiring, and float wiring. The terminal board shall be located at the bottom of the panel. All wiring shall be clearly identified and numbered.
- .3 All wiring shall be numbered and identified at both ends to facilitate service and troubleshooting.
- .4 The floats shall be equipped with intrinsically safe, CSA approved relays.
- .5 An alarm circuit shall be provided with the panel. This circuit will energize an alarm buzzer mounted on the panel door.
- .6 Provide alarm contacts for remote annunciation of alarm to the BAS system.

.20 900mm dia. X 2400mm deep, F.R.P. basin with anti-floatation ring, 3/8” bolted checker plate cover in epoxy coated steel.

.21 Tetherless internally weighted float switches. 10 amps, 120V/1Ø, ABS floats, 16.2 AWG black S.J.O.W.

END OF SECTION 15154

Steel Piping, Valves and Fittings – Gas

PART 1 - GENERAL

1.1 Reference Standards

.1 Complete piping system work in accordance with CAN 1-B149.1 for natural gas.

1.2 Product Data

.1 Submit product data in accordance with General Conditions.
.2 Indicate on manufacturer's catalogue literature the following: valves, strainers, etc.

1.3 Maintenance Data

.1 Provide maintenance data for incorporation into maintenance manual specified.

PART 2 - PRODUCTS

2.1 Pipe

.1 Steel pipe: to ASTM A53, Schedule 40 seamless as follows:
  .1 NPS 1/2 to 1 1/2 screwed
  .2 NPS 2 to 10, plain end.

2.2 Jointing Material

.1 Screwed fittings: pulverized lead paste.
.2 Welded fittings: to CSA W 47.1.

2.3 Fittings

.1 Steel pipe fittings, screwed, flanged or welded as follows:
  .1 Malleable iron screwed fittings (banded): Class l50 to ANSI B16.2.
  .2 Steel butt-welding fittings: to ANSI B 16l9.
  .3 Unions, Malleable Iron, brass to iron, ground seat: to ANSI B16.3.
  .4 Bolts and nuts: to ANSI B18.2.1 and ANSI B18.2.2
  .5 Nipples, Schedule 40: to ASTM A53.

2.4 Valves

.1 Code approved, C.G.A. listed Neo brass ball valves Model 3380 150 lb. rating installed at all appliances with unions and dirt legs. Equal: Kitz 58

2.5 Gas Valve Cabinet

.1 16 gauge cold rolled steel cabinet with corbin lock. Piano hinge, glass panel, bevel edge. Prime coat.
.2 250 mm wide x 800 mm high x 150 mm depth.
.3 Acceptable manufacturer:
Wilson & Cousins

2.6 **Emergency Gas Solenoid Valve**

.1 Two (2) way normally closed all bronze construction.
.2 Suitable for 120V and natural gas.
.3 C.G.A. Approved blocking valve
.4 Acceptable material: Asco

2.7 **Gas Regulator**

.1 Reduce pressure from 34.5 kPa (5 psi) to 1.74 kPa (7" WC) capacity as indicated.
.2 Acceptable products:
Singer
Schlumberger
.3 Vent interior relief valve to outdoors with gooseneck and stainless steel insect screen.
.4 Isolate with lubricated plug valve and union connection.

2.8 **Roofing Supports**

.1 450 mm high aluminum pipe support. Refer to Details.
.2 Adjustable leg assembly, base plate, roller assembly.
.3 Acceptable material: Thaler MERS-600A series.

2.9 **Carbon Steel Press-Connect Fittings – 2" IPS and under**

.1 Viega LLC; MegaPress G

.2 Viega MegaPress G shall conform to CSA 6.32a/ ANSI LC4a, ASTM F3226, ASME B31.1, B31.3, or B31.9. MegaPress G fittings ½-inch thru 2-inch for use with schedule 10 thru 40 ASTM A53 carbon steel pipe.

.3 Press Connect fitting shall have Viega Smart Connect technology to detect unpressed fittings shall be integrated into the body of the fitting

.4 1/2 inch thru 2 inch fittings shall have stainless-steel grip ring with bidirectional teeth, 304 stainless separator ring, and HMBR sealing element at each press connection.

.5 There shall be no mixing of manufacturers.

.6 The manufacturer's installation instructions shall be strictly adhered to.

.7 Special attention shall be given to the required two step pressure test.
.1 Initial test for unpressed fitting detection per manufacturer's installation manual
.2 Full pressure test in accordance with code requirements

.8 Approved manufacturer: Viega (no exceptions)

2.10 **Carbon Steel Press-Connect Fittings – 2 ½ "to 4" IPS**

.1 Viega LLC; MegaPress G XL

.2 Viega MegaPress G XL shall conform to CSA 6.32a/ ANSI LC4a, ASTM F3226, ASME B31.1, B31.3, or B31.9. MegaPress G fittings 2 ½-inch thru 4-inch for use with schedule 10 thru 40 ASTM A53 carbon steel pipe.

.3 Contractor must submit an Application for a Variance/Deviation to TSSA for installation of MegaPress G XL 2 ½" to 4"

.4 Press Connect fitting shall have Viega Smart Connect technology to detect unpressed fittings shall be integrated into the body of the fitting

.5 2-1/2 inch thru 4 inch shall have stainless-steel grip ring with bidirectional teeth, graphite separator ring, and HMBR sealing element at each press connection

.6 There shall be no mixing of manufacturers.

.7 The manufacturer's installation instructions shall be strictly adhered to.

.8 Special attention shall be given to the required two step pressure test.
- .1 Initial test for unpressed fitting detection per manufacturer's installation manual
- .2 Full pressure test in accordance with code requirements

.9 Approved manufacturer: Viega (no exceptions)

PART 3 - EXECUTION

3.1 Piping

- .1 Install natural gas piping in accordance with CAN 1-B149.1 latest edition. Provide co-ordination for contract with gas company for the service installation and gas meter locations.
- .2 Connect to equipment in accordance with manufacturer's instructions unless otherwise indicated.
- .3 Slope piping down in direction of flow to low points.
- .4 Use eccentric reducers at pipe size change installed to provide positive drainage.
- .5 Provide clearance for access for maintenance of equipment, valves and fittings.
- .6 All piping systems components shall be approved for use in natural gas systems under CSA/CGA CAN B149.1.
- .7 Ream pipes, clean scale and dirt, inside and out.
- .8 Cap open ends during construction to prevent entry of foreign material.
- .9 Make connection to equipment with unions or flanges or mechanical couplings. Install piping to minimize pipe dismantling for equipment removal.
- .10 All gas piping within drywall bulkheads and chases shall be welded.

3.2 Testing

.1 Test entire gas piping system in accordance with CAN1-B149.1.

3.3 Purging

.1 Purge after pressure test in accordance with CAN 1-B49.1

3.4 Valves

- .1 Install valves with stems upright or horizontal unless approved otherwise.
- .2 Install valves at all branch take-offs to isolate each piece of equipment, and as indicated.

3.5 **Protection**

.1 All piping and tubing shall be run, supported and protected in strict accordance with the Ontario Gas Utilization Code.

3.6 **Painting**

.1 Paint all gas piping with 2 coats of solid bright yellow paint unless otherwise instructed by the Engineer or as directed by the Architect for finish colours to match building finishes.

3.7 **Roof Piping**

.1 Support piping at 3.0 m (10') O.C. as indicated.
.2 Provide support within 450 mm of each piece of equipment.
.3 Provide support at each elbow and fitting.
.4 Provide support at each regular and/or isolating valve.
.5 Seismic supports as specified and indicated.

END OF SECTION 15192

Plumbing Specialties

PART 1 - GENERAL

1.1 Reference Standards

.1 Complete plumbing specialties and accessories work in accordance with Ontario Plumbing Code and local authority having jurisdiction.

1.2 Shop Drawings

.1 Submit shop drawings in accordance with General Conditions.

1.3 Product Data

.1 Submit product data in accordance with General Conditions.

.2 Indicate dimensions, construction details and materials for the following: floor drains, cleanouts, wall hydrants, water hammer arrestors, hose bibs and grease interceptors.

PART 2 - PRODUCTS

2.1 Cleanouts

.1 Finished Cleanouts

	Area	Model	Description
1	Ceramic tile areas	Zurn ZN-1613	square type with nickel bronze top and frame.
2	Carpeted areas	Zurn -ZN-1603	round nickel bronze top and carpet marker.
3	Urinal cleanouts	Zurn ZSS-1666-1-VP	with stainless steel access cover and neoprene plug.
4	Altro areas	Zurn ZN-1602-X-DX	Round nickel bronze top with surface clamp ring.
5	Ancon Cleanouts considered equal.		

.2 Access Covers

	Area	Model	Description
1	Wall access: face or wall type,	Zurn ZI460, Ancon C0480XS.	polished nickel bronze or stainless steel square cover with flush head securing screws, bevelled edge frame complete with anchoring lugs.
2	Cover for tile and vinyl floors	Zurn Z-I400 series, Ancon C0200TS	polished brass with recessed cover for vinyl or tile infill, complete with vandal-proof locking screws
3	Cleanout plugs (cast iron)	Zurn ZI450 series, Ancon	heavy ci male ferrule with brass screws and threaded brass or bronze plug. Sealing-caulked seat or with neoprene gasket.

2.2 **Floor Drains**

	Area	Model	Description
1	Finished Floors - FD-1	Zurn ZN-211BP, 125BP	125 mm round nickel bronze strainer.
2	Shower drains - SD	Zurn-ZN-401JP	100 x 100 nickel bronze strainer
3	Unfinished areas - in waterproof membrane areas	Zurn ZXN -211AP ZXN- 401AP,	nickel bronze strainer.
4	Ceramic tile areas	Zurn ZXN-211-HP	with nickel bronze strainer, 150 x 150 size.
5	Funnel floor drains - FFD	Zurn -ZN-211FP	with cast iron funnel.
6	Altro areas	Zurn ZN-400-R	Surface membrane clamp.
7	ANCON drains considered equal to Zurn.		

2.3 **Miscellaneous**

	Area	Model	Description
1	Encased recessed non-freeze wall hydrant	Zurn, Ancon HY-725-VB.	with NPS 3/4" hose outlet. Removable operating key. Polished bronze finish with vacuum breaker
2	Water Hammer Arrestors	Zurn Zl700 size No. l00, Amtrol Diatrol 536.	Stainless steel construction, bellows type: to Plumbing and Draining Institute Standard PDI-WH201-77.
3	Hose Bibbs - Bronze construction	Crane C5046, Emco, Ancon.	Bronze construction complete with hose thread spout, replaceable composition disc, and chrome plated in finished areas.
4	Trap Seal Primers - Provide for all floor drains bronze automatic trap primer complete with sediment strainer, union and access door for concealed installations.	Zurn, Ancon, Empoco.	Provide NPS 9 mm type K hard copper tubing connection between trap primer valve and floor drain. Prime floor drains in mechanical rooms and as indicated with 22L urinal flush tank.
5	Strainers - 860 kPa gauge		pressure Y type strainer with 20 mesh, bronze or stainless steel removable screen
		Sarco BT, Crane 888 - ½, Armstrong F4SC.	50 mm nominal and under, bronze, and screwed with brass cap.

	Area	Model	Description
		Sarco BF-l50, Crane 989 - 1/1, Armstrong F4Fl, Toyo	65 mm nominal and over, cast iron, flanged with bolted cap
6	Traps		Cast iron body deep seal traps, threaded, hub, or spigot on inlet.
7	Backflow Preventers Install where shown on the drawings, where required by code or where potable water connections are made to mechanical equipment.	BFP-1 Watts series up to 50mm size # 009-QTS-E909-AG BFP-2 Watts Model # 957QT-AG BFP-3 Watts Model # 957NRS-AG	Backflow preventers are to be C.S.A. approved for reduced pressure protection.
8	Pressure Type Vacuum Breaker	Watts Series 800, size 2	Anti-syphon pressure type vacuum breaker. Install on 2" domestic cold water line after water meter.

PART 3 - EXECUTION

3.1 Cleanouts

.1 In addition to those required by code, install at base of all soil and waste stacks, and rainwater leaders and where indicated.
.2 Bring cleanouts to wall or finished floor unless serviceable from below floor.
.3 Building drain cleanout and stack base cleanouts: line size to maximum NPS 4.
.4 Provide carpet markers for cleanouts in carpeted areas.

3.2 Hydrants

.1 Install non-freeze wall hydrant 600 mm above finished grade unless otherwise indicated.

3.3 Water Hammer Arrestors

.1 Install on branch supplies to each fixture or group of fixtures. Size arrestors to manufacturer's recommendations. Install with isolation ball valve.
.2 Install arrestors in accessible locations or provide access doors for direct access.

3.4 Hose Bibbs

.1 Install at bottom of all risers, at low points to drain system, and as indicated.

3.5 Trap Seal Primers

.1 Install on cold water supply to nearest plumbing fixture, in concealed space and in accordance with manufacturer's recommendations.

3.6 **Strainers**

.1 Install in accordance with manufacturer's instructions. Allow sufficient room to remove basket.

3.7 **Backflow Preventers**

.1 Backflow preventers are to be installed in accordance with the manufacturer’s instructions.

3.8 **Tanks**

.1 Install according to piping layout. Pipe drains and blow off connections to nearest drain.

.2 Maintain proper clearance around equipment to permit performance of service maintenance. Check final locations with Consultant if different from that indicated prior to installation.

.3 Should deviations beyond allowable clearances arise, request and follow Consultant’s directive.

.4 Refer to manufacturers installation drawings.

.5 Check that all openings for appurtenances and equipment operating weight conform to shop drawings.

.6 If accessories, ancillaries, are received knocked down, check assembly with Engineer.

END OF SECTION 15401

Plumbing Fixtures and Trim

PART 1 - GENERAL

1.1 Reference Standards

.1 Complete the work in accordance with CAN 3-B45 Series N81 and CSA B125-1975 except where specified otherwise.

1.2 Shop Drawings

.1 Submit shop drawings in accordance with General Conditions.
  .1 Indicate: dimensions and construction details.

1.3 Maintenance Data

.1 Provide maintenance data for incorporation into maintenance manual specified in General Conditions.
.2 Data to include:
  .1 Description of equipment giving manufacturer's name, type, model year, capacity and serial numbers.
  .2 Details of operation, servicing and maintenance.
  .3 Recommended spare parts list.

1.4 Fixtures and Trim

.1 Architectural drawings to govern in determination of number and location of fixtures.
.2 Fixtures to be product of one manufacturer and of same type.
.3 Trim to be product of one manufacturer and of same type.

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PART 2 – PRODUCTS

2.1 Products

.1 Refer to the Fixture Schedule on the Mechanical drawings.

PART 3 - EXECUTION

3.1 Fixture Installation

.1 Connect fixtures complete with supplies and drains, separately trapped, supported level and square. Hot water faucets shall be on left. Fixtures on outside walls to have supplies from floor, other fixtures to be served from wall or as shown.
.2 Provide chrome plated flexible supplies to fixtures with screwdriver stops, reducers and escutcheons.
.3 Fixtures mounted on glazed tile surfaces shall have ground faces to finished surface

3.2 Chair Carriers

.1 Provide for all wall mounted plumbing fixtures, factory manufactured floor mounted arm chair carrier systems. Build into masonry walls.

END OF SECTION 15410

Packaged High Efficiency Rooftop Air Conditioning Units

PART 1 - GENERAL

1.0 **Sections Includes**

.1 Packaged Roof Top Unit
.2 Heat Exchanger
.3 Refrigeration Components
.4 Refrigerant Detection System
.5 Unit Operating Controls
.6 Roof Curb
.7 Electrical Power Connections
.8 Operation And Maintenance Service

1.1 **Related Sections**

.1 Section 15170 - Motors.
.2 Section 15242 - Vibration Isolation.
.3 Section 15290 - Ductwork Insulation.
.4 Section 15885 - Air Cleaning.
.5 Section 15952 - Controls and Instrumentation.
.6 Section 16180 - Equipment Wiring Systems.

1.2 **References**

.1 NFPA 90 A & B - Installation of Air Conditioning and Ventilation Systems and Installation of Warm Air Heating and Air Conditioning Systems.
.2 ANSI/ASHRAE 15 - Safety Code for Mechanical Refrigeration.
.3 AHRI 340/360- 2015 - Commercial and Industrial Unitary Air Conditioning Equipment testing and rating standard.
.4 ANSI/ASHRAE 37 - Testing Unitary Air Conditioning and Heat Pump Equipment.
.5 ANSI/ASHRAE/IESNA 90.1-1999 - Energy Standard for New Buildings Except Low-Rise Residential Buildings.
.6 ANSI Z21.47/UL1995 - Unitary Air Conditioning Standard for safety requirements and testing requirements for commercial warm air furnaces.
.7 AHRI 210/240 - Unitary Air-Conditioning Equipment and Air- Source Heat Pump Equipment.
.8 AHRI 270 - Sound Rating of Outdoor Unitary Equipment.
.9 AHRI 370 - Sound Rating of Large Outdoor Refrigerating and Air Conditioning Equipment.
.10 UL STANDARD 60335-2-40.

1.3 **Submittals**

.1 Submit unit performance data including: capacity, nominal and operating performance.

.2 Submit Mechanical Specifications for unit and accessories describing construction, components and options.

.3 Submit shop drawings indicating overall dimensions as well as installation, operation and services clearances. Indicate lift points and recommendations and center of gravity. Indicate unit shipping, installation and operating weights including dimensions.

.4 Submit data on electrical requirements and connection points. Include recommended wire and fuse sizes or MCA, sequence of operation, safety and start-up instructions.

.5 Shop drawings submitted for approval shall be accompanied by a copy of the purchase agreement between the Contractor and an authorized service representative of the manufacturer for check, test and start up and first year service.

1.4 **Delivery, Storage and Handling**

.1 Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.

.2 Protect units from physical damage. Leave factory shipping covers in place until installation.

1.5 **Warranty**

.1 3 Year Parts Warranty – Whole Unit
.2 1 Year Labor Warranty - Whole unit
.3 5 Year Parts Warranty - Compressor
.4 15 Year Parts Warranty - Heat Exchanger

1.6 **Startup**

.1 Unit start-up and commissioning to be performed by OEM technician.

1.7 **Regulatory Requirements**

.1 Unit shall conform to UL STANDARD 60335-2-40 for construction of packaged air conditioner (with A2L refrigerant) and shall have UL/CSA label affixed to rooftop package.
  .1 In the event the unit is not UL approved, the manufacturer must, at his expense, provide for a field inspection by a UL representative to verify conformance to UL standards. If necessary, contractor shall perform modifications to the unit to comply with UL, as directed by the UL representative, at no additional expense to the Owner.

.2 Conform to Canadian Standards Association (CAN/CSA-2.3/CAN/CSA C22.2 #236) for construction of packaged air conditioner and attach CSA label to unit.
  .1 In the event the unit is not CSA approved, the manufacturer must, at his expense, provide for a field inspection by a CSA representative to verify conformance to CSA standards. If necessary, contractor shall perform modifications to the unit to comply with CSA, as directed by the CSA representative, at no additional expense to the Owner.

1.8 **Operation and Maintenance Data**

.1 Maintenance Data: Provide instructions for installation, maintenance and service.

1.9 **Qualifications**

.1 Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum five years documented experience, who issues complete catalog data on total product.

.2 Startup must be done by trained personnel experienced with rooftop equipment.

.3 Do not operate units for any purpose, temporary or permanent, until ductwork is clean, filters and remote controls are in place, bearings lubricated, and manufacturers' installation instructions have been followed.

PART 2 - PRODUCTS

2.1 **Summary**

.1 The contractor shall furnish and install package rooftop unit(s) as shown and scheduled on the contract documents. The unit(s) shall be installed in accordance with this specification and perform at the specified conditions as scheduled.

.2 Approved manufacturers:
.1 Trane

2.2 **General Unit Description**

.1 Packaged rooftop units cooling, heating capacities, and efficiencies are AHRI Certified within scope of AHRI Standard 210-240 for 6 to 25 Tons and ANSIZ21.47 and 10 CFR Part 431 pertaining to Commercial Warm Air Furnaces (all gas heating units).

.2 Rooftop unit shall be factory assembled, internally wired, fully charged with R-454B, and 100 percent run tested to check cooling operation, fan and blower rotation, and control sequence before leaving the factory.

.3 All units, 3-25 tons shall have field convertible airflow.

.4 Internal wiring must be colored and numbered for simplified identification.

.5 Symbio controls operating range shall be between 0°F and 125°F in cooling mode.

2.3 **Unit Casing**

.1 Cabinet: Galvanized steel with baked enamel finish.

.2 Rooftop unit casing shall be zinc coated, heavy gauge, steel. Casing panels are weather resistant pre-painted metal with galvanized substrate and meet ASTM B117, 672 hour salt spray test.

.3 Cabinet top cover shall be one piece construction or where seams exits, it shall be double-hemmed and gasket-sealed.

.4 Unit shall include hinged maintenance access panels.

.5 Unit's base pan shall have a raised 1 1/8 inch high lip around the supply and return openings for water integrity.

.6 Exposed vertical panels and top covers in the indoor air section are insulated with a cleanable foil-faced, fire-retardant permanent, odorless glass fiber material.

.7 Base pan shall have no penetrations within the perimeter of the curb other than the raised 1 inch high downflow supply/return openings to provide an added water integrity precaution, if the condensate drain backs up.

.8 Base of the unit is insulated with 1/8 inch, foil-faced, closed-cell insulation.

.9 Provide openings either on side of unit or through the base for power, control, condensate, and gas connections.

.10 Unit base shall contain provisions for forklift and/or crane lifting on three sides of unit.

2.4 **Air Filters**

.1 Provide 2-inch MERV 13 filters.

2.5 **Fans and Motors**

.1 Supply fan shall be a direct drive plenum fan with backward-curved fan wheel with an external rotor direct drive variable speed motor.

.2 Supply fan shall be variable speed, capable of single zone VAV operation

.3 Supply fan speed adjustments shall be made using the control user interface or mobile app.

.4 Provide Fan Fail indication. The indication will be registered at the on-board user interface, mobile service app., or building management system.

.5 Motors are thermally protected.

.6 Outdoor fans shall be direct drive, statically and dynamically balanced, draw through in the vertical discharge position. Outdoor motors shall be 3 phase.

.7 Provide shafts constructed of solid hot rolled steel, ground and polished, with key-way, and protectively coated with lubricating oil.

2.6 **Gas Fired Heating Section**

.1 The heating section shall have a progressive tubular heat exchanger with corrosion-resistant stainless steel tubes and burners as standard on all models.

.2 On initial call for heat, the combustion blower shall purge the heat exchanger for 20 seconds before ignition.

.3 Completely assembled and factory installed heating system shall be integral to unit, UL or CSA approved specifically for outdoor applications for use downstream from refrigerant cooling coils. Threaded connection with plug or cap provided.

.4 Heating section shall be factory run tested prior to shipment.

.5 Induced draft combustion blower shall be used to pull the combustion products through the firing tubes. System shall use direct spark ignition (DSI).

.6 After three unsuccessful ignition attempts, entire heating system shall be locked out until manually reset at the thermostat/zone sensor.

.7 Induced draft blower to pull the gas mixture through the burner tubes.

.8 Compact cabinet features a tubular heat exchanger in low, medium and high heat capacities. Corrosion-resistant aluminized steel tubes and burners are standard on all models.

.9 Limit controls: High temperature limit controls will shut off gas flow in the event of excessive temperatures resulting from restricted indoor airflow or loss of indoor airflow.

.10 Units shall be suitable for use with natural gas or propane (field-installed kit).

2.7 **Evaporator Coil**

.1 Evaporators shall have aluminum microchannel that provide optimal heat transfer performance due to flat, streamlined tubes with small ports, and metallurgical tube-to-fin bond.

.2 Provide a removable, reversible, cleanable double sloped drain pan for base of evaporator coil constructed of PVC.

2.8 **Condenser Section**

.1 Provide vertical discharge, direct drive fans with aluminum blades. Fans shall be statically balanced. Motors shall be permanently lubricated, with integral thermal overload protection in a weather tight casing.

.2 Cooling only, gas heat, and electric heat condensers shall be microchannel.

.3 Provide tool-less factory installed corrosion resistant louvered hail/vandalism guards to protect condenser coils from hail or physical damage.

.4 Provide corrosion protected Condenser Coil Option that shall include an all-aluminum Microchannel. Condenser coil protection shall consist of a corrosion resistant coating that shall withstand ASTM B117 Salt spray test for 6000 Hours and ASTM G85 A2 cyclic Acidified salt for test for 2,400 hours. This coating shall be added after coil construction covering all tubes, headers and fin edges, therefore providing optimum protection in more corrosive environments

2.9 **Reheat Section**

.1 Unit shall be provided with a modulating hot gas reheat coil for humidity control

.2 A humidity sensor shall be provided by the manufacturer and installed in ductwork by the installing contractor

2.10 **Refrigeration System**

.1 All units have direct-drive, hermetic, scroll type compressors with centrifugal type oil pumps. Suction gas-cooled motor with voltage utilization range of plus or minus 10 percent of unit nameplate voltage. Internal overloads standard with scroll compressors. Crankcase heaters are standard on all compressors.

.2 Compressors shall have thermostatic temperature motor winding control for protection against excessive temperatures caused by over/under voltage operation or loss of charge. Also provide high and low pressure switches.

.3 Thermal Expansion valves are standard for all models.

.4 All units to have dual compressors.

.5 Units shall have cooling capabilities down to 0 degree F as standard

.6 Three stages of cooling shall be available

2.11 **Outdoor Air Section**

.1 A modulating 0 to 100% economizer with comparative enthalpy control shall be provided.

.2 Barometric relief damper shall be provided.

.3 Provide spring return motor for outside air damper closure during unit shut down or power interruption.

.4 Provide microprocessor unit-mounted control which when used with an electronic zone sensor provides proportional integral room control. This UCM shall perform all unit functions by making all heating, cooling and ventilating decisions through resident software logic.

.5 Provide factory-installed indoor evaporator defrost control to prevent compressor slugging by interrupting compressor operation.

.6 Provide an anti-cycle timing and minimum on/off between stages timing in the microprocessor.

2.12 **System Control**

.1 Multi-Speed Indoor fan System - unit shall be provided with indoor fan system designed for use in applications for meeting the minimum requirements of CA Title 24. This system incorporates a multi-speed fan control to change speed of the fan to 66% of full airflow based off of compressor stages.

2.13 **Operating Controls**

.1 Provide factory-wired roof top units with 24 volt control circuit with control transformers, contactor pressure lugs or terminal block for power wiring. Units shall have single point power connections. Field wiring of zone controls to be NEC Class II.

.2 Provide microprocessor unit-mounted control which when used with an electronic zone sensor provides proportional integral room control. This UCM shall perform all unit functions by making all heating, cooling and ventilating decisions through resident software logic.

.3 Unit control shall be capable of being set up, shall show status and alarms via Bluetooth connection to a mobile device. Mobile app shall report diagnostic information in plain language, failure codes not allowed.

.4 Provide factory-installed indoor evaporator defrost control to prevent compressor slugging by interrupting compressor operation.

.5 Provide an anti-cycle timing and minimum on/off between stages timing in the microprocessor.

.6 Economizer Preferred Cooling: Compressor operation is integrated with economizer cycle to allow mechanical cooling when economizer is not adequate to satisfy zone requirements. Compressors are enabled if space temperature is recovering to cooling setpoint at a rate of less than 0.2 degrees per minute. Compressor low ambient lockout overrides this function.

.7 Unit shall be provided with a programmable zone sensor.

2.14 **Refrigerant Leak Detection System**

.1 Unit shall be furnished by the manufacturer with a factory installed refrigerant leak detection system (RLDS) compliant to UL 60335-2-40.

2.15 **Building Automation System**

.1 Connection to Building Automation System to be furnished by rooftop unit manufacturer. Through this interface, all Building Automation functions (specified in Building Automation Section) shall be performed. See Building Automation and Automatic Temperature Control System Specifications. The only field connection to Building Automation System shall be a single communication link.

.2 Control Functions: Include unit scheduling, occupied/unoccupied mode, start-up and coast-down modes, nighttime free-cool purge mode, demand limiting, night setback, discharge air set point adjustment, timed override and alarm shutdown.

.3 Factory installed BACnet card shall be standard on all units.

2.16 **Electrical System**

.1 An electrical service entrance shall be provided allowing electrical access for both control and main power connections inside the curb and through the base of the unit. Provide field installation of liquid-tight conduit.

.2 Unit shall have 5kA SCCR rating from the factory.

.3 Provide a factory installed 3-pole, molded case, disconnect switch with provisions for through the base electrical connection.

.4 The unit shall be equipped with a phase monitor in the control box. The phase monitor shall protect against phase loss, imbalance and reversal of the line voltage.

.5 Unit shall include a factory installed, 20A, unpowered convenience outlet. Outlet is to be powered from the line side of the disconnect or circuit breaker such that power is available when the circuit breaker is open. Outlet shall be GFCI type.

2.17 **Roof Curb**

.1 Contractor shall provide 24 inch high factory supplied roof curbs, 16 gauge perimeter made of zinc coated steel with supply and return air gasketing and wood nailer strips. Ship knocked down and provided with instructions for easy assembly.

.2 Curb shall be manufactured in accordance with the National Roofing Contractors Association guidelines.

2.18 **Standard of Acceptance**

.1 Base Bid: Trane

.2 Acceptable Alternate: Daikin

PART 3 - EXECUTION

3.1 **Examination**

.1 Contractor shall verify that roof is ready to receive work and opening dimensions are as Indicated on shop drawings.

.2 Contractor shall verify that proper power supply is available.

3.2 **Manufacturer's Field Services**

.1 The manufacturer shall furnish an alternative price for:

- .1 Extended compressor warranty for one years.
- .2 Extended heat exchanger warranty for five years.
- .3 Extended parts and labor by manufacturer to be provided to the owner for a period of one years.

.2 The contractor shall furnish manufacturer complete submittal wiring diagrams of the package unit as applicable for field maintenance and service.

3.3 **Installation**

.1 Install as per manufacturer's instructions on roof curbs provided by manufacturer. Refer to detail on the architectural drawings for concrete work by the general trades within the roof curbs. Install duct sleeves as required.

.2 Mark out location and set all roof curbs, general trades will flash in.

.3 Thermostats shall be mounted at 1650 AFF.

.4 All control wiring shall be by Division 15900 including mounting of thermostats. Turn over all controls to Division 15900 for installation.

.5 The manufacturer shall provide start-up and commissioning of the roof top units by trained personnel. The manufacturer shall submit to the Engineer, written notice that the units have been completely checked and approved in working order as specified.

.6 Install roof mounting curb level.

.7 The contractor shall furnish manufacturer's complete submittal wiring diagrams of the package unit as applicable for field maintenance and service.

.8 Contractor to provide field-installed unit-mounted disconnect switch.

.9 Contractor to provide field installed condensate P-trap for all units.

.10 Mechanical Contractor shall supply and install two layers of 5/8" cement board panelling and 6" of Roxul insulation within the roof-curb rail assembly beneath the compressor section and above the roof-deck. The insulation shall be installed between the upper and lower drywall panels.

END OF SECTION 15732

Vantage Infra-Red Heaters

PART 1 - GENERAL

1.1 General Requirements

.1 Conform to the requirements of the General Conditions.

1.2 Description

.1 Provide the low intensity gas fired radiant systems as indicated on the drawings and as specified herein.

1.3 Quality Assurance

.1 Systems to be installed in accordance with the Ontario Gas Utilization code.
.2 Equipment to be certified by Canadian Gas Association for vented infra-red heaters.

1.4 Submittals

.1 Shop drawings are required for:
  .1 Burners
  .2 Controls
  .3 Blowers

.2 Method of submittal is specified in the General Conditions.

1.5 Codes and Standards

1. American National Standard / CSA Standard Gas-Fired Low Intensity Infrared Heaters: Construct and certify gas fired radiant heaters in accordance with latest edition ANSI Z83.20 / CSA 2.34 "Gas-Fired Low-Intensity Infrared Heaters" including all current supplements.

2. Installation Compliance: Install gas fired radiant heaters in accordance with Z223.1 National Fuel Gas Code (latest edition).

3. CSA Compliance: Provide CSA Seal affixed to each burner name plate and provide CSA Certification of heater design as vented or unvented infrared heater for indoor installation.

4. National Standard Gas Piping Compliance: Install and connect gas piping to gas fired radiant heaters in accordance with Z223.1 National Fuel Gas Code (latest edition).

5. National Electrical Code Compliance: Install and connect electrical wiring to gas fired radiant heaters in accordance with NFPA 70 "National Electrical Code" (latest edition).

PART 2 – PRODUCTS

2.1 Infra-Red Heater

.1 Burner Box
  .1 Natural Gas model, enclosed and sealed box design with silicone gasketed doors and internally mounted blower, nickel plated steel burner cup, outside air adapter, hot surface ignition, four-try ignition, door interlock safety switch, all components easily

accessed, durable spot welded construction, mica flame observation window, balanced air rotor, gas and electric controls are separated from the combustion air stream, and CSA approved. Burner box paint shall be epoxy-polyester powder coat for corrosion resistance. Stainless steel flexible gas line and high-pressure gas cock assembly included.

.2 Heater shall be equipped with permanently lubricated motor with thermal overload protection enclosed inside burner compartment.

.2 Burner Controls

.1 Factory Wired: All burners shall be factory wired for 120 Vac operation, Hot Surface Ignition and Honeywell® SmartValve control.

.2 Fail-Safe Controls: To assure a high degree of fail-safe operation, the design shall include an air proving safety pressure switch to verify blower operation before gas valve opens.

.3 Ignition Controls: All units shall be equipped with a fully automatic Hot Surface Ignition Module (HSI). The ignition module shall have a prepurge and timed trial for ignition with multiple ignition trial before lockout occurs. In addition, the ignition module shall be capable of a minimum of 4 trials for ignition to provide maximum reliability. Burner shall have automatic reset from lockout.

.3 Reflectors

.1 Provide aluminum, or other highly radiant reflective material reflectors, installed to provide continuous coverage over all straight lengths of heat exchanger. In order to maximize radiant output and minimize convection losses, reflectors are to extend below the bottom of the heat exchanger pipe.

.1 Cover Elbow Fittings: Provide reflector joint pieces over heat exchanger elbows so reflector covers heat exchanger continuously.

.2 End Cap Fittings: All reflectors at terminant of the heat exchanger pipe and any elbows shall have end caps to prevent convective heat from escaping.

.3 Side Reflectors: System to have perimeter side extension reflector in certain areas of layout as shown on plan where specified. Side reflectors permanently attach to side to top reflector and are secured to the pipe by three side reflector supports and two "Z" clips for each 8 ft. section of side reflector. To prevent convection losses, tilting of reflectors will not be acceptable.

.4 Outside Air

.1 Provide fresh outside air to supply each burner for the support of combustion air.

.5 Thermostats

.1 Provide where indicated, line voltage or low voltage type connected to radiant heater. Mount thermostat 5 ft. –6 ft. above finish floor or otherwise as noted on the drawing.

.1 All thermostats shall be numbered instead of marked in degrees and shall not have thermometers.

.6 Radiant Piping - Heat Exchanger

.1 Radiant Tube shall be new 4 in. O.D. (Heat Treated Aluminized) (Hot-Rolled) steel tube X 16 gauge wall with an emissivity factor of 0.80 or greater.

.2 Burner Tube: shall be ALUMITHERM® steel (aluminized steel/titanium alloy) tube for the first 10 ft. of each radiant heater.

.3 Fittings for radiant tube shall be as described in the installation manual.

.4 Hanging Materials: All system's tube must be supported in accordance with acceptable practices, local codes, seismic requirements, and applicable standards and as shown on plans. Heat exchanger tube shall pitch down at least 1/2 inch in 20 ft. on radiant tube, away from burner box.

2.2 **Installation Of Gas Fired Radiant Heaters**

.1 General
Install gas fired radiant heaters as indicated, in accordance with manufacturer's installation instructions and in compliance with applicable codes and approvals. Allow adequate space for servicing or removal of the unit without disturbing other piping or equipment.

.2 Support
Suspend heat exchanger, burner, gas piping, conduit, and reflectors from building substrate as indicated, or if not indicated, in manner to provide durable and safe installation; and in accordance with manufacturer's installation instructions. Mounting height as per the drawings.

.3 Clearance to Combustibles
Do not exceed clearance to combustibles outlined and printed on burner nameplate, and in manufacturer's product data. Measure clearance distance from surface of heat exchanger or as indicated by approval agency's listing.

.4 Venting
Install vent piping as indicated. Terminate where indicated on the drawings with a vent terminal assembly as supplied by the manufacturer.

.5 Gas Piping
Install gas piping as indicated and in accordance with Z233.1 National Fuel Gas Code installation codes (latest edition).

.1 Required Gas Supply Inlet Pressures:

Nat. Gas Units	Req'd Min. Gas Pressure		Max. Gas Pressure
	40,000-150,000 Btu/Hr	4.6" W.C	14"W.C.
	175,000 Btu/Hr	5.0" W.C	14"W.C.

.2 Local Codes: Gas supply piping must meet local requirements and be sized in accordance with BTU demand, available pressure and total length of supply line required for the installation. Connection from supply line to burner unit must be made in accordance with installation instructions. Gas shut-off cock, as supplied with unit, and controls in unit must not be subjected to more than 1/2 lb. or 14 in. W.C. pressure. If high pressure testing of gas supply line is required, this test must be made with a plug in the 1/2 in. branch line to each burner. Never test the gas line with the shut-off cock installed or with the burner unit connected.

.3 Drip Legs: Provide drip legs at all gas risers.

.6 Electrical Wiring
Install electrical wiring as indicated. Connect power wiring to burners and control wiring between burners and thermostats in accordance with manufacturer's wiring diagrams.

1. Provide outlet box with 3-wire grounded 120 Vac receptacle (NEMA Type 5-15R) within 12 in. of each burner.

.7 Thermostats
Mount thermostats 5 ft. - 6 ft. above finished floor, if not otherwise indicated. Moisture resistant thermostats to be used in vehicle wash bay areas. Thermostat wiring must follow local codes.

.8 Thermostat Guards
All thermostats to be covered with a locking thermostat cover.

2.3 **Field Quality Control**

.1 Start-Up
Start-up, test, and adjust gas fired radiant heaters in accordance with manufacturer's start-up instructions, and Utility Company's requirements. Check and calibrate controls, adjust burners if applicable according to manufacturer's instructions for maximum efficiency.

2.4 **Closeout Procedures**

.1 Training
Provide services of manufacturer's technical representative to instruct operating personnel in operation and maintenance of gas fired radiant heaters.
1. Schedule instruction with operating building owner, provide at least 7 days notice.

2.5 **Warranty**

.1 Provide written warranty, by manufacturer, agreeing to replace/repair, within warranty period, components of gas fired radiant systems furnished by manufacturer, which are defective in either material or workmanship, provided manufacturer's instructions for handling, installing, protecting, and maintaining units have been adhered to during warranty periods follows:
.1 Three (3) year warranty on the burner system and on the tubing from date of final acceptance of the infrared heaters.
.2 Three (3) from date of final acceptance of all other components including electrical.

2.6 **Quality Assurance**

.1 Approved Manufacturers
Infrared heating system shall be VANTAGE® II radiant heaters as manufactured by Roberts-Gordon Inc., Buffalo, New York.

.2 Manufacturer's Qualifications
Firms regularly engaged in manufacture of gas fired radiant systems with characteristics, sizes, and capacities required, whose products have been in satisfactory use in similar service for not less than 15 years.

.3 Alternate Manufacturers
1. Other low intensity radiant heaters of equal or greater thermal efficiency and with the same or lower burner firing rate capacity, and with the radiant distribution pattern shown on drawing may be acceptable provided they meet the intent of these specifications and prior approval in writing is obtained from the engineer at least twenty (20) days before the bid date. If such systems are approved, the contractor assumes responsibility for the design, performance and expense of same. The redesigned system, gas piping, and electric wiring shall be done by a registered mechanical engineer. Shop drawings of the entire new system shall be provided by this contractor. The contractor should state the amount to be credited to the owner due to this substitution.

2. Where approved substitutes are used, the contractor assumes all responsibility for physical dimensions and all other resulting changes. This responsibility extends to cover all extra work as necessitated by other trades as a result of the substitutions.

3. The engineer reserves the right to require the contractor to remove and replace any material or equipment which does not meet specifications or does not have any prior approval as a substitute item. Work shall be completed immediately without cost or inconvenience to the owner.

2.7 **Performance Schedule**

.1 Equipment
Provide gas fired infrared radiant heaters to deliver the performance capacities indicated on the drawings.

PART 8 - EXECUTION

3.1 **Installation**

.1 The installation of the system shall be supervised by the manufacturer's staff and shall be started off by same. A start-up report shall be issued by the manufacturer to the Engineer for review.

.2 Obtain manufacturer's installation instructions regarding clearances, supports, etc.

.3 The exact heat input of each system to be adjusted so that condensation of flue gases does not occur.

.4 Hang heaters from turnbuckles and threaded rod with safety chains. Refer to the drawing details.

.5 Install all exhausts and combination air through roof as shown to meet manufacturer's recommendations. Provide roof flashings.

.6 Low voltage (24 volt) control wiring for the infra-red heating and control systems will be completed by Division 15900. Refer to the drawings for details and locations.

END OF SECTION 15769

Rooftop Make-Up Air Units

PART 1 - GENERAL

1.1 Shop Drawings

.1 Submit shop drawings in accordance with General Conditions.

1.2 Maintenance Data

.1 Provide maintenance data for heating and ventilating units for incorporation into maintenance manual.

.2 Provide brief description of systems and include same at beginning of manual, properly indexed, with details of function, operation, control and service for each piece of apparatus.

.3 Manufacturer's instructions shall govern installation and unless otherwise noted, operation, maintenance and service of items. Include names and addressed of spare part suppliers.

.4 Data shall constitute more than general advertising information. Include the following:

.1 Provide for each piece of equipment and system manufacturer's name, type, year, serial number, number of units, capacity and identification of related systems with wiring diagrams and details of optional equipment.

PART 2 - PRODUCTS

2.1 General

.1 Air Handling Units shall be built to the level of quality as herein specified and to the description of the Air Handling Unit Schedule.

.2 Unless stated otherwise, air-handling units are to be shipped to the job in one piece, factory assembled. Modular units assembled to achieve a close approximation to the intent of this specification will not be considered equal. All equipment shall where specified and applicable, be pre-wired and factory certified by an approved testing agency such as ETL, UL, or CSA for the destination.

.3 All electrical circuits shall undergo a dielectric strength test and shall be factory tested and checked as to proper function.

.4 The air handling units and major components shall be products of manufacturers regularly engaged in the production of such equipment and with a minimum of sixty (60) continuous years of proven production experience.

.5 Air Handling Units / Air Make-up Units shall be manufactured by Engineered Air. No approved equals or alternates.

.6 Custom packaged cooling units must conform to regulations set out in the Canadian Energy Efficiency Act for large air conditioners as set out in the Energy Efficiency Regulations of the Ontario Electricity Act.

.7 Packaged units shall be third-party energy verified and tested to CSA Standard C746-17 and must bear an EEV (energy efficiency verification) label provided by CSA. Field approval will not be accepted as equal or alternate to third-party verification.

2.2 **Unit Construction**

.1 Unit casing shall be of minimum 18 ga (1.3 mm) satin coat galvanized sheet metal. Surfaces on indoor and outdoor units shall be cleaned with a degreasing solvent to remove oil and metal oxides. Outdoor units shall be primed with a two-part acid based etching primer. All unprotected metal and welds shall be factory coated.

.2 All exposed surfaces shall have a finish coat of DTM polyurethane (single coat) to all exposed surfaces with an ASTM B117-11 salt spray rating of 1,500 hrs.

.3 All walls, roofs, and floors shall be of formed construction with at least two breaks at each joint. Joints shall be secured by sheet metal screws or pop rivets. Wall and floor joints shall be broken in and on all outdoor units roof joints broken out (exposed) for rigidity. All joints shall be caulked with a water resistant sealant.

.4 Provide a 22 ga (.85 mm) solid satin coat galvanized metal liner over insulated areas throughout the unit air stream.

.5 Units shall be provided with access doors to the following components: fans, motors, filters, dampers and operators, access plenums, humidifiers/wet cells, electrical control panels and burner/compressor compartments. Access doors shall be as large as practical for easy access. Screwed wall panel access will not be acceptable for the above listed components.

.6 Units shall be provided with hinged access doors with e-profile gasket, fully lined, and a minimum of two lever handles.

.7 All units shall be internally insulated with 2" (51 mm) thick, 1 1/2 lb./ ft.^{3} (24 kg/m^3) density coated insulation.

.8 The coated insulation shall be secured to metal panels with a fire-retardant adhesive and welded steel pins at 18" (450 mm) o/c. All longitudinal insulation joints and butt ends shall be covered by a sheet metal break to prevent deterioration of exposed edges. Drain pans and all floor areas shall be insulated on the underside.

.9 Cooling coil drain pans shall be fabricated of 304 stainless steel and are an integral part of the floor paneling, a minimum of 2" (51 mm) deep with welded corners. Drain pans shall extend a minimum of 6" (152 mm) downstream of coil face and be provided with a 1 ½" (38 mm) S.S. M.P.T. drain connection. All cooling coil drain pans shall have a fast pan and be sloped and pitched such that there is no standing water. Intermediate drain pans shall be provided where required for effective moisture removal.

.10 Outdoor units shall be weatherproofed and equipped for installation outdoors. Units shall be fabricated to prevent the infiltration of rain and snow: louvers or hoods shall be provided on air intakes and exhaust openings. Rain gutters or diverters shall be installed over all access doors. All joints shall be caulked with a water resistant sealant. The roof joints shall be turned up 2" (51 mm) with three break interlocking design and the outer wall panels shall extend a minimum of ¼" (6 mm) below the floor panel.

.11 Units to be provided with structural steel base channel only. Formed channel is not equivalent and will not be considered equal or alternate.

.12 Provide full perimeter roof mounting curb of heavy gauge sheet metal at a minimum of 18” (458 mm) high complete with wood nailer, neoprene sealing strip, and fully welded "Z" bar with 1" (25 mm) upturn on inner perimeter to provide a complete seal against the elements. External insulation and flashing of the roof-mounting curb shall be provided by the roofing subcontractor.

2.3 **Fans**

.1 Centrifugal fans shall be rated in accordance with AMCA Standard Test Code - Bulletin 210. Fan manufacturer shall be a member of AMCA. All fans and fan assemblies shall be dynamically balanced during factory test run. Fan shafts shall be selected for stable operation at least 20% below the first critical RPM. Fan shafts shall be provided with a rust inhibiting coating.

.2 Single low pressure forward curved fans of 18" (457 mm) diameter or smaller shall be equipped with greaseable pillow block bearings supported on a rigid structural steel frame.

.3 Fan motor sheaves shall be adjustable with motors 7 1/2 HP (5.6 kW) and smaller. On fans with larger motors, fixed drives shall be provided. All drives shall be provided with a rust inhibiting coating. The air balancer shall provide for drive changes (if required) during the air balance procedure.

.4 Direct-drive plug fans, or plenum fans are not permitted.

.5 Fan and motor sheaves shall be factory installed, fan balanced and tested prior to shipment.

.6 Variable Frequency Drives

.1 A pulse width modulated (PWM) inverter designed for use with both asynchronous and permanent magnet motors shall be provided.

.2 IEEE 519-2014 is an electrical system standard for harmonic mitigation and not intended to be applied to an individual piece of equipment. Drives are only one of many sources of harmonics; thus, verification of system IEEE 519-2014 compliance is beyond the manufacturer’s scope. The EOR (Engineer of Record) is responsible for conducting an electrical system study and verifying the drive schedule has specified proper harmonic mitigation for the drives.

.3 Drives shall be UL labeled as a complete assembly.

.4 The base drive shall be SEMI-F47 certified. The drive must tolerate voltage sags to 50% for up to 0.2 seconds, sags to 70% for up to 0.5 seconds, and sags to 80% for up to one second.

.5 The drive shall provide full rated output from a line of +10% to -15% of nominal voltage. The drive shall continue to operate without faulting from a line of +25% to -35% of nominal voltage.

.6 Multiple home view screens shall be capable of displaying up to 21 points of information.

.7 The control panel shall display the following items on a single screen: output frequency, output current, reference signal, drive name, time, and operating mode (Hand vs Auto, Run vs Stop). Bi-color (red/green) status LED shall be included. Drive (equipment) name shall be customizable.

.8 There shall be a built-in time clock. The clock shall have a battery backup with 10 years minimum life span. Daylight savings time shall be selectable.

.9 The drive shall automatically backup parameters to its control panel. In addition to the automatic backup, the drive shall allow two additional unique backup parameter sets to be stored. Backup files shall include a time and date stamp. In the event of a drive failure, the control panel of the original drive can be installed on the replacement drive, and parameters from that control panel can be downloaded into the replacement drive.

.10 The control panel shall be removable capable of remote mounting.

.11 The control panel shall have the ability to store screen shots which are downloadable via USB.

.12 All drives shall have the following hardware features/characteristics as standard:

.1 Two (2) programmable analog inputs shall accept current or voltage signals. Current or voltage selection configured via the VFD control panel. Drives that require access to internal components to perform these functions are not acceptable.

.2 Two (2) programmable analog outputs. At least one of the analog outputs shall be adjustable for current or voltage signal configured via the VFD control panel. Drives that require access to internal components to perform these functions are not acceptable.

.3 Six (6) programmable digital inputs. All digital inputs shall be programmable to support both active high and active low logic and shall include adjustable on/off time delays. The digital input shall be capable of accepting both 24 VDC and 24 VAC.

.4 Three (3) programmable form-C relay outputs. The relay outputs shall include programmable on/off time delays. The relays shall be rated for a continuous current rating of 2 amps and maximum switching voltage of 250 VAC / 30 VDC. Open collector and Form-A relays are not acceptable. Drives that have less than (3) Form-C relay outputs shall provide an option card to provide additional relay outputs.

.5 Drive terminal blocks shall be color coded for easy identification of function.

.6 The drive shall include an isolated USB port for interface between the drive and a laptop. A non-isolated USB port is not acceptable.

.7 An auxiliary power supply rated at 24 VDC, 250 mA shall be included.

.8 At a minimum, the drives shall have internal impedance equivalent to 5% to reduce the harmonics to the power line. 5% impedance may be from dual (positive and negative DC link) chokes or AC line reactor. Drives with only one DC link choke shall add an AC line choke integral to the drive enclosure.

.9 The drive shall have cooling fans that are designed for field replacement. The primary cooling fan shall operate only when required and be variable speed for increased longevity and lower noise levels. Drives whose primary cooling fans are not variable speed shall include a spare cooling fan.

.10 The overload rating of the drive shall be 110% of its normal duty current rating for 1 minute every 10 minutes, 130% overload for 2 seconds every minute. The minimum current rating shall meet or exceed the values in the NEC/UL table 430.250 for 4-pole motors.

.11 The input current rating of the drive shall not be greater than the output current rating.

.12 Circuit boards shall be coated per IEC 60721-3-3, chemical gasses class 3C2 and solid particles class 3S2.

.13 Earth (ground) fault detection shall function in both modulating (running) and non-modulating modes.

.14 Coordinated AC transient surge protection system consisting of 4 MOVs (phase-to-phase and phase-to-ground), a capacitor clamp, and internal chokes. The MOVs shall comply with UL 1449 4th edition. Drives that do not include coordinated AC transient surge protection shall include an external TVSS/SPD (Transient Voltage Surge Suppressor/Surge Protection Device).

.15 The drive shall include a robust DC bus to provide short term power-loss ride through. The DC bus Joule to drive kVA ratio shall be 4.5 J/kVA or higher. An inertia-based ride through function should help maintain the DC bus voltage during power loss events. Drives with control power ride through only are not acceptable.

.13 All drives shall have the following software features as standard:

.1 A Fault Logger that stores the last 16 faults in non-volatile memory. The most recent 5 faults save at least 9 data points including but not limited to: Time/date, frequency, DC bus voltage, motor current, DI status, temperature, and status words. The date and time of each fault and fault reset attempt shall be stored in the Fault Logger.

.2 An Event Logger that stores the last 16 warnings or events that occurred in non-volatile memory. Events shall include, but not limited to: warning messages, checksum mismatch, run permissive open, start interlock open, and automatic reset of a fault. The date and time of each event's start and completion points shall be stored in the Event Logger.

.3 Programmable start method. Start method shall be selectable based on the application: flying-start, normal-start, and brake-on-start.

.4 Programmable loss-of-load (broken belt / coupling) indication. Indication shall be selectable as a control panel warning, relay output, or over network communications. This function to include a programmable time delay to eliminate false loss-of-load indications.

.5 Motor heating function to prevent condensation build up in the motor. Motor heating adjustment, via parameter, shall be in "Watts." Heating functions based only on "percent current" are not acceptable.

.6 Advanced power metering abilities shall be included in the drive. Drives without these data points must include a separate power meter with each drive.

.1 Instantaneous output power (kW)

.2 Total power broken down by kWh, MWh, and GWh units of measurement. Power meters that only display kWh and roll over or "max out" once the maximum kWh value is reached are not acceptable. There shall be resettable and non-resettable total power meters within the drive.

.3 Time based kWh metering for: current hour, previous hour, current day, and previous day.

.4 Energy saving calculation shall be included that shows the energy and dollars saved by the drive.

.7 The drive shall include a motor flux optimization circuit that will automatically reduce applied motor voltage to the motor to optimize energy consumption and reduce audible motor noise.

.8 External fault circuit – three separate external fault inputs shall be provided. This circuit shall have the same features and functionality as the start interlock circuit except it shall require a manual reset before the drive is allowed to operate the motor.

.9 The drive shall include a switching frequency control circuit that reduces the switching frequency based on actual drive temperature and allows higher switching frequency settings without derating the drive. It shall be possible to set a minimum and a target switching frequency.

.10 The ability to automatically restart after an over-current, over-voltage, under-voltage, external fault, or loss of input signal protective trip. The number of restart attempts, trial time, and time between attempts shall be programmable. Each of these faults may have automatic restart individually disabled via a parameter selection.

.11 Three (3) programmable critical frequency lockout ranges to prevent the drive from operating the load continuously at an unstable speed/load.

.12 Seven (7) programmable preset frequencies/speeds.

.13 Two independently adjustable accel and decel ramps with 1 – 1800 seconds adjustable time ramps.

.14 At least 4 parameter user sets that can be saved to the permanent memory and recalled using a digital input, timed function, or supervision function.

.15 Drive shall be compatible with an accessory that allows the control board to be powered from an external 24 VDC/VAC source allowing the drive control to remain powered by a UPS during an extended power outage.

.16 The drive shall include a fireman's override mode. Upon receipt of a contact closure from the Fire Alarm Life Safety system, the drive shall operate in a dedicated override mode distinct and separate from the drive's normal operation mode. The following features will be available in the drive override function:

.1 The override mode shall be secured by password to prevent changes once programmed.

.2 The drive shall ignore external inputs and commands not defined as part of the override function.

.3 Override operation mode shall be selectable between: single frequency, multiple fixed frequencies, follow an analog input signal, PID control, or come to a forced stop.

.4 High priority safeties shall stop the drive and lower priority safeties shall be ignored in override mode.

.5 Drive faults shall be defined in critical and low priority groups. Critical faults shall stop the drive. Low priority faults shall be reset. Reset trials and timing shall be programmable.

.6 The drive shall be configurable to receive from 1 to 3 discrete digital input signals and operate at up to three discrete speeds.

.14 Security Features

.1 The drive shall include password protection against parameter changes.

.2 There shall be multiple levels of password protection including: end user, service, advanced, and override.

.3 The drive shall support a customer generated unique password between 0 and 99,999,999.

.4 The drive shall log an event whenever the drive password has been entered.

.5 The drive shall provide a security selection that prevents any “back door” entry. This selection even prevents the drive manufacturer from being able to bypass the security of that drive.

.6 A security level shall be available that prevents the drive from being flashed with new firmware.

.15 Network Communications

.1 The drive shall have an EIA-485 port with removable terminal blocks.

.2 Provide communication cards for BACnet/IP. The use of third party gateways are not acceptable.

.3 The drive shall have the ability to communicate via two protocols at the same time, one onboard protocol, and one option card based protocol. Once installed, the drive shall automatically recognize any optional communication cards without the need for additional programming.

.4 The drive shall not require a power cycle after communication parameters have been updated.

.5 The embedded BACnet connection shall be a MS/TP interface. The drive shall be BTL listed to revision 14 or later. Use of non-BTL listed drives are not acceptable.

.6 The drive shall be classified as an Applications Specific Controller (B-ASC). The interface shall support all BIBBs defined by the BACnet standard profile for a B-ASC including, but not limited to:

.1 Data sharing: read property Multiple-B, write property Multiple-B, COV-B

.2 Device management: Time synchronization-B

.3 Object type support: MSV, Loop

.7 The drive’s relay output status, digital input status, analog input/output values, hand-auto status, warning, and fault information shall be capable of being monitored over the network. The drive’s start/stop command, speed reference command, relay outputs, and analog outputs shall be capable of being controlled over the network. Remote drive fault reset shall be possible.

.16 Unit mounted manual VFD bypass switch shall lock out VFD. Fan shall run on maximum set volume. Bypass switch and all interlock contacts are factory mounted and pre-wired.

.17 Load reactors shall be provided for all 460 and 575 volt applications.

.18 Drive(s) shall be factory supplied and installed.

.19 Minimum air flow rate of 50% CFM.

.7 Motor, fan bearings, and drive sheaves assembly shall be located inside the fan plenum to minimize bearing wear and to allow for internal vibration isolation of the fan-motor assembly where required. Motor mounting shall be adjustable to allow for variations in belt tension.

.8 Fan-motor assemblies shall be provided with vibration isolators. Isolators shall be bolted to steel channel welded to unit floor that is welded to the structural frame of the unit. Use of separate bumpers or snubbers are not acceptable. Fans shall be attached to the discharge panel by a polyvinyl chloride coated polyester woven fabric with a sealed double locking fabric to metal connection.

.9 All forward curve fans 18” (457mm) in diameter and larger and all backward inclined fans shall incorporate vertical spring isolators with leveling bolts and bridge bearing waffled pads with minimum 1" (25 mm) static deflection designed to achieve high isolation efficiency.

.10 Provide single extended grease line from far side to access side bearing.

.11 Fan motors shall be ODP (open drip proof) high efficiency.

2.4 **Coils**

.1 Coils shall be as manufactured by Engineered Air and constructed of copper tube, aluminum fin. Microchannel or aluminum coils are not acceptable. Third-party, purchased coils are not acceptable.

.2 Fins constructed of aluminum or copper shall be corrugated for maximum heat transfer and shall be mechanically bonded to the tubes by mechanical expansion of the tubes. The coils shall have a galvanized steel casing. All hydronic and DX refrigerant coils shall be factory tested with air at 300 psig (2068 kPa) while immersed in an illuminated water tank. All condenser refrigerant coils shall be factory tested with air at 650 psig (4482 kPa) while immersed in an illuminated water tank.

.3 Headers shall be outside the air-handling unit for maximum serviceability except for blow through applications where headers are internal. The non-headered end of the coil shall be fully concealed.

.4 Coils shall be removable from the unit at the header end unless shown otherwise on the drawings.

.5 DX refrigerant coils shall be circuited to provide adequate tube velocities to meet design requirements.

.6 Refrigerant evaporator type coils shall be equipped with distributors connected to the coil by copper tubes. When a condensing unit is supplied by Engineered Air and a hot gas bypass valve is required, a 5/8” (16 mm) O.D. spigot will be provided at the top of the suction header.

.7 Refrigerant coils with multiple compressors shall be alternate tube circuited in order to distribute the cooling effect over the entire coil face at reduced load conditions.

2.5 **Gas Heat Section (DJX) – Indirect Fired**

.1 General
- .1 Heating units shall be indirect natural gas fired approved for both sea level and high-altitude elevations. The entire package including damper controls, fan controls, and all other miscellaneous controls and accessories shall be pre-wired and factory certified by an approved testing agency such as ETL, UL, or CSA for the destination.
- .2 Operating natural gas pressure at unit(s) shall be 7”WC (1750 Pa).
- .3 Gas fired units shall be approved for operation in -20°F (-29°C) locations.

.2 Heat Exchanger/Burner Assembly
- .1 Heat exchanger shall be a primary drum and multi-tube secondary assembly constructed of titanium stainless steel with multi-plane metal turbulators and shall be of a floating stress relief design. Heat exchanger shall be provided with condensate drain connection. The heat exchanger casing shall have 1" (25 mm) of insulation between the

outer cabinet and inner heat reflective satin coat galvanized steel liner. Blower location shall be engineered to optimize the required air flow pattern around the heat exchanger. Duct type furnaces with closed coupled blowers are not acceptable.

.2 The heat exchanger shall be designed and fabricated by the same manufacturer as the make-up air unit. Third-party, purchased, heat exchangers are not acceptable.

.3 Units with high efficiency heat exchangers shall be tested and certified to the National Energy Code of Canada and local authorities having jurisdiction. A minimum of 91% efficiency shall be provided throughout the entire operating range of the heat exchanger. The manufacturer shall be routinely engaged in the manufacture of this type of high efficiency equipment.

.4 The heat exchanger/burner assembly shall be a blow through positive pressure type. Units incorporating the Cencon shall have an interrupted pilot ignition system to provide increased safety. Units using continuous or intermittent pilots are not acceptable.

.5 Flame surveillance shall be from the main flame after ignition not the pilot flame. The burner and gas train shall be in a cabinet enclosure. Atmospheric burners or burners requiring power assisted venting are not acceptable.

.3 Venting

.1 Outdoor DJX unit provided with wedge style vent.

.4 The heat exchanger/burner assembly shall include 15:1 turndown for all input ranges. The high turn down heat exchanger/burner assembly minimum input shall be capable of controlling down to 6.7% of its rated input, excluding the pilot assembly, without on/off cycling and include built in electronic linearization of fuel and combustion air. Efficiency shall increase from high to low fire.

.5 The CenCon c/w J-XM module (modulating fuel and combustion air) shall be complete with proportional and integral control and discharge air sensor to maintain set point temperature and provide rapid response to incremental changes in the discharge air temperature.

.1 The controller shall be certified by ETL

.2 The combustion air motor speed shall vary proportionally in response to the modulation of gas flow to provide optimum fuel/air mixture and efficiency at all conditions. The combustion blower RPM shall be proved using a Hall Effect speed sensor. Efficiency of the heat exchanger shall increase as the firing rate decreases.

.3 The controller shall provide a pre-purge and post purge cycle to provide a minimum of four air changes for each purge cycle through the heat exchanger.

.4 The controller shall provide a low fire start with controlled burner startup and shutdown.

.5 To ensure longevity of the equipment, the controller shall provide heat exchanger cooldown timing.

.6 For MUA applications, the blower shall not start until after the burner pre-purge and warmup are completed if the ambient temperature is more than 8°F (4.4°C) cooler than the setpoint and ambient is below 20°F (-7°C)

.6 Controllers for heating only units to incorporate low limit feature.

.7 Discharge air sensor shall be field mounted in supply ductwork by installing contractor.

.8 On Make-up air units, provide a reverse airflow high limit switch in series with the standard high limit switch mounted in the blower discharge.

.9 DJX Condensate

.1 Installing contractor to check with local codes and jurisdictions regarding field connecting condensate drain connection to sanitary sewer. A condensate neutralizer may be required. Contractor to provide piping to condensate drain connection on all

DJX heat exchangers.

.2 Installing contractor is to locate condensate neutralizing tank in a heated space away from the appliance at a point lower than the unit heat exchanger to promote gravity flow to sanitary sewer. Where this is not possible, a condensate pump may be required.

2.6 **Filters**

.1 Filter sections shall be provided with adequately sized access doors to allow easy removal of filters. Filter removal shall be from one side of the unit as noted on the drawings.

.2 The filters shall be designed to slide out of the unit. Side removal filters shall slide into a formed metal track sealing against metal spacers at each end of the track.

.3 2" (50 mm) Extended Media (Pleated) Disposable Filters: Filters shall be extended surface pleated complete with 100% synthetic media that does not support microbial growth. Frame shall be a high wet strength beverage board with a cross member design that increases filter rigidity and prevent breaching. Frame shall be recyclable. Filters shall have an expanded metal support grid bonded to the air-exiting side of the filter to maintain pleat uniformity and prevent fluttering. Metal support grid shall be recyclable. The filters shall be MERV 8 per ASHRAE 52.2. and rated U.L. 900 Class II. A permanent re-usable metal enclosing frame shall be provided for side-loaded applications.

.4 4" (100 mm) Extended Media (Pleated) Disposable Filters: Filters shall be mini-pleat air filters complete with 100% synthetic media that does not support microbial growth. Frame shall be constructed with high-impact plastic and impervious to moisture and high humidity. Media pack shall be adhered to plastic frame on all sides to prevent air by-pass. Filters shall have a hot melt bead separator to maintain pleat pack stability and ensure consistent pleat spacing for optimum air flow. The filters shall be MERV 13 per ASHRAE 52.2 and rated U.L. 900 Class II. A permanent re-usable metal enclosing frame shall be provided for side-loaded applications.

2.7 **Dampers**

.1 Dampers shall be extruded aluminum, low leak, insulated blade Tamco Series 9000.

.2 Two position inlet dampers shall be parallel blade type.

.3 Makeup air inlet damper control shall be complete with a two position, normally closed electric damper operator. This damper operator shall be interlocked so that when the unit is shut down, or on a power failure, the damper shall return to the closed position.

2.8 **Mechanical Cooling**

.1 Compressors shall be hermetic scroll type set on resilient neoprene mounts. The compressors shall incorporate an internal or external pressure-limiting device to protect the compressor in the event of overpressure. Compressors shall be provided with a means of overload protection. External crankcase heaters shall be locked out during compressor operation.

.2 Packaged Air Conditioning Units

.1 The entire package including fan controls, head pressure control, and all other miscellaneous controls and accessories shall be pre-wired and factory certified by an approved testing agency such as ETL, UL, or CSA for the destination.

.2 Unit must conform to regulations set out in the Canadian Energy Efficiency Act for large air conditioners. Packaged units shall be tested to CSA Standard C746-17 and must bear an EEV (energy efficiency verification) label provided by CSA.

.3 Unit must conform to regulations set out by the Department of Energy for large air conditioners. Packaged units shall be tested to AHRI 340/360-2007 and must bear an EEV (energy efficiency verification) label provided by CSA.

.4 Equipment shall operate down to 58°F (14.4°C) ambient temperature for make-up-air applications. Where applicable, multiple refrigeration circuits shall be separate from each other. Refrigeration circuits shall be complete with TX valves, sight glass, liquid line filter-driers, and service ports fitted with Schrader fittings. Equipment shall have condensers designed for 15°F (8°C) liquid sub-cooling. The complete piping system shall be purged and pressure tested with dry nitrogen, then tested again under vacuum. Each system shall be factory run and adjusted prior to shipment.

.5 Packaged units shall be supplied with R-454B refrigerant.

.6 Controls for hermetic compressor units shall include compressor and condenser fan motor contactors, supply fan contactors and overload protection, control circuit transformer, cooling relays, ambient compressor lockout, anti-short-cycle and inter-stage timers, and automatic reset low pressure controls. Compressors over 6 tons (21 kW) shall be complete with manual reset high pressure controls. Head pressure actuated fan cycling control shall be provided on all multiple condenser fan units.

.7 Provide hot gas bypass on the lead compressor to provide freeze protection in the event of low loads.

.8 Compressors shall be located on the side of the unit in a service enclosure complete with hinged access doors c/w lever handles for ease of service.

.9 Make-up air and VAV units to have a minimum of three compressors.

.3 Cooling Control

.1 The CenCon c/w C-XM module shall be complete with proportional and integral control with a discharge air sensor to maintain set point temperature and provide rapid response to incremental changes in discharge air temperature.

.1 The controller shall provide 3 stages of mechanical cooling.

.2 The controller shall have built-in minimum run time and anti-cycle timers.

.3 Mechanical cooling shall be disabled below a fixed low ambient temperature setpoint.

.4 Cooling enable/disable shall be through controller demand.

.5 When controller is in economizer mode, the mechanical cooling shall be disabled.

.6 Dehumidification is enabled through BACnet IP communication

2.9 **Factory Supplied Controls/Wiring**

.1 Provide a system of motor control, including all necessary terminal blocks, motor contactors, motor overload protection, grounding lugs, control transformers, auxiliary contactors, and terminals for the connection of external control devices or relays.

.2 Gas fired units shall also include high limit and combustion airflow safeties.

.3 Fire alarm circuits (where required) shall be powered from a relay in unit circuitry.

.4 Factory installed and wired non-fused disconnect switch in NEMA type 3R weatherproof configuration.

.5 Controls shall be housed in a control panel mounted in or on the unit that will meet the standard of the specific installation.

.6 Remote Panel - Provide for each air handling unit a NEMA 1 rated remote mounted control panel for the purpose of visual indication of operations. Each panel to include the following items:
-Engraved lamicoid faceplate
-System on light
-Heat on Light
-Cool on light
-Clogged pre-filter light with unit mounted filter air pressure switch
-Clogged pre-filter light with unit mounted filter air pressure switch

.7 Provide a discharge air low limit equipped with an automatic by-pass time delay to allow for cold weather start-up. On a heating system failure, this device will shut down the fan and close the outdoor air damper.

.8 CenCon

.1 The controller shall be ETL and BTL certified.

.2 A graphic OLED display module shall provide temperatures and status of the equipment.

.3 The controller shall have a 9-button keypad for navigation of screens.

.4 The controller shall have a computer connection diagnostics via Ethernet complete with web based interface.

.5 The controller shall have 4 distinct modes (heating, economizer, ventilation and cooling). Each mode change is determined by the demand of the system.

.6 Minimum operating ambient temperature shall be -40°F (-40°C).

.7 The controller shall provide continuous ambient temperature sensing.

.8 Self-check on start-up shall be provided to ensure air proving and all sensors are operating within design tolerances.

.9 Blower delay functionality shall be provided to ensure damper(s) are open before blower starts.

.1 A damper end switch shall be provided. Controller shall have an input for external damper end switch contact that enables the fan to start once damper contact is closed (Internal time delays are bypassed)

.10 The controller shall have non-recycling auto by-pass low limit with alarm contacts.

.11 Temperature control shall be discharge air c/w adjustable setpoint via BACnet IP.

.12 Dehumidification mode and DX coil face temperature shall both be adjustable via BACnet IP.

PART 3 – EXECUTION

3.1 Install air makeup unit on roof on factory curb as noted and indicated on the drawings.

3.2 The general contractor shall prepare the roofing surface and set the curbs as directed by this division. Division 15 shall install the ventilating units on the curbs and shall securely fasten to the curbs the ventilation units.

3.3 Refer to Section 15900 for control wiring and sequence of operation.

3.4 Manufacturer's representative shall provide startup and issue detailed startup reports.

END OF SECTION 15779

HVAC Duct Cleaning

PART 1 - GENERAL

1.1 **Reference Standards**

.1 Complete all work in this Section in accordance with the General Conditions.
.2 The fees for this work shall be carried by the Sheet Metal Contractor in the mechanical tender price.
.3 The duct cleaning contractor shall have been in this field for a minimum of five (5) years with access to all the proper equipment required to provide a thorough duct cleaning service using a 8" dia. vacuum suction hose and compressed air hose.

PART 2 - PRODUCTS

2.1 All duct access holes will be patched using 8" x 8" galvanized access doors with frames and locks. Standard of acceptance: Ductmate or Nexus.

PART 3 - EXECUTION

3.1 **New Supply, Return and Exhaust Air Ductwork**

.1 The duct cleaning contractor shall access holes and duct patches for all work on air duct systems.
.2 The sheet metal contractor shall provide blank off sealing at the inlets to all ductwork in preparation of work by this contractor.

3.2 **Supply Air and Return Air Units**

.1 The contractor shall vacuum and hand wipe to clean all construction debris and dust from the fan sections, and casings, filter plenums, blower fan coils (Section 15760), coil sections and mixing boxes.

3.3 **Ductwork Systems**

.1 All new supply, return and exhaust ductwork systems are included in the scope of work.

3.4 **Schedule of Work**

.1 This work shall be scheduled to commence in each area when the Owner allows access to the space.
.2 This contractor shall assume that all ceiling grids are installed. No extras will be allowed for interferences caused by the existing ceiling and lights.
.3 This work shall be completed and reviewed by the consultant and the mechanical contractor before any fan systems are started up.

3.5 **Acceptable Duct Cleaning Firms**

.1	Power Vac Duct Cleaning, Ancaster, Ontario	905 - 318-0622
.2	Ontario Duct Cleaning, Oakville, Ontario	1-800-993-0537
.3	Ventcare	905 - 201-7887
.4	DDK Duct Cleaning	416-283-2673

END OF SECTION 15809

Ductwork – Low Pressure – Metallic

PART 1 - GENERAL

1.0 General Instructions

.1 Read and be governed by Conditions of the Contract and Sections of Division 1.
.2 Comply with Mechanical General Requirements, Section 15010.
.3 Meet or exceed SMACNA 2005 “HVAC Duct Construction Standards”.
.4 Conform to SMACNA 2012 “HVAC Air Duct Leakage Test Manual”.

1.1 Shop Drawings and Product Data

.1 Submit shop drawings and product data in accordance with the General Conditions.

.2 Indicate the following:
- .1 Sealants
- .2 Tape
- .3 Proprietary Joints data.
- .4 Fittings

1.2 Maintenance Data

.1 Provide maintenance data for incorporation into manual specified in the General Conditions.

1.3 Certification of Ratings

.1 Catalogue or published ratings shall be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.

PART 2 - PRODUCTS

2.1 Classification

.1 Ductwork classification as follows (refer to duct pressure classifications indicated on the drawings):

Class	Maximum Pressure PA (positive & negative pressure)	Maximum Velocity M/S	Seal Class	Leakage Class
I	500 (2” W.C.)	12.5	A	4
II	250 (1” W.C.)	12.5	B	8

2.2 Duct Leakage

.1 Construct and test ductwork systems to SMACNA 2012 “HVAC Air Duct Leakage Test Manual”.
.2 F = Leakage in CFM / 100 sq.ft. duct surface area for full supply air flow.
C_L = Leakage Class
P = Design Static Pressure
$F = C_L * (P)$ exp 0.65

2.3 **Seal Classification**

.1 Class A: longitudinal seams, and transverse joints, wall penetrations and connections made airtight with sealing compound and tape.

.2 Class B: longitudinal seams, and transverse joints and connections made airtight with sealing compound.

2.4 **Sealant and Tape**

.1 Sealant: oil resistant, polymer type flame resistant high velocity duct sealing compound. Temperature range of minus 30C to plus 93C.
.1 Standard of acceptance: Duro Dyne S-2

.2 Tape: polyvinyl treated, open weave fibreglass tape, 50 mm wide
.1 Standard of acceptance: Duro Dyne FT-2.

2.5 **Galvanized Steel**

.1 Lock forming quality: to ASTM A525M, Z90 zinc coating.

.2 Thickness and Reinforcement: to ASHRAE and SMACNA for specified function and operating pressure range.

.3 Galvanized Steel:
.1 Galvanized steel with Z90 designation zinc coating lock forming quality: to ASTM A525M.
.2 Thickness:
Square and Rectangular
Up to 300 mm (12") – 26GA
325 mm to 600 mm (13" to 24") – 24GA
625 mm to 1200 (25" to 48") – 22GA
1225 mm (49") and over – 20GA
.3 Spacing of joints, reinforcement code and reinforcement spacing options to conform to SMACNA 2005 “HVAC Duct Connection Standards”.
.4 All ductwork between HVAC units and silencers shall be 18 gauge.

.4 Fabrication: to ASHRAE and SMACNA - Pittsburgh Lock seams or button lock. All ductwork cross broken. Maximum joint spacing is l0 feet.

.5 Joints: to ASHRAE and SMACNA. Proprietary manufactured flanged duct joint shall be considered to be a class A seal. Transverse joints up to 900 mm to be slip type with sealant and tape. Over 900 mm to be Ductmate 25 joints.

.6 Over 1200 wide Ductmate 35 joints with welded corners. Equal; Elgin.

2.6 **Stainless Steel**

.1 To ASTM A480/A480M, Type 304.

.2 Thickness, fabrication and reinforcement: to ASHRAE and SMACNA or as indicated.

.3 Joints: to ASHRAE and SMACNA.
.1 Acceptable material:
Ductmate Canada Ltd., Elgin

2.7 **Aluminum**

.1 To ASHRAE and SMACNA. Aluminum type: 3003-H-14.

.2 Thickness, fabrication and reinforcement: to ASHRAE and SMACNA or as indicated.

.3 Joints: to ASHRAE and SMACNA.
.1 Acceptable material:
Ductmate Canada Ltd., Elgin

2.8 **Hangers and Supports**

.1 Strap hangers: of same material as duct but next sheet metal thickness heavier than duct.

.2 Hanger configuration: to ASHRAE and SMACNA. Maximum size duct supported by strap hanger: 500 mm. Turn ends under duct and fasten with screws to duct.

.3 Hanger: black steel angle with galvanized steel rods to ASHRAE and SMACNA or following table:

Duct Size (mm)	Angle Size (mm)	Rod Size (mm)
up to 705	25 x 25 x 3	6
751 to 1050	40 x 40 x 3	6
1051 to 1500	40 x 40 x 3	10
1501 to 2100	50 x 50 x 3	10
2101 to 2400	50 x 50 x 5	13
2401 and over	50 x 50 x 6	13

.4 Hanger spacing as follows:

Duct Size (mm)	Spacing (mm)
to 1500	3000
1501 and over	2000

.5 Upper hanger attachments;
.1 For concrete: manufactured concrete inserts.
.1 Standard of acceptance: Myatt fig. 485.

.2 For steel joist: manufactured joist clamp or steel plate washer
.1 Standard of acceptance: Grinnell fig. 6l or 86 for joist clamps; Grinnell fig. 60 for plate washer.

.3 For steel beams: manufactured beam clamps
.1 Standard of acceptance: Grinnell fig. 60.

2.9 **Fittings**

.1 Fabrication: to SMACNA with longitudinal seams with Pittsburgh lock.

.2 Radiused elbows: standard radius or short radius with double thickness turning vanes. Turning vanes indicated on the drawings shall be double thickness.

.3 Square elbows: to 400 mm with single thickness vanes.

.4 Square elbows: over 400 mm with double thickness vanes.

.5 Main supply duct branches with splitter damper. If splitter damper not used provide branch and main duct balancing dampers.

.6 Sub branch duct with 45° entry and balancing damper on branch or extractors as indicated on the drawings.

.7 Transitions:
.1 Diverging: 20 degrees maximum included angle.
.2 Converging: 30 degrees maximum included angle.

.8 Offsets: square elbows or radiused elbows.

.9 Obstruction deflectors: maintain full cross-sectional area. Maximum included angles as for transitions.

2.10 **Low Pressure Flexible Duct**

.1 Flexible duct shall be TL/A by Flexmaster. The core will be factory-wrapped with fiberglass insulation and protected by a vapour barrier outer sleeve. Flexible triple lock acoustic perforated aluminium duct will be listed in accordance with ULC-S110 and classified as Class 1.

.1	Temperature range	-40 deg. F to 400 deg. F. (-40 deg.C. to 200 deg.C)
.2	Rated Velocity	400 f/m (20.3 m/s)
.3	Positive Pressure	2" w.g. (500 Pa)
.4	Negative Pressure	1" w.g. (0.25 kPa)

.5 Provide galvanized sleeve couplers and screws with bands as required.

2.11 **Prefabricated Circular Ductwork**

.1 General
.1 Prefabricated round supply, return and exhaust ductwork shall be SPIROsafe as supplied by Flexmaster Canada Ltd. & Lindab Inc. (905-731-9411). The duct system shall consist of fittings that are factory fitted with a sealing gasket and spiral duct which, when installed according to the manufacturer’s instructions, will seal the duct joints without the use of duct sealer.

.2 The contractor may, at his option, convert any or all rectangular ductwork to round provided that the project space limitations are properly addressed and that the overall system design static pressure not be exceeded.

.2 Materials

.1 Unless otherwise noted, all duct and fittings shall be galvanized steel in accordance with ASTM A-653 and A-924.

.2 When specified on contract documents, stainless steel type 304 or type 316 in accordance with ASTM A-240 shall be provided.

.3 Construction

.1 Unless otherwise noted, all duct and fittings shall be constructed in accordance to the latest SMACNA's Duct Construction Standards for +10" water gauge pressure.

.2 Fittings:

.1 All fitting ends shall come factory equipped with a double lipped, U-profile, EPDM rubber gasket. Gasket shall be manufactured to gauge and flexibility so as to insure that system will meet all of the performance criteria set forth in the manufacturer's literature. Gasket shall be classified by an internationally recognized laboratory authority to conform to ASTM E84-91a and NFPA 90A flame spread and smoke developed ratings of 25/50.

.2 All fitting ends shall be calibrated to manufacturer's published dimensional tolerance standard and associated spiral duct.

.3 All fitting ends from 3" to 24" Dia. Shall have rolled over edges for added strength and rigidity.

.4 All elbows from 3" to 12" Dia. Shall be 2 piece die stamped and continuously stitch welded. All elbows 14" Dia. And larger shall be standing seam gorelock construction and internally sealed.

.5 The radius of all 90° and 45° elbows shall be 1.5 times the elbow diameter, unless otherwise noted on the contract documents to be 1.0 times the elbow diameter. The radius of all 15°, 30° and 60° elbows shall be 1.0 times the elbow diameter.

.6 All fittings that are of either spot-welded or button punched construction shall be internally sealed. When contract documents require divided flow fittings, only full body fittings will be accepted. The use of duct taps is unacceptable except for retrofit installations.

.7 All volume dampers shall be SPIROsafe type DRU, DSU or DTU or approved equal. Damper shall be fitting sized to slip into spiral duct. Damper shall have the following features:

.1 Locking quadrant with blade position indicator
.2 2" sheet metal insulation stand-off
.3 Integral shaft/blade assembly
.4 Shaft mounted, load bearing bushings
.5 Gasketed shaft penetrations to minimize leakage

.4 Spiral Duct

.1 Spiral duct shall be calibrated to manufacturer's published dimensional tolerance standard.

.2 Spiral seam slippage shall be prevented by means of a flat seam and a mechanically formed indentation evenly spaced along the spiral seam.

.5 Performance

.1 Duct system performance shall meet SMACNA's Leakage Class 3 requirements at the system design static pressure as indicated on the contract documents not to exceed – 20 in W.G. or +12 in W.G.

.6 Equal: Peppertree

2.12 **Site Fabricated Circular Ductwork**

.1 All circular ductwork shall be fabricated galvanized spiral seam with fabricated fittings.

.2 All branch take offs to be 45 degree conical laterals. "Spun-in" take offs will not be accepted.

.3 Material gauges shall be to SMACNA recommendations but not less than 28 gauge up to 8" and as follows:

Size		Gauge	
Diameter		Galvanized	Galvanized
Inches	mm	Spiral Duct	Longitudinal Seam
3 - 14	75 - 350	28	28
16 - 24	400 - 600	26	24
28 - 36	700 - 900	24	22
38 - 54	905 - 1350	22	20

.4 Straight sections shall be joined with sleeve type couplings.

.5 All system joints are to be sealed with flexible medium pressure duct sealant.

.6 Fittings, reinforcement and hangers to SMACNA 2005 standards.

2.13 **Roof Flashings**

.1 Unless otherwise specified all roof exhaust and intake duct flashings shall be provided by Division 15811 and:

.1 Shall be Thaler MEF3-A for exhaust ducts and venting flashings and

.2 Shall be Thaler 'B' vents, MEF4-A for combustion air and 'B' Vents from mechanical systems.

PART 3 - EXECUTION

3.1 **General**

.1 Install ducts in accordance with ASHRAE and SMACNA.

.2 Do not break continuity of insulation vapour barrier with hangers or rods. Insulate band hangers 100 mm beyond insulated duct.

.3 Support risers in accordance with ASHRAE and SMACNA or as indicated.

.4 Seal all ductwork systems to meet item 2.1.

3.2 **Installation**

.1 Adhere to drawings as closely as possible in installing the work. However, the right is reserved to vary the run and shape of ducts and make offsets during progress work, if required, to meet structural and other interferences.

.2 All exposed flexible ductwork shall be supported with a continuous angle under the flex on straight lengths.

.3 All diffusers shall be supported independently of ductwork.

3.3 **Duct Leakage**

.1 Make trail leak test, as instructed to demonstrate workmanship.

.2 Install no additional ductwork until trial test has been passed.

.3 Test section minimum of 60 m long with not less than 6 branch takeoffs and 4-90 degree elbows. The Consultant shall designate the specific duct sections for testing.

.4 The Testing and Balancing firm shall conduct tests in accordance with SMACNA 2012 manual for leakage testing.

3.4 **Sealing and Taping**

.1 Apply sealant to outside of joint to manufacturer's recommendations.

.2 Bed tape in sealant and recoat with minimum of one (l) coat of sealant to manufacturer's recommendations.

.3 Exterior ducts to be completely sealed at all joints with high pressure duct sealers and 50 year silicone 1/4" coating.

3.5 **Watertight Ducts**

.1 Provide watertight duct for:
- .1 Dishwasher exhaust.
- .2 Fresh air intake, plenums.
- .3 As indicated.

.2 Form bottom of horizontal duct without longitudinal seams. Solder or weld joints of bottom and side sheets. Seal all other joints with duct sealer.

.3 Slope horizontal branch ductwork down towards hoods served. Slope header ducts down toward risers.

.4 Fit base of riser with 150 mm (6") deep drain sump and 25 mm (1") drain connected, with deep seal trap and valve and discharging to open funnel drain.

3.6 **Duct Cleaning**

.1 Refer to Section 15809 (HVAC Duct Cleaning) for sheet metal contractors scope of work to assist the duct cleaning contractor.

END OF SECTION 15811

Ductwork – High Pressure – Metallic

PART 1 - GENERAL

1.0 General Instructions

.1 Read and be governed by Conditions of the Contract and Sections of Division 1.
.2 Comply with Mechanical General Requirements, Section 15010.
.3 Meet or exceed SMACNA 2005 “HVAC Duct Construction Standards”.
.4 Conform to SMACNA 2012 “HVAC Air Duct Leakage Test Manual”.

1.1 Shop Drawings and Product Data

.1 Submit shop drawings and product data in accordance with General Conditions.

.2 Indicate the following:
- .1 Sealants
- .2 Tape
- .3 Proprietary joints
- .4 Fittings

1.2 Maintenance Data

.1 Provide maintenance data for incorporation into manual specified in the General Conditions.

1.3 Certification of Ratings

.1 Catalogue or published ratings shall be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.

PART 2 - PRODUCTS

2.1 Classification

.1 Classification as follows and as shown on the drawings (refer to drawings for indicated pressure classifications):

Class	Max. Pressure PA	Max. Velocity m/S	Sealant Class	Leakage Class
High Pressure	2500 (10” W.C.)	20	"A"	4
Medium Pressure	1500 (6” W.C.)	20	"A"	4
Medium Pressure	750 (3” W.C.)	20	“A”	4

2.2 Duct Leakage

.1 Construct and test ductwork systems to SMACNA 2012 “HVAC Air Duct Leakage Test Manual”.
.2 F = Leakage in CFM / 100 sq.ft. duct surface area for full supply air flow.
C_L = Leakage Class
P = Design Static Pressure
$F = C_L * (P)$ exp 0.65

2.3 **Seal Classification**

.1 Class A: longitudinal seams, and transverse joints, wall penetrations and connections made airtight with sealing compound and tape.

.2 Class B: longitudinal seams, and transverse joints and connections made airtight with sealing compound.

2.4 **Ductwork**

.1 Material
- .1 Galvanized steel with Z90 designation zinc coating lock forming quality; to ASTM A525M-80.
- .2 Thickness: to SMACNA.

.2 Construction
- .1 Circular and oval: factory fabricated spiral wound with matching fittings and specials to SMACNA.
  - .1 Transverse joints: up to 600 mm to be slip type with sealant and tape. Over 600 mm to be Ductmate.
    - .1 90 degree elbows, smooth, long radius.
    - .2 Branch fittings combination lateral elbow and conical tee.
- .2 Rectangular ducts and fittings: to SMACNA. All transverse joints to be welded or proprietary duct joint.
  - .1 Elbows: radiused non-vaned to SMACNA.
  - .2 Branch fittings: 45 deg. entry and conical tee.

2.5 **Sealant and Tape**

.1 Sealant: oil resistant, polymer type flame resistant high velocity duct sealing compound.
- .1 Standard of Acceptance: Foster 30-02, Duro Dyne S-2.

.2 Tape: polyvinyl treated, open weave fibre glass tape, 50 mm wide.
- .1 Standard of Acceptance: Duro Dyne FT-2.

2.6 **Hangers and Supports**

.1 Band hangers; use on round and oval ducts only up to 500 mm diameter, of same material as duct but next sheet metal thickness heavier than duct.

.2 Hanger configuration: all ducts over 400 mm to use trapeze hangers to ASHRAE and SMACNA.

.3 Hanger: black steel angle with galvanized steel rods to ASHRAE and SMACNA or following table:

Duct Size (mm)	Angle Size (mm)	Rod Size (mm)
up to 750	25 x 25 x 3	6
751 to 1050	40 x 40 x 3	6

Duct Size (mm)	Angle Size (mm)	Rod Size (mm)
1051 to 1500	40 x 40 x 3	10
1501 to 2100	50 x 50 x 3	10
2101 to 2400	50 x 50 x 3	13
2401 and over	50 x 50 x 6	13

.4 .1 Band hangers: install in accordance with SMACNA.
.2 Angle hangers: complete with locking nuts and washers.
.3 Hanger spacing as follows:

Duct Size (mm)	Spacing (mm)
to 1500	3000
1501 and over	2000

.5 Upper hanger attachments:
.1 For concrete: manufactured concrete inserts.
.1 Standard of Acceptance: Myatt Fig. 485.
.2 For steel joist: manufactured joist clamp or steel plate washer.
.1 Standard of Acceptance: Grinnell fig. 61 or 86 for joist clamps.
.3 For steel beams: manufactured beam clamps.
.1 Standard of Acceptance: Grinnell fig. 60.

2.7 Round Ductwork

.1 Materials
.1 Unless otherwise noted, all duct and fittings shall be G-90 galvanized steel in accordance with ASTM A-653 and A-924.
.2 When specified on Contract Documents, stainless steel type 304 or type 316 in accordance with ASTM A240 shall be provided.

.2 Construction
.1 Unless otherwise noted, all duct and fittings shall be constructed per SMACNA's Duct Construction Standards (+10 in W.G.) [2500 Pa] shown in the following table:

Size		Gauge	
Diameter		Galvanized	Galvanized
Inches	mm	Spiral Duct	Longitudinal Seam
3 - 4	75 - 350	28	28
16 - 24	400 - 600	26	24
28 - 36	700 - 900	24	20
38 - 54	905 - 1350	22	20

.3 Fittings:

.1 All fitting ends shall come factory equipped with a double lipped, U-profile, EPDM rubber gasket. Gasket shall be manufactured to gauge and flexibility so as to insure that system will meet all of the performance criteria set forth in the manufacturer's literature. Gasket shall be classified by Underwriter's Laboratories to conform to ASTM E84-91a and NFPA 90A flame spread and smoke developed ratings of 25/50.

.2 All fitting ends shall be calibrated to manufacturer's published dimensional tolerance standard and associated spiral duct.

.3 All fitting ends from 3" to 24" (75 to 600) dia. shall have rolled over edges for added strength and rigidity.

.4 All elbows from 3" to 12" (75 to 300) dia. shall be 2 piece die stamped and continuously stitch welded. All elbows 14" (350 dia. and larger shall be standing seam gorelock construction and internally sealed.

.5 The radius of all 90 deg. and 45 deg. elbows shall be 1.5 times the elbow diameter, unless otherwise noted on the Contract Documents to be 1.0 times the elbow diameter. The radius of all 15 deg., 30 deg., and 60 deg., elbows shall be 1.0 times the elbow diameter.

.6 All fittings that are of either spot welded or button punched construction shall be internally sealed. When Contract Documents require divided flow fittings, only full body fittings will be accepted. The use of duct tape is unacceptable except for retrofit installations.

.7 All volume dampers shall be SPIROsafe® type DRU, DSU or DTU, or approved equal. Damper shall be fitting sized to slip into spiral duct. Damper shall have the following features.

.1 Locking quadrant with blade position indicator.
.2 2" (50) sheet metal insulation stand-off.
.3 Integral shaft/blade assembly.
.4 Shaft mounted, load bearing bushings.
.5 Gasketted shaft penetrations to minimize leakage.

.4 Spiral Duct:

.1 Spiral duct shall be calibrated to manufacturer's published dimensional tolerance standard.

.2 All spiral duct 14" (350) dia. and larger shall be corrugated for added strength and rigidity.

.3 Spiral seam slippage shall be prevented by means of a flat seam and a mechanically formed indentation evenly spaced along the spiral seam.

.4 Performance

.1 Duct system performance shall meet SMACNA's Leakage Class 3 requirements at the system design static pressure as indicated on the Contract Documents not to exceed -20 in. W.G. (-5000 Pa) or +12 in. W.G. (+3000 Pa).

2.8 **<u>High Pressure Flexible Duct</u>**

.1 Flexible duct shall be T/L-T by Flexmaster. The core will be made of perforated dead soft aluminum and manufactured in a manner to produce a triple-lock mechanical joint. The core will be factory-wrapped with fiberglass insulation and protected by a polyethylene (max 25/50 flame/smoke spread) outer sleeve. Flexible acoustic aluminum duct will be listed in accordance with ULC-S110 and classified as Class 1.

.1	Temperature range	-40 deg. F to 400 deg. F. (-40 deg.C. to 200 deg.C)
.2	Rated Velocity	400 f/m (20.3 m/s)
.3	Positive Pressure	12" w.g. (3.0 kPa)
.4	Negative Pressure	1" w.g. (0.25 kPa)
.5	Bend Radius	1 ½" x diameter

.6 Standard length : 10 ft. (3.048 m)
.7 Provide galvanized sleeve couplers and screws with bands as required.

PART 3 - EXECUTION

3.1 General

.1 Install ducts in accordance with ASHRAE and SMACNA.

.2 Do not break continuity of insulation vapour barrier with hangers or rods. Insulate band hangers 100 mm beyond insulated duct.

.3 Support risers in accordance with ASHRAE and SMACNA or as indicated.

3.2 Installation

.1 Adhere to drawings as closely as possible in installing the work. However, the right is reserved to vary the run and shape of ducts and make offsets during progress work, if required, to meet structural and other interference.

3.3 Duct Leakage

.1 Make trail leak test, as instructed to demonstrate workmanship.

.2 Install no additional ductwork until trial test has been passed.

.3 Test section minimum of 60 m long with not less than 6 branch takeoffs and 4-90 degree elbows. The Consultant shall designate the specific duct sections for testing.

.4 The Testing and Balancing firm shall conduct tests in accordance with SMACNA 2012 manual for leakage testing.

3.4 Sealing and Taping

.1 Apply sealant in accordance with SMACNA and to manufacturer's recommendations.

.2 Bed tape in sealant and recoat with minimum of one coast of sealant to manufacturer's recommendations.

3.5 Duct Cleaning

.1 Refer to Section 15809 for sheet metal contractors scope of work to assist duct cleaning contractor.

3.6 Design Submittals

.1 The Contractor shall provide a schedule of the duct service, gauge, reinforcement, hanger, tie-rod conformance requirements for Consultant to review prior to fabricating or delivering any high pressure ductwork to the site. Conform to the latest SMACNA commercial duct design and construction standards.

END OF SECTION 15812

Ductwork Accessories

PART 1 - GENERAL

1.0 **General Instructions**

.1 Read and be governed by Conditions of the Contract and Sections of Division 1.

.2 Comply with Mechanical General Requirements, Section 15010.

1.2 **Shop Drawings**

.1 Submit shop drawings in accordance with the General Conditions.

1.3 **Maintenance Data**

.1 Provide maintenance data for incorporation into manual specified in the General Conditions.

1.4 **Product Data**

.1 Submit product data in accordance with General Conditions and indicate the following:
- .1 Turning vanes
- .2 Flexible connections.
- .3 Sealants and tapes
- .4 Instrument test ports.
- .5 Duct access doors

1.5 **Certification of Ratings**

.1 Catalogue or published ratings shall be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.

PART 2 - PRODUCTS

2.1 **Access Doors**

.1 General:
- .1 Insulated sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm thick complete with sheet metal angle frame and 25 mm thick rigid glass fibre insulation. Where a fire rated separation is pierced by the access door, the door shall carry a U.L.C. rating sufficient for the application.
- .2 Standard: Acudor, Zurn.

.2 Gaskets: neoprene or foam rubber.

.3 Hardware:
- .1 Up to 300 x 300 mm: 2 sash locks.
- .2 301 to 450 mm : 4 sash locks
- .3 451 to 1000 mm: piano hinge and minimum 2 sash locks
- .4 Doors over l000 mm: piano hinge and two handles operable from both sides.

2.2 **Flexible Connections**

.1 Frame: galvanized sheet metal frame with fabric clenched by means of double locked seams.

.2 Material: neoprene.
.1 Fire resistant, self extinguishing, neoprene coated glass fabric, temperature rated at minus 40 deg. C to plus 90 deg. C., density of l.3 kg/m.

2.5 **Sealant and Tape**

.1 Sealant - oil resistant, polymer type flame resistant high winter based sealant velocity duct sealing compound. Temperature range of minus 30 deg. C to plus 93 deg. C.
.1 Standard of acceptance: Ductmate Proseal Non-VOC Sealant UL listed, flame spread of 5, smoke spread of 10.

.2 Tape - polyvinyl treated, open weave fibre glass tape, 50 mm wide.
.1 Standard of acceptance: Duro Dyne FT-2.

2.6 **Turning Vanes**

.1 Factory or shop fabricated double thickness to recommendation of SMACNA. Standard of Acceptance: Duro Dyne.

2.7 **Instrument Test Ports**

.1 1.6 mm thick steel zinc plated after manufacture.
.2 Cam lock handles with neoprene expansion plug and handle chain.
.3 28 mm minimum inside diameter. Length to suit insulation thickness.
.4 Neoprene mounting gasket.
.5 Standard of acceptance: Duro Dyne IPI or IP2.

PART 3 - EXECUTION

3.1 **Installation**

	General	Locations
1	Access Doors	
	6l0 x 6l0 mm for person size entry 300 x 300 mm for servicing entry l50 x l50 mm for viewing as indicated	at fire and smoke dampers at control dampers at devices requiring maintenance at locations required by code as indicated.
2	Flexible Connections	
	Minimum distance between metal parts when systems in operation: 75 mm. Install in accordance with recommendations of SMACNA.	inlets to supply air units. outlets from supply air units on duct connections to all exhaust fans.
3	Sealants and Tapes	

	General	Locations
	Apply sealant in accordance with SMACNA and to manufacturer's recommendations. Bed tape in sealant and recoat with minimum of one (l) coat of sealant of manufacturer's recommendations.	
4	Turning Vanes	
	Install to SMACNA Standards and as shown and noted on the drawings.	Install double thickness turning vanes in all ducts from mechanical rooms.
5	Instruction Test Ports	
	For traverse readings, install in accordance with recommendation of SMACNA. For temperature readings, install in accordance with recommendations of SMACNA. Install in accordance with manufacturer's instructions.	Traverse at ducted inlets to roof and wall exhausters at inlets and outlets of other fan systems at main and sub-main ducts and as indicated.

END OF SECTION 15820

Balancing Dampers

PART 1 - GENERAL

1.0 General Instructions

.1 Read and be governed by Conditions of the Contract and Sections of Division 1.
.2 Comply with Mechanical General Requirements, Section 15010.

1.2 Shop Drawings

.1 Submit shop drawings in accordance with the General Conditions.

1.3 Maintenance Data

.1 Provide maintenance data for incorporation into manual specified in the General Conditions.

1.4 Product Data

.1 Submit product data in accordance with the General Conditions.

PART 2 - PRODUCTS

2.1 Multi-Bladed Dampers

.1 Factory manufactured of material compatible with duct.
.2 Opposed blade: configuration to recommendations of SMACNA.
.3 Maximum blade height: l00 mm.
.4 Bearings: pin in bronze bushings.
.5 Linkage: shaft extension with locking quadrant.
.6 Channel frame complete with angle stop.
.7 Standard of acceptance; N.C.A. MBD-57 and Ruskin CD 36
.8 Minimum 300 wide X 250 high
.9 Sizes as indicated.

2.2 Splitter Dampers

.1 Of same material as duct but one sheet metal thickness heavier, with appropriate stiffening.
.2 Single thickness construction.
.3 Control rod with locking device and position indicator.
.4 Rod configuration to prevent end from entering duct.
.5 Pivot: piano hinge.
.6 Folded leading edge.

2.3 Single Blade Dampers

.1 Of same material as duct, but one sheet metal thickness heavier. V-groove stiffened.
.2 Size and configuration to recommendations of SMACNA, except maximum height 100mm.
.3 Duro-Dyne locking quadrant with shaft extension to accommodate insulation thickness.
.4 Inside and outside nylon end bearings.
.5 Channel frame of same material as adjacent duct, complete with angle stop.

PART 3 - EXECUTION

3.1 **Installation**

.1 Install where indicated using either balance damper or extractors as drawing indicates.
.2 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.
.3 Provide shaft extensions as needed for complete, full and smooth operation of balancing device.

END OF SECTION 15821

Fire Dampers

PART 1 - GENERAL

1.0 General Instructions

.1 Read and be governed by Conditions of the Contract and Sections of Division 1.
.2 Comply with Mechanical General Requirements, Section 15010.

1.2 Shop Drawings

.1 Submit shop drawings in accordance with the General Conditions.

1.3 Maintenance Data

.1 Provide maintenance data for incorporation into manual specified in the General Conditions.

1.4 Product Data

.1 Submit product data in accordance with Section 01300.

.2 Indicate the following:
  .1 Fire dampers.
  .2 U.L.C. installation details for fire dampers in all construction assemblies and positions.

1.5 Certification of Ratings

.1 Catalogue or published ratings shall be those obtained from tests carried out by manufacturer or those ordered by him from independent testing agency signifying adherence to codes and standards.

PART 2 - PRODUCTS

2.1 Fire Dampers

.1 Fire dampers: listed and bear label of ULC and shall meet requirements of Provincial Fire Marshall NFPA 90A-1987 and authorities having jurisdiction.

.2 Mild steel, factory fabricated for fire rating requirement to maintain integrity of fire wall and/or fire separation.

.3 Top hinged: offset single damper, round or square; multi-blade hinged or interlocking type; roll door type; guillotine type; sized to maintain 100% full duct cross section. (Type "B" damper) Square framed 'C' type dampers for round ducts. Dampers to be rated for low or high pressure ductwork for appropriate class installation.

.4 Fusible link actuated, 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.

.5 Frame and 40 x 40 x 3.1 mm angle iron on full perimeter of frame on both sides of fire wall being pierced.

.6 Standard of Acceptance: Ruskin, Nailor, Controlled Air, Ventex, Price.

.7 ULC rated Nailor Combination Smoke/Fire Dampers. Vee-Groove blade dampers, 24-volt DC actuator, normally closed damper. Power to open actuator. Class II, for 250º F, maximum 2000 fpm, 16 gauge frame, maximum leakage 10 cfm/sq.ft. at 4.0 WC, 1 ½ hour rating. Install as indicated where the CSFD tags are indicated. Division 16 to wire power and Fire Alarm interlocks and smoke detectors.

PART 3 - EXECUTION

3.1 Installation

.1 Install fire dampers in accordance with NFPA 90A and ULC standards with backup angles and breakaway joints. Provide duct access doors as well as drywall access doors for complete accessibility.

.2 Maintain integrity of fire wall and/or fire separation.

.3 After completion and prior to concealment obtain approvals of complete installation.

.4 Fire dampers that have been installed prior to the approval of the shop drawings shall be removed from the mounting position.

.5 The contractor shall demonstrate complete knowledge and ability to install these devices to the U.L.C. listing instructions before proceeding with site work.

.6 Co-ordinate installation with fire stopping trades.

.7 Division 16 to wire power and smoke detectors. Smoke detectors by Div. 16 required on both sides of air transfer ducts and duct type smoke detectors downstream of dampers in ducted systems. Dampers to be normally open until smoke detectors trip and close the dampers.

END OF SECTION 15823

Commercial Fans

PART 1 - GENERAL

1.1 **Shop Drawings and Product Data**

.1 Submit shop drawings and product data in accordance with general conditions.

.2 Product data to include fan curves and sound rating data.

1.2 **Manufactured Items**

.1 Catalogued or published ratings shall be those obtained from tests carried out by manufacturer or those ordered by him from independent testing agency signifying adherence to codes and standards in force.

.2 Provide confirmation of testing.

1.3 **Operation and Maintenance Data and Materials**

.1 Provide operation and maintenance data for incorporation into maintenance manual specified in general conditions. Provide maintenance materials in accordance with general conditions.

PART 2 - PRODUCTS

2.1 **Fans General**

.1 Capacity, static pressure, revolutions per minute, power, model, size and sound power levels: as indicated.

.2 Sound ratings: comply with AMCA 302-76 tested to AMCA 300-67. (Unit shall bear AMCA certified sound rating seal).

.3 Fans: statically and dynamically balanced, constructed to conformity with AMCA 99-76.

.4 Ratings: based on tests performed in accordance with AMCA 210-74, and ASHRAE 5l-75.

.5 Bearings: Heavy duty, grease lubricated ball or roller bearings of self aligning type with oil retaining, dust excluding seals and 80,000 h service in accordance with ANSI B3.15-1972 for ball bearings and ANSI B3.16-1972 for roller bearings and AFBMA L-10 life standards.
.1 Standard of acceptance: SKF

.6 Motors: sizes as indicated, refer to schedule for two speed motor or inlet vane requirements. Fans specified as Penn Zephyrs are field convertible fans for two speed operation. Alternate fans shall be equipped for similar field sped adjustment.

.7 Supply factory roof curbs where indicated on the schedules.

.8 Accessories and hardware: V-belt drives, adjustable slide rail motor bases, belt guards, coupling guards and fan inlet safety screen. Provide variable pitch motor sheaves set at mid point for the capacities on the drawings.

.9 Factory primed before assembly in colour standard to manufacturer.

.10 Standard of acceptance: Greenheck, Penn, Loren Cook, Carnes, Jenco, Airex.

2.2 **Utility Seats**

.1 Characteristics and construction: as per 2.1.

.2 Preassemble single width centrifugal fan with removable protective hood with vents, and automatic back draft dampers and birdscreens.

.3 Provide belt driven sets with adjustable motor bed plate and variable pitch driver sheave.

.4 Standard of acceptance: Trane, Greenheck, Penn, Loren Cook

.5 Alternates: Carnes

PART 3 - EXECUTION

3.1 **Fan Installation**

.1 Install fans as indicated, complete with resilient mountings and flexible electrical leads.

.2 Install fans with l00 mm flexible connection on inlet ductwork and on discharge ductwork. Ensure metal bands of connectors are parallel with minimum 25 mm flex between ductwork and fan during running.

.3 Install fan restraining snubbers as indicated. Flexible connections shall not be in tension during running.

.4 Suspend fans from structure on rubber-in-shear isolators.

.5 Manufacturers shall provide sheaves and belts.
- .1 As directed to achieve final air balances.
- .2 One set of belts for each fan for the final speed. Mark each belt with fan number.

.6 **All** fans shall be installed with gravity back draft dampers in the ductwork at the exterior wall or roof unless otherwise noted.

END OF SECTION 15831

Welding Extraction Arms

PART 1 - GENERAL

1.1 **Shop Drawings and Product Data**

.1 Submit shop drawings and product data in accordance with General Conditions.

.2 Indicate the following: motor voltages, motor hp's, sound power levels at fan discharge, CFM, static pressure, filter media and area, spark detection and extinguishing system drawings and installation instructions.

1.2 **Maintenance Data**

.1 Provide maintenance data for incorporation into manual specified.

1.3 **Manufactured Items**

.1 Catalogued or published ratings shall be those obtained from tests carried out by manufacturer or those ordered by them from independent testing agency signifying adherence to codes and standards in force.

PART 2 - PRODUCTS

2.1 **Item 0000112776 - KUA-200 / 4H / Extraction arm**.
This extraction arm for wall mounting with a 200mmØ (7.87”) has a working range of 4 meters (13’) and is suitable for welding fumes and oil mist.

2.2 **Item 0000112882 – FlexMax-45 / 200 / Extension Crane**
The Plymovent FlexMax is a crane arm which can increase the working range of the KUA-200 arms by 4.5 meters (14.75’)

2.3 **Item 0000102938 – TEV-585 636 NEMA UVD**
TEV-585 (636) 7.5 HP 575V/3-/60Hz
The TEV is an extraction fan that is designed to remove welding fumes

2.4 **Item 7900020730 VFD-5.5 / Frequency Inverter**

2.5 **Item 7900024100 PT-2500 / Pressure Transmitter**
Pressure Transmitter, to be mounted to the ductwork of an extraction system.

2.6 **Item 0000100334 TEV-Kit / 5**

2.7 **Item 0017012030 SAS-315 (straight) / Silencer**

2.8 **Manufacturers**
.1 Base bid: Plymovent

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END OF SECTION 15832

Insulated Dampers

PART 1 - GENERAL

1.0 General Instructions

.1 Read and be governed by Conditions of the Contract and Sections of Division 1.
.2 Comply with Mechanical General Requirements, Section 15010.

1.1 Shop Drawings

.1 Submit shop drawings in accordance with the General Conditions.

1.2 Product Data

.1 Submit product data in accordance with the General Conditions.
.2 Indicate the following:
  .1 Insulated dampers
  .2 Damper motors

1.2 Maintenance Data

.1 Provide maintenance data for incorporation into the Maintenance Manual.

1.3 Certification of Ratings

.1 Catalogue or published ratings shall be those obtained from tests carried out by the manufacturer or those ordered by him from an independent testing agency signifying adherence to codes and standards.

PART 2 - PRODUCTS

2.1 Insulated Automatic Control Dampers

.1 All two-position control dampers shall be parallel blade. All modulating control dampers shall be opposed blade. Sizes as indicated.

.2 Damper frames and blades shall not be less than 12 gauge, 0.081" (2.1 mm) extruded aluminum. Channel frame to be 4" (101.6 mm) deep.

.3 Blades on all multi-blade dampers shall be not more than 6" (152.4 mm) in width.

.4 Blades are single unit, internally reinforced and connected to frame with a 7/16" hexagon rod. Internal hollows are insulated with 7/8" thick polyurethane foam with "R" factor of 5.0 per inch. Blades shall be thermally broken.

.5 Blade and frame seals shall be extruded synthetic rubber and shall be secured in an integral slot in the blade extrusion.

.6 Frame to be insulated with polystyrene, "R" factor of 5.0 per inch.

.7 Bearings shall be comprised of Celcon inner bearing fixed on hexagon rod rotating within a polycarbonate outer bearing inserted into a frame, resulting in no metal to metal contact.

.8 Linkage hardware shall be out of airstream and constructed of aluminum and corrosion resistant zinc plated steel, with cup-point trunnion screw for slip-proof slip.

.9 Dampers shall be suitable for operating in temperature range from -40 deg. F. to 165 deg. F.

.10 Leakage shall not exceed 0.6% of the rated air flow at 10" wg differential static pressure across the damper.

.11 Pressure drop with damper fully open shall not exceed 0.050 in wg at 1000 fpm face velocity for 24" x 24" (600 x 600 mm) damper.

.12 Dampers to be made to size required, not to be limited to standard sizes.

.13 Damper shall be TAMCO Series 9000 manufactured by T.A. Morrison & Co. Inc.

.14 Equals: Ventex, Alumavent, Nailor, Ruskin.

2.2 **Damper Motors**

.1 Damper motors shall be by Division 15900.

PART 3 - EXECUTION

3.1 Install in strict compliance to SMACNA and manufacturers recommendations.

END OF SECTION 15834

Louvres, Intakes and Vents

PART 1 - GENERAL

1.1 **Product Data**

.1 Submit product data in accordance with General Conditions.

1.2 **Certification of Ratings**

.1 Catalogued or published ratings shall be those obtained from tests carried out by manufacturer or those ordered by him from independent testing agency signifying adherence to code and standards.

PART 2 - PRODUCTS

2.1 **Standard Stationary Louvres**

.1 Construction: welded with exposed joints ground flush and smooth.

.2 Material: extruded aluminium alloy 6063-T5.

.3 Blade: storm proof pattern with centre watershed in blade, reinforcing bosses and maximum blade length of l500 mm, set at 45 deg. angle as indicated by Model No.

.4 Frame, head, sill and jamb: 100 mm deep one piece extruded aluminium, minimum 3 mm thick with approved caulking slot, integral to unit.

.5 Mullions: at l500 mm maximum centres.

.6 Screen: l2 mm intake mesh, 2 mm diameter wire aluminium birdscreen on inside face of louvres in formed U-frame.

.7 Finish: factory applied baked enamel with Kynar 500 epoxy coat. Colour to match Architect's colour chip.

.8 Standard of Acceptance: Airolite (Model Numbers are indicated)

.9 Acceptable equal: Ventex, Price, Ruskin.

2.2 **Brick Vents**

.1 Extruded aluminium frame and blades

.2 1/2" x 1/2" birdscreen.

.3 Sizes as indicated.

.4 Colour selection by the Architect.

.5 Kynar 500 finish.

PART 3 - EXECUTION

3.1 **Installation**

.1 Install in accordance with manufacturer's recommendations and in accordance with recommendations of SMACNA.

.2 Coordinate all locations and layouts with general trades at the initial stages of construction.

.3 Provide a louvre schedule to the engineer indicating size, type, service, location and colour once material shop drawings have been approved.

END OF SECTION 15851

Grilles, Registers and Diffusers

PART 1 - GENERAL

1.1 Shop Drawings and Product Data

.1 Submit shop drawings and product data in accordance with General Conditions.

.2 Indicate the following size, style, finish and accessories.

.3 Clearly reference the shop drawings for each unit with the notation given on the drawing schedules.

1.2 Maintenance Data

.1 Provide maintenance data for incorporation into maintenance manual.

1.3 Manufactured Items

.1 Grilles, registers and diffusers shall be product of one manufacturer for generic type, e.g. grilles and registers by one, diffusers by one, or same. Refer to the schedule on the drawings.

.2 The schedule on the drawings is based on E.H. Price.

.3 Equal: Titus.

.4 Alternates: Nailor, Metalair, Krueger

PART 2 - PRODUCTS

2.1 General

.1 Provide standard product to meet capacity, throw, noise level, throat and outlet velocity.

.2 Where grilles, registers and diffusers penetrate fire walls and fire partitions, provide approved steel sleeve secured to structure in accordance with NFPA 90A.

.3 Refer to drawing details for special grilles, frames, etc.

PART 3 - EXECUTION

3.1 Installation

.1 Install in accordance with manufacturer's instructions.

.2 Install clear of obstacles and interferences from structural elements.

.3 Install flush to architectural finishes and parallel to building lines.

.4 Fully coordinate locations of grilles and diffusers with the general contractor if interferences with architectural finishes or lighting occur; inform the engineer.

END OF SECTION 15852

Variable Frequency Drives

PART 1 - GENERAL

1.1. General Instructions

.1 Read and be governed by Conditions of the Contract and Sections of Division 1.
.2 Comply with Mechanical General Requirements, Section 15010.

1.2. Description

.1 The project drawings and specifications are based on Adjustable Frequency Drive (VFD) for each fan and pump as manufactured by Danfoss, Allen Bradley, Siemens or Trane.

.2 Alternate manufacturers include Graham and Toshiba. These alternates must meet all aspects of the plans and specifications (performance, construction, configuration, dimensions, weights, etc.) in order to be considered.

1.3 Standards

.1 All VFD's to be certified by ULC or CSA/UL approved.

1.4 Submittals

.1 Provide catalog, technical data, outline dimensions, shipping section dimensions, weight, control schematics, external connection diagram showing function and identification of all terminals requiring field connections.

PART 2 - PRODUCTS

2.1. Design

.1 Manufacturer shall submit a computerized harmonics analysis of the facility system based on the most recent single line diagram. Analysis shall illustrate the effect of VFD's on system harmonics.

.2 Manufacturer shall provide input line reactors and/or line filters required to reduce the total harmonic distortion (THD) to 5% at the point of common coupling or 3% at each VFD input where the analysis has shown that the incremental effect of the addition of the VFD's would cause the THD to exceed these values as per IEEE 519-1992.

.3 The VFD shall be of the fully digital pulse width modulated (PWM) type utilizing insulated gate bipolar transistors (IGBT's) in the inverter section of the VFD. The VFD shall accept AC line voltage variation of +10%, -15%. No transformers shall be used on either the input or output of the VFD.

.4 Provide NEMA 1 wall or floor mounted enclosure. NEMA 1 shall have a fan cooled enclosure with sprinkler proof hood.

.5 Provide incoming, horsepower rated, disconnect switch with an operating mechanism, door interlocked and padlockable in the open position.

.6 Provide input line fuses coordinated with the VFD's electronic protection circuits so as not to blow under normal output faults such as overcurrent, short circuit and ground fault.

.7 Provide output filters on all 460 & 575 volt VFDs to limit the dv/dt to 1,000 volts/0.5 micro seconds at the motor terminals.

2.2. **Protection**

.1 Provide the following VFD protection features as a minimum:
- .1 Line over and under voltage protection.
- .2 Phase loss and unbalance protection.
- .3 Short circuit protection for line to line and line to ground faults.
- .4 Electronic instantaneous overcurrent protection.
- .5 Current limit, adjustable between 0% and 110% for 30 minutes.
- .6 The VFD shall have a continuous duty service factor of 100% of rated output current with overload protection rating of 150% for 1 minute.
- .7 Internal over temperature protection.
- .8 Electronic motor stall protection to trip the VFD off should a motor overload or stall occur.

2.3. **Environment**

.1 The VFD shall have the following minimum environmental tolerances:
- .1 Ambient temperature range of 0 C to 40 C. Units located in non-heated areas shall be provided with thermostatically controlled heater weather enclosure.
- .2 Maximum humidity of 95% non-condensing.
- .3 Maximum altitude of 1000m for rated output.

2.4. **Performance**

.1 The VFD shall have the following performance features as a minimum:
- .1 Minimum efficiency of 97% at maximum load and speed.
- .2 Minimum line side displacement power factor of 0.98 at all speeds and loads.
- .3 Adjustable minimum and maximum motor frequency of 0 to 360 Hz.
- .4 Vector Control mode without tachometer feedback.
- .5 Separately adjustable acceleration and deceleration ramps from 0 to 3,600 seconds with damping and smoothing parameters for (0% to 100% speed).
- .6 DC Injection Braking.
- .7 Automatic restart after an inverter fault trip. The VFD shall attempt to restart automatically 5 times with Lock-Out after the third attempt if a restart has not occurred.
- .8 The VFD shall restart the motor at the speed at which it is rotating and then re-accelerate to the speed called for by the speed reference signal.
- .9 Capable of running without a motor connected for setup and testing.
- .10 Capable of accepting the opening of a remote motor disconnect while running without causing damage to the VFD.
- .11 Auto restart after power outage.
- .12 Skip frequency reject point to prevent the fan/pump from operating at a resonant speed. Adjustable centre frequency with a band width of 0 - 10 Hz.
- .13 Automatic/manual signal follower for 4-20 mA, 0-20mA, 0-10 VDC or 2-10 VDC reference.

2.5 **Operator Interface**

.1 Provide a door mounted keypad with a 32 character Alpha-numeric high resolution display to allow the operations personnel to set up and monitor the VFD parameters, observe output speed, load or other programmable values and monitor status and fault information, complete with tactile keys and backlit display.

.2 Provide maintenance monitoring to display the time since starting, total elapsed run time and total KWH. Also provide maintenance target alarm to alert the operator with a displayed message.

.3 Provide the following control functions on the door mounted keypad:
- .1 Run (Manual Mode)
- .2 Stop (Auto and Manual Mode)
- .3 Parameterisation button (to toggle between parameters)

.4 Provide a selectable display to observe the following parameters:
- .1 Frequency
- .2 Frequency Setpoint
- .3 Motor Current
- .4 DC-Link Voltage
- .5 Motor Torque (% nominal)
- .6 Motor RPM

2.6 **Fault Information**

.1 Provide fault diagnostics to simplify troubleshooting. In the event of a fault condition, the display shall indicate the nature of the fault, Including:
- .1 Overvoltage
- .2 Undervoltage
- .3 Overcurrent
- .4 Overload
- .5 Overheating of Motor (monitoring with PTC)
- .6 Inverter over temperature
- .7 Main phase missing (for 3 phase units)

2.7 **Communication and Control**

.1 Provide the following to interface with the Building Automation Control System (BAS):
- .1 Dry contact closure from BAS for run Command (Auto Mode).
- .2 4-20 mA (0-20 mA, 0-10 VDC, 2-10 VDC) signal from BAS for speed control (Auto Mode).
- .3 Dry contact (N.O.) output to BAS to indicate:
  Inverter Fault
  Inverter Running
- .4 0-20 mA or 4-20 mA analog output to BAS, proportional to 0-100% speed or load.
- .5 Terminal for interlocking of up to 5 external interlocks e.g. Firestat, Freezestat, etc.

.2 Provide serial communications interface and software to permit remote monitoring and modification of all VFD parameters. Interface shall have the following features:
- .1 Connection capable of RS-485 communications standards.

.3 Provide a process controller with the following feature as a minimum:
- .1 Input: Field process signal (temperature, pressure, etc.)
- .2 Output: 4-20 mA or 0-10 V speed reference to the VFD.
- .3 Programmable proportional, integral and derivative gains.
- .4 Operator adjustable process setpoint.

2.8 **System Operation**

.1 If "Manual" mode is selected the VFD/motor will start when the run key is depressed. The speed will be controlled by depressing the Accelerate or Decelerate keys on the keypad or by the direct speed set mode.

.2 If "Auto" mode is selected the VFD/motor will start when a contact closure run command is received from the BAS. The speed will be controlled by a speed reference signal from the BAS.

.3 In the event of a power outage the VFD shall automatically restart when the power returns provided the run command is maintained.

.4 In the event of an inverter fault trip the VFD shall attempt to restart automatically up to maximum of 5 attempts. If, after 5 attempts, restart does not occur, the VFD shall lock out.

PART 3 – EXECUTION

3.1 **Installation**

.1 Install each VFD in accordance with manufacturer's recommendations and local, provincial and national safety codes.

.2 Use motors with a minimum of CLASS F insulation. Motor shall be rated for inverter duty.

.3 Provide on site commissioning (start-up) of the VFDs by a factory authorized technician. Allow a minimum of ½ day per system. Also include an allowance for a second visit to site of one day duration to train operating personnel in the operation and maintenance of the VFDs.

.4 Provide all necessary field control wiring between VFDs, control panels and sensors.

.5 Upon completion of the installation the supplier of VFDs shall supply four complete sets of service and maintenance manuals including wiring and connection diagrams.

.6 Upon completion of the commissioning the supplier of VFDs shall supply four compete sets of typed report and one floppy disk of parameters ready for uploading for future use.

END OF SECTION 15856

Inspection and Testing of Mechanical Systems

PART 1 - GENERAL

1.0 General Instructions

.1 Read and be governed by Conditions of the Contract and Sections of Division 1.
.2 Comply with Mechanical General Requirements, Section 15010.

1.1 Tendering

.1 The cost of this Division shall be carried by the mechanical contractor within the mechanical tender cost.

.2 Acceptable Balancing Firms:

.1	Dynamic Flow Balancing	905-338-0808
.2	Air Audit	905-740-0871
.3	Air Velocities	905-270-1460

1.2 Scope of Work

.1 The work included in this section consists of furnishing labour, instruments, and tools required in testing, adjusting and balancing the HVAC systems, as described in these specifications or shown on accompanying drawings. Services shall include checking equipment performance, taking the specified measurements, and recording and reporting the results.

.2 The items requiring testing, adjusting, and balancing include the following:

.1 Systems - Fans
ERV
Pumps
Chillers
Exhaust systems
Pumps, heat exchangers
Fan coils
Reheat coils

.2 Air Systems
Supply fan AHU's
Return fans
Exhaust fans
Supply fans
Zone branch and main ducts.
CV systems and terminal units
Diffusers, Registers and Grilles
Coils (air temperature)

.3 Hydronic Systems
Pumps
System mains and branches

Heat exchangers
Coils
Terminal units (radiation units)

.4 Domestic hot water systems

.5 Plumbing systems.

.6 Building Pressurization

.7 Work co-operatively with Division 15900 for full T.A.B. of the supply and exhaust systems.

1.3 **Qualifications and Quality Assurance**

.1 All work shall be in accordance with the latest edition of the AABC National Standards. If these contract documents set forth more stringent requirements than the AABC National Standards, these contract documents shall prevail. The TAB Agency shall be a current member of the Associated Air Balance Council (AABC).

.2 Any deficiencies in the installation or performance of a system or component observed by the TAB Agency shall be brought to the attention of the Consultant.

.3 The work necessary to correct items on the deficiency listing shall be performed and verified by the affected contractor before the TAB Agency returns to retest. Unresolved deficiencies shall be noted in the final report.

1.4 **Schedules**

.1 Accuracy:
.1 Complete testing, adjusting, and balancing to within plus 10% or minus 5% of design values.
.2 Measurements to be accurate to within plus or minus 2% of actual values.

.2 Instrument Calibration: to be in accordance with testing, adjusting, and balancing referenced standard, but within 3 months of commencement of testing, adjusting, and balancing. Calibration certificates to be made available to the Consultant upon request.

1.5 **Duties of the Testing Company**

.1 Balance and test all control systems for proper adjustments.

.2 Supervise operating testing in preparation for the final eight (8) hour operating test to ensure that all systems conform to the plans and specifications. This test to be performed in the presence of the Engineer.

.3 Review with the Owner's representative the start-up and operation of the systems, including all the air systems for a minimum of two eight (8) hour days.

.4 Balance all systems at each outlet shown on the drawings.

.5 A draft balancing report shall be issued to the engineer for review. The Testing Company shall review the draft of the balancing report on site with the Engineer and make adjustments to the fans, valves and terminal units as directed by the engineer as part of the scope of work. Once these adjustments are made, reviewed on site and accepted by the Engineer, the final report shall be issued.

.6 The Testing Company shall provide all instruments required for testing the system, and shall keep records of all trial balances as well as final balance. These records shall be submitted to the Engineer at the completion of tests. Air balance shall be done as outlined in the Ventilating and Air conditioning Contractors Association Testing and Balancing Manual.

.7 The testing Company shall allow for two (2) site visits during construction to review and report the mechanical contractor's progress to the Engineer.

.8 The Testing Company shall allow for two (2) additional site visits during the one year guarantee period to make system adjustments as directed by the engineer.

.9 The Testing Company shall receive from the mechanical sub-contractor one (1) set of Manufacturer's Operating and Maintenance Instruction for review.

.10 The final testing and balancing report shall be reviewed with the Owner's representative and the Engineer to ensure thorough understanding of the equipment, its operation and final balancing of the systems.

1.6 **Submittals and Reports**

.1 Report
- .1 Format to be in accordance with testing, adjusting and balancing referenced standard in Item 1.3.
- .2 Report to include “as-built” full system schematics showing results of testing, adjusting, and balancing.
- .3 Submit six (6) copies of testing, adjusting, and balancing reports, each in 3-ring binders, complete with index tabs for review by Consultant.

.2 Settings - Lock and permanently mark settings as required by reference standard.

1.7 **Verification**

.1 All reported results subject to verification by Consultant.
.2 Provide manpower and instrumentation to verify up to 30% of all reported results.
.3 Number and location of verified results to be at discretion of Consultant after review of report.
.4 Bear costs to repeat TAB as required to satisfaction of Consultant.

1.8 **Completion**

.1 Testing, adjusting, and balancing to be considered complete only when final reports are approved by Consultant.

1.9 **Air Systems**

.1 General - measurements as required by referenced standards, including, but not limited to, the following:

.1 Measurements
Air velocity
Static pressure
Velocity pressure
Temperature
Wet bulb
Dry bulb
Cross sectional area
RPM
Electrical power
Voltage
Current draw

.2 Location of equipment measurements
Inlet and outlet of each
Fan
Coil
Damper
Filter
Humidifier
CV box
Other auxiliary equipment
New air handling units

.3 Location of system measurements at:
Main ducts
Main branch ducts
Sub-branch ducts
Each supply, exhaust and return air inlet and outlet.
Other auxiliary equipment.
All areas served by system.

.4 For zone, branch and main ducts
.1 adjust ducts to within design CFM requirements. As applicable at least one zone balancing damper shall be complete open. Multi-diffuser branch ducts shall have at least one outlet or inlet volume damper completely open.

.5 For CV systems -
.1 Set volume regulators on all terminal boxes to meet design maximum and minimum CFM requirements.
.2 Identification - identify the type, location, and size of each terminal box. This information shall be recorded on terminal box data sheets.

.6 Air Systems

.1 The supply air systems shall be balanced to provide air quantities shown on the drawings with air patterns set for best draft free air distribution and sound levels. Set flows within ± 10 or - 5% of design flows. Branch dampers shall be used for majority of balancing, grille and diffuser dampers to set final 10% adjustment.

.2 The return air systems shall be set to provide a slight positive pressure in the building unless otherwise noted.

.3 The exhaust air systems shall be set to exhaust the air quantities listed on the drawings.

.4 Fan systems shall be set to divulge the specified air flow at the lowest possible pressure and noise levels. Adjust all sheaves and belts as required.

.5 Adjust all spring isolators to ensure free isolation of equipment and that all equipment is level.

.6 Ensure all condensate traps are draining under the normal operating static pressures.

.7 For coils:

.1 Air temperature - once air flows are set to acceptable limits, take wet bulb and dry bulb air temperatures on the entering and leaving side of each cooling coil. Dry-bulb temperature shall be taken on the entering and leaving side of each heating coil.

1.10 **Hydronic Systems**

.1 Measurements - to include, but not limited to, following as appropriate for systems, equipment, components, controls: flow rate, static pressure, pressure drop (or loss), temperature, specific gravity, density, RPM, electrical power voltage, noise, vibration.

.2 Locations of equipment measurement - to include, but not be limited to, following as appropriate.

.1 Inlet and outlet of each heat exchanger (primary and secondary sides), coil, humidifier, condenser, pump, PRV, control valve, other equipment causing changes in conditions.

.2 At each controller, controlled device.

.3 Locations of systems measurements to include, but not be limited to, following as appropriate - supply and return of each primary and secondary loop (main, main branch, branch, sub-branch) of all hydronic systems, inlet connection of make-up water.

.4 For pumps:

.1 Test and adjust chilled water, hot water, and glycol water pumps to achieve maximum or design GPM. Check pumps for proper operation. Pumps shall be free of vibration and cavitation. Record appropriate gauge readings for final TDH and Block-off / Dead head calculations.

.2 Current and voltage - test and record motor voltage and amperage, and compare data with the nameplate limits to ensure pump motor is not in or above the service factor.

.5 For heat exchangers -

.1 Verify that heat exchangers have been filled and started by mechanical contractor, and are in operation.

.2 Test and adjust water flow through heat exchangers.
.3 Test and record temperature and pressure profiles of water or steam heat exchangers.

.6 For coils
.1 Tolerances - test, adjust, and balance all chilled water and hot water coils within 10% of design requirements.

.7 .Water Systems
.1 Adjust water systems to achieve temperature drops (rises) and flows as specified.
.2 Set flows to ± 10% of design flows.
.3 All temperature controls to be adjusted to operate properly.
.4 Check all system fill levels and pressures, vent the expansion tanks, and vent any air locks in the systems.
.5 Record all pump data, motor loads, fluid temperatures fluid pressures.
.6 Blowdown all strainers and drains before measurements.
.7 Recommend final pump impeller sizes to the mechanical contractor so that proper trimming can be done.

1.11 Zone Pressure Differences

.1 Adjust HVAC systems, equipment, controls to establish specified air pressure differentials, with all systems in all possible combinations of normal operating modes.

.2 TAB procedures:
.1 Building / Zone Pressurization
The TAB Agency shall test and adjust building / zone pressurization by setting the design flows to meet the required flow direction and pressure differential. For positive pressure areas, it shall set the supply air to design flow, and gradually reduce the exhaust air rate to obtain the required flow or pressure difference. For negative pressure areas, it shall set the supply air to design flow, and gradually increase the exhaust air rate to obtain the required flow or pressure difference. Relative zone pressurization to be checked with CV systems operating under conditions with exhaust systems running and off.

1.12 Duties of the Mechanical Contractor

.1 Duties of the Mechanical Contractor:
.1 The mechanical contractor shall be responsible for the initial balancing of the system.
.2 Place at the disposal of the Testing Company a competent person to make all system adjustments. He shall act under the supervision of the Testing Company, and provide all equipment required for the adjustment of the system and erect all ladders, scaffolding, etc. required for access all the parts of the system requiring testing.
.3 Provide shop drawings, literature, etc. necessary for the operating and maintenance manuals and place at the disposal of the Testing Company men competent in the specific areas of the work during the start-up and operating instructions to the Owner.
.4 Provide all balancing devices where required by the balancing firm.

.5 Change sheaves and belts of fans and trim impellers of pumps as required by the balancing contractor. Sheaves and belts shall be supplied by the Equipment Manufacturers.

.6 Pre-Start-up Checks

.1 All equipment will be rendered fully operational by the Mechanical Contractor before testing and balancing commences. All rotations, lubrication, alignments, controls, pressure tests and jog tests shall be made and logged on a proper pre-startup checklist before any equipment is started. This list shall be reviewed with other sub-trades to correct any deficiencies before any equipment is started for any reason other than to check rotation.

.2 Any suppliers checklists and required site visits and reports must be made at this time.

.3 Submit the completed pre-startup checklist to the engineer.

.4 Replace drive belts and sheaves as required by the testing and balancing firm in order to achieve the proper operating conditions.

1.13 **Post Occupancy TAB**

.1 Measure DBT, WBT or % RH, air velocity, air flow patterns, NC levels, in occupied zone of following areas.

.2 Emergency evacuation: participate in full scale emergency evacuation exercises.

.3 Participate in systems checks twice during Warranty Period - #1 approximately 3 months after acceptance, and #2 within one month of termination of warranty period.

END OF SECTION 15877

Commissioning

PART 1 - GENERAL

1.1 Description

A. The purpose of this section is to specify Division 15 responsibilities in the commissioning process.

B. Commissioning is a systematic process of ensuring that all building systems function in compliance with criteria set forth in the project contract documents to satisfy the owner's operational needs. The commissioning authority works with the contractors to verify the installation, schedule commissioning activities, verify training, observe equipment startup, conduct tests, resolve deficiencies, re-test, and provide documentation of the process. The contractor is expected to verify the functional readiness of systems to be tested prior to execution of performance tests.

C. The following equipment and systems will be commissioned in this project.

- Chillers
- Boilers
- Heat exchangers
- Pumps
- Heat Recovery units
- Rooftop AC units
- Fan coil units
- Terminal units
- Exhaust fans
- Unit heaters
- Force flow heaters and radiation
- Piping systems
- Ductwork
- Building control system
- Testing, adjusting and balancing work
- Testing, adjusting and balancing work

1.2 Responsibilities

A. Mechanical, Controls and TAB Contractors. The commissioning responsibilities applicable to each of the mechanical, controls and TAB contractors are as follows:

Construction Phase

1. In each purchase order or subcontract written, include requirements for submittal data, commissioning documentation, O&M data and training.
2. Attend a commissioning kickoff meeting and other meetings necessary to facilitate the commissioning process.
3. Contractors shall provide the commissioning authority with normal cut sheets and shop drawing submittals of commissioned equipment.
4. Provide additional requested documentation, prior to normal O&M manual submittals, to the commissioning authority for development of installation, operation and performance test sheets.
   a. Typically this will include detailed manufacturer installation and start-up, operating, troubleshooting and maintenance procedures, full details of any owner-contracted tests, fan and pump curves, full factory testing reports, if any, and full warranty information, including all responsibilities of the Owner to keep the warranty in force clearly identified. In addition, the installation, start-up and checkout materials that are actually shipped inside the equipment and the actual field checkout sheet forms to be used by the factory or field technicians shall be submitted to the commissioning authority.

b. The commissioning authority may request further documentation necessary for the commissioning process.
c. This data request may be made prior to normal submittals.

5. Provide a copy of the O&M manuals and submittals of commissioned equipment, through normal channels, to the commissioning authority for review and approval.
6. Contractors shall assist in clarifying the operation and control of commissioned equipment in areas where the specifications, control drawings or equipment documentation is not sufficient for writing detailed testing procedures.
7. Contractors shall review performance test procedures to ensure that equipment, assemblies, systems, or people will not be endangered or warranties voided.
8. Develop a full start-up and initial checkout plan using manufacturer's start-up procedures for all commissioned equipment. Submit to commissioning authority for review and approval prior to startup.
9. During the startup and initial checkout process, execute the mechanical-related portions of the operation checks for all commissioned equipment.
10. Perform and clearly document all completed startup and system operational checkout procedures, providing a copy to the commissioning a.
11. Address current design professional punch list items before functional performance testing. Air and water balancing shall be completed with discrepancies and problems remedied before functional performance testing.
12. Provide skilled technicians to execute startup of equipment and for problem solving during functional performance testing. Ensure that they are available and present during the agreed upon schedules and for sufficient duration to complete the necessary tests, adjustments and problem-solving.
13. Correct deficiencies (differences between specified and observed performance) as interpreted by the commissioning and design professionals and retest the equipment.
14. Prepare O&M manuals according to the Contract Documents, including clarifying and updating the original sequences of operation to as-built conditions.
15. During construction, maintain as-built red-line drawings for all drawings and final CAD as-builts for contractor-generated coordination drawings. Update after completion of commissioning (excluding deferred testing).
16. Provide training of the Owner's operating staff using expert qualified personnel, as specified.
17. Coordinate with equipment manufacturers to determine specific requirements to maintain the validity of the warranty.

Warranty Period

1. The commissioning authority will execute and document seasonal or deferred functional performance testing and recall contractors only if there are problems.
2. Correct deficiencies and make necessary adjustments to O&M manuals and as-built drawings for applicable issues identified in any seasonal testing.

B. Mechanical Contractor. The responsibilities of the mechanical contractor, during construction phase in addition to those listed in (A) are:

1. Provide startup for all equipment, except for the building automation control system.
2. Place all equipment and systems into continued operation during each working day of TAB work.
3. Install a P/T plug at each water sensor which is an input point to the control system.
4. Prepare a preliminary schedule for Division 15 pipe and duct system testing, flushing and cleaning, and equipment start-up for use by the commissioning authority. Update the schedule as appropriate.

5. Notify the commissioning authority, when pipe and duct system testing, flushing, cleaning, and startup of each piece of equipment will occur. Be responsible to notify the commissioning authority, ahead of time, when commissioning activities not yet performed or not yet scheduled will delay construction. Be proactive in seeing that commissioning processes are executed and that the commissioning authority has the scheduling information needed to efficiently execute the commissioning process.

C. Controls Contractor. The commissioning responsibilities of the controls contractor, during construction phase in addition to those listed in (A) are:

1. Sequences of Operation Submittals. The controls contractor's submittals of control drawings shall include complete detailed sequences of operation for each piece of equipment, regardless of the completeness and clarity of the sequences in the specifications. They shall include:
   a. An overview narrative of the system (1 or 2 paragraphs) generally describing its purpose, components and function.
   b. All interactions and interlocks with other systems.
   c. Detailed delineation of control between any packaged controls and the building automation system, listing what points the BAS monitors only and what BAS points are control points and are adjustable.
   d. Written sequences of control for packaged controlled equipment. (Equipment manufacturers' stock sequences may be included, but will generally require additional narrative).
   e. Start-up sequences.
   f. Warm-up mode sequences.
   g. Normal operating mode sequences.
   h. Unoccupied mode sequences.
   i. Shutdown sequences.
   j. Capacity control sequences and equipment staging.
   k. Temperature and pressure control: setbacks, setups, resets, etc.
   l. Detailed sequences for all control strategies, e.g., economizer control, optimum start/stop, staging, optimization, demand limiting, etc.
   m. Effects of power or equipment failure with all standby component functions.
   n. Sequences for all alarms and emergency shut downs.
   o. Seasonal operational differences and recommendations.
   p. Initial and recommended values for all adjustable settings, setpoints and parameters that are typically set or adjusted by operating staff; and any other control settings or fixed values, delays, etc. that will be useful during testing and operating the equipment.
   q. Schedules, if known.

2. Control Drawings Submittal
   a. The control drawings shall have a key to all abbreviations.
   b. The control drawings shall contain graphic schematic depictions of the systems and each component.
   c. The schematics will include the system and component layout of any equipment that the control system monitors, enables or controls, even if the equipment is primarily controlled by packaged or integral controls.
   d. Provide a full points list with at least the following included for each point:
   1) Controlled system
   2) Point abbreviation
   3) Point description
   4) Display unit

5) Control point or setpoint (Yes / No)
6) Monitoring point (Yes / No)
7) Intermediate point (Yes / No)
8) Calculated point (Yes / No)

Key:
Point Description: DB temp, airflow, etc.
Control or Setpoint: Point that controls equipment and can have its setpoint changed (OSA, SAT, etc.)
Intermediate Point: Point whose value is used to make a calculation which then controls equipment (space temperatures that are averaged to a virtual point to control reset).
Monitoring Point: Point that does not control or contribute to the control of equipment, but is used for operation, maintenance, or performance verification.
Calculated Point: "Virtual" point generated from calculations of other point values.

The controls contractor shall keep the commissioning authority informed of all changes to this list during programming and setup.

3. An updated as-built version of the control drawings and sequences of operation shall be included in the final controls O&M manual submittal.

4. Assist and cooperate with the TAB contractor in the following manner:

   a. Meet with the TAB contractor prior to beginning TAB and review the TAB plan to determine the capabilities of the control system toward completing TAB. Provide the TAB any needed unique instruments for setting terminal unit boxes and instruct TAB in their use (handheld control system interface for use around the building during TAB, etc.).
   b. For a given area, have all required control setup and checkout completed and approved by the commissioning authority prior to TAB work.
   c. Provide a qualified technician to operate the controls to assist the TAB contractor in performing TAB, or provide sufficient training for TAB to operate the system without assistance.

5. Assist and cooperate with the commissioning authority in the following manner:

   a. Using a skilled technician who is familiar with this building, assist in the functional performance testing of the controls system as per test requirements developed in the commissioning check sheets (prepared by the commissioning authority). Provide two-way radios during the testing.
   b. Execute all control system trend logs specified in BAS points list on drawings.

6. The controls contractor shall prepare a written plan indicating in a step-by-step manner, the procedures that will be followed to test, checkout and adjust the control system prior to functional performance testing. At minimum, the plan shall include for each type of equipment controlled by the automatic controls:

   a. System name.
   b. List of devices.
   c. Step-by-step procedures for testing each controller after installation, including:
      1) Process of verifying proper hardware and wiring installation.

2) Process of downloading programs to local controllers and verifying that they are addressed correctly.
3) Process of performing operational checks of each controlled component.
4) Plan and process for calibrating valve and damper actuators and all sensors.
5) A description of the expected field adjustments for transmitters, controllers and control actuators should control responses fall outside of expected values.

d. A copy of the log and field checkout sheets that will document the process. This log must include a place for initial and final read values during calibration of each point and clearly indicate when a sensor or controller has “passed” and is operating within the contract parameters.
e. A description of the instrumentation required for testing.
f. Indicate what tests on what systems should be completed prior to TAB using the control system for TAB work. Coordinate with the commissioning authority and TAB contractor for this determination.

7. Provide a signed and dated certification to the commissioning authority upon completion of the checkout of each controlled device, equipment and system prior to functional performance testing for each piece of equipment or system, that all system programming is complete as to all respects of the Contract Documents, except functional testing requirements.
8. Beyond the control points necessary to execute all documented control sequences, provide monitoring, control and virtual points as specified in the BAS points list on drawings.
9. List and clearly identify on the as-built duct and piping drawings the locations of all static and differential pressure sensors (air, water and building pressure).

D. TAB Contractor. The duties of the TAB contractor, in addition to those listed in (A) are:

1. Six weeks prior to starting TAB, submit to the general contractor the qualifications of the site technician for the project, including the name of the contractors and facility managers of recent projects the technician on which was lead. The Owner will approve the site technician’s qualifications for this project.
2. Submit the outline of the TAB plan and approach for each system and component to the commissioning authority, general contractor and the controls contractor six weeks prior to starting the TAB. This plan will be developed after the TAB has some familiarity with the control system.
3. The submitted plan will include:
   a. Certification that the TAB contractor has reviewed the construction documents and the systems with the design engineers and contractors to sufficiently understand the design intent for each system.
   b. An explanation of the intended use of the building control system. The controls contractor will comment on feasibility of the plan.
   c. All field checkout sheets and logs to be used that list each piece of equipment to be tested, adjusted and balanced with the data cells to be gathered for each.
   d. Discussion of what notations and markings will be made on the duct and piping drawings during the process.
   e. Final test report forms to be used.
   f. Detailed step-by-step procedures for TAB work for each system and issue: terminal flow calibration (for each terminal type), diffuser proportioning, branch / sub-main proportioning, total flow calculations, rechecking, diversity issues,

expected problems and solutions, etc. Provide the analogous explanations for the water side.

g. List of all air flow, water flow, sound level, system capacity and efficiency measurements to be performed and a description of specific test procedures, parameters, formulas to be used.
h. Details of how *total* flow will be determined (Air: sum of terminal flows via BAS calibrated readings or via hood readings of all terminals, supply (SA) and return air (RA) pitot traverse, SA or RA flow stations. Water: pump curves, circuit setter, flow station, ultrasonic, etc.).
i. The identification and types of measurement instruments to be used and their most recent calibration date.
j. Specific procedures that will ensure that both air and water side are operating at the lowest possible pressures and provide methods to verify this.
k. Confirmation that TAB understands the outside air ventilation criteria under all conditions.
l. Details of whether and how minimum outside air cfm will be verified and set, and for what level (total building, zone, etc.).
m. Details of how building static and exhaust fan / relief damper capacity will be checked.
n. Proposed selection points for sound measurements and sound measurement methods.
o. Details of methods for making any specified coil or other system plant capacity measurements.
p. Details of any TAB work to be done in phases (by floor, etc.), or of areas to be built out later.
q. Details regarding specified deferred or seasonal TAB work.
r. Details of any specified false loading of systems to complete TAB work.
s. Details of all exhaust fan balancing and capacity verifications, including any required room pressure differentials.
t. Details of any required interstitial cavity differential pressure measurements and calculations.
u. Plan for hand-written field technician logs of discrepancies, deficient or uncompleted work by others, contract interpretation requests and lists of completed tests (scope and frequency).
v. Plan for formal progress reports (scope and frequency).
w. Plan for formal deficiency reports (scope, frequency and distribution).

4. A running log of events and issues shall be kept by the TAB field technicians. Submit hand-written reports of discrepancies, deficient or uncompleted work by others, contract interpretation requests and lists of completed tests to the commissioning authority and general contractor at least twice a week.
5. Communicate in writing to the controls contractor all setpoint and parameter changes made or problems and discrepancies identified during TAB which affect the control system setup and operation.
6. Provide a draft TAB report within two weeks of completion. A copy will be provided to the commissioning authority. The report will contain a full explanation of the methodology, assumptions and the results in a clear format with designations of all uncommon abbreviations and column headings. The report should follow the latest and most rigorous reporting recommendations by AABC, NEBB or ASHRAE Standard 111.
7. Provide the commissioning authority with any requested data, gathered, but not shown on the draft reports.
8. Provide a final TAB report for the commissioning authority with details, as in the draft.
9. A random sample of up to 30% of the TAB report data shall be selected for verification, witnessed by the commissioning authority.

PART 2 - PRODUCTS

2.1 Test Equipment

A. Division 15 shall provide all test equipment necessary to fulfill the testing requirements of this Division.

PART 3 - EXECUTION

3.1 Submittals

A. Division 15 shall provide submittal documentation relative to commissioning as required in Section 15010.

3.2 Startup

A. The HVAC mechanical and controls contractors shall follow the start-up and initial checkout procedures listed in the Responsibilities list in this section and in 15010. Division 15 has start-up responsibility and is required to complete systems and sub-systems so they are fully functional, meeting the design objectives of the Contract Documents. The commissioning procedures and functional testing do not relieve or lessen this responsibility or shift that responsibility partially to the commissioning authority or Owner.

B. Functional performance testing is intended to begin upon completion of a system. Functional performance testing may proceed prior to the completion of systems or sub-systems at the discretion of the commissioning authority and general contractor. Beginning system testing before full completion, does not relieve the Contractor from fully completing the systems as soon as possible.

3.3 Tab

A. Refer to the TAB responsibilities in Part 1.2 above.

3.4 Functional Performance Tests

A. Refer to this section Part 1.4 for a list of systems to be commissioned and to sample commissioning verification sheets at the end of this section for specific details on the required functional performance tests.

3.5 Testing Documentation, Non-Conformance And Approvals

A. The commissioning authority will record the results of the installation/operation checks and performance tests on the commissioning verification forms. All deficiencies or non-conformance issues will be noted and reported to the general contractor on a standard issue report form.

B. Corrections to deficiencies shall be documented on the issues report form. The commissioning authority reschedules the test and the test is repeated until satisfactory performance is achieved.

C. The commissioning authority recommends acceptance of each test to the owner. The owner gives final approval on each test, providing a signed copy to the commissioning authority and the contractor.

3.6 **Operation And Maintenance (O&M) Manuals**

A. The following O&M manual requirements do not replace O&M manual documentation requirements elsewhere in these specifications.

B. Division 15 shall compile and prepare documentation for all equipment and systems covered in Division 15 for inclusion in the O&M manuals prior to the training of owner personnel.

C. The commissioning authority shall receive a copy of the O&M manuals for review.

D. Special Control System O&M Manual Requirements. In addition to documentation that may be specified elsewhere, the controls contractor shall compile and organize at minimum the following data on the control system in labeled 3-ring binders with indexed tabs.

1. Three copies of the controls training manuals in a separate manual from the O&M manuals.
2. Operation and Maintenance Manuals containing:

    a. Specific instructions on how to perform and apply all functions, features, modes, etc. mentioned in the controls training sections of this specification and other features of this system. These instructions shall be step-by-step. Indexes and clear tables of contents shall be included. The detailed technical manual for programming and customizing control loops and algorithms shall be included.
    b. Full as-built set of control drawings (refer to Submittal section above for details).
    c. Full as-built sequence of operations for each piece of equipment.
    d. Full points list. In addition to the updated points list required in the original submittals (Part 1 of this section), a listing of all rooms shall be provided with the following information for each room:
        1) Floor
        2) Room number
        3) Room name
        4) Air handler unit ID
        5) Reference drawing number
        6) Air terminal unit tag ID
        7) Heating and/or cooling valve tag ID
        8) Minimum cfm
        9) Maximum cfm
    e. Full print out of all schedules and set points after testing and acceptance of the system.
    f. Full as-built print out of software program.
    g. Electronic copy on disk of the entire program for this facility.
    h. Marking of all system sensors and thermostats on the as-built floor plan and mechanical drawings with their control system designations.
    i. Maintenance instructions, including sensor calibration requirements and methods by sensor type, etc.
    j. Control equipment component submittals, parts lists, etc.
    k. Warranty requirements.
    l. Copies of all checkout tests and calibrations performed by the Contractor (not commissioning tests).

3. The manual shall be organized and subdivided with permanently labeled tabs for each of the following data in the given order:
   a. Sequences of operation
   b. Control drawings
   c. Points lists
   d. Controller / module data
   e. Thermostats and timers
   f. Sensors and DP switches
   g. Valves and valve actuators
   h. Dampers and damper actuators
   i. Program setups (software program printouts)

E. Special TAB Documentation Requirements. The TAB will compile and submit the following with other documentation that may be specified elsewhere in the *Specifications.*

1. Final report containing an explanation of the methodology, assumptions, test conditions and the results in a clear format with designations of all uncommon abbreviations and column headings.
2. The TAB shall mark on the drawings where all traverse and other critical measurements were taken and cross reference the location in the TAB report.

F. Review and Approvals. Prior to substantial completion, the commissioning authority shall review the O&M manuals, documentation and redline as-built drawings for systems that were commissioned. The commissioning authority will communicate deficiencies in the manuals to the design professional. This work does not supersede the design professional's review of the O&M manuals.

3.7. Training Of Owner Personnel

A. The general contractor shall be responsible for training, coordination and scheduling and ultimately to ensure that training is completed.

B. The commissioning authority shall be responsible for overseeing and approving the content and adequacy of the training of owner personnel for commissioned equipment.

C. Video taping of the training sessions will be provided by the commissioning authority.

D. The mechanical contractor shall have the following training responsibilities:

1. Provide the CA with a training plan two weeks before the planned training.
2. Provide designated Owner personnel with comprehensive orientation and training in the understanding of the systems and the operation and maintenance of each piece of HVAC equipment including, but not limited to, pumps, boilers, chillers, air cooled condenser, rooftop air conditioning units, heat recovery units, fan coil units, terminal units, fans, controls, domestic solar system and rain water harvesting system, etc.
3. Training shall normally start with classroom sessions followed by hands-on training on each piece of equipment, which shall illustrate the various modes of operation, including startup, shutdown, fire/smoke alarm, power failure, etc.
4. During any demonstration, should the system fail to perform in accordance with the requirements of the O&M manual or sequence of operations, the system will be repaired or adjusted as necessary and the demonstration repeated.
5. The appropriate trade or manufacturer's representative shall provide the instructions on each major piece of equipment. Practical building operating expertise as well as in-

depth knowledge of all modes of operation of the specific piece of equipment is required.

6. The controls contractor shall attend sessions other than the controls training, as requested, to discuss the interaction of the controls system as it relates to the equipment being discussed.
7. The training sessions shall follow the outline in the Table of Contents of the operation and maintenance manual and illustrate whenever possible the use of the O&M manuals for reference.
8. Training shall include:
   a. Use of the printed installation, operation and maintenance instruction material included in the O&M manuals.
   b. A review of the written O&M instructions emphasizing safe and proper operating requirements, preventative maintenance, special tools needed and spare parts inventory suggestions. The training shall include start-up, operation in all modes possible, shut-down, seasonal changeover and any emergency procedures.
   c. Discussion of relevant health and safety issues and concerns.
   d. Discussion of warranties and guarantees.
   e. Common troubleshooting problems and solutions.
   f. Explanatory information included in the O&M manuals and the location of all plans and manuals in the facility.
   g. Discussion of any peculiarities of equipment installation or operation.
   h. The format and training agenda in *The HVAC Commissioning Process, ASHRAE Guideline 1-1989R*, 1996 is recommended.
   i. Classroom sessions shall include the use of overhead projections, slides, video/audio-taped material as might be appropriate.
9. Hands-on training shall include start-up, operation in all modes possible, including manual, shut-down and any emergency procedures and preventative maintenance for all pieces of equipment.
10. The mechanical contractor shall fully explain and demonstrate the operation, function and overrides of any local packaged controls, not *controlled* by the central control system.
11. Training shall occur after functional testing is complete, unless approved otherwise by the owner.
12. Duration of Training. The mechanical contractor shall provide 8 hours of training for the owner operating personnel. Training shall cover the following equipment.

Hours	System
_____	Chillers and System
_____	Air Cooled Condenser
_____	Boilers and System
_____	Piping Systems and Devices (make-up, expansion tank, air eliminator)
_____	Chemical Treatment
_____	Heat Recovery Units
_____	Variable Speed Drives
_____	Packaged Rooftop Units
_____	Fan Coil Units
_____	Air Terminal Units
_____	Exhaust Fans
_____	Unit Heaters
_____	Force Flow Heaters
_____	Radiators
_____	Kitchen Exhaust System
_____	Plumbing Fixtures

E. Controls Contractor. The controls contractor shall have the following training responsibilities:

1. Provide the commissioning authority with a training plan four weeks before the planned training.
2. The controls contractor shall provide designated owner personnel training on the control system in this facility. The intent is to clearly and completely instruct the owner on all the capabilities of the control system.
3. Training manuals. The standard operating manual for the system and any special training manuals will be provided for each trainee, with three extra copies left for the O&M manuals. In addition, copies of the system technical manual will be demonstrated during training and three copies submitted with the O&M manuals. Manuals shall include detailed description of the subject matter for each session. The manuals will cover all control sequences and have a definitions section that fully describes all relevant words used in the manuals *and* in all software displays. Manuals will be approved by the commissioning authority. Copies of audiovisuals shall be delivered to the owner.
4. The trainings will be tailored to the needs and skill-level of the trainees.
5. The trainers will be knowledgeable on the system and its use in buildings. For the on-site sessions, the most qualified trainer(s) will be used. The Owner shall approve the instructor prior to scheduling the training.
6. During any demonstration, should the system fail to perform in accordance with the requirements of the O&M manual or sequence of operations, the system will be repaired or adjusted as necessary and the demonstration repeated.
7. The controls contractor shall attend sessions other than the controls training, as requested, to discuss the interaction of the controls system as it relates to the equipment being discussed.
8. There shall be three training sessions:
   a. Training I - Control System: The first training shall consist of 4 hours of actual training. This training may be held on-site or in the supplier's facility. If held off-site, the training may occur prior to final completion of the system installation. Upon completion, each student, using appropriate documentation, should be able to perform elementary operations and describe general hardware architecture and functionality of the system.
   b. Training II - Building Systems: The second session shall be held on-site for a period of 4 hours of actual hands-on training after the completion of system commissioning. The session shall include instruction on:
      1) Specific hardware configuration of installed systems in this building and specific instruction for operating the installed system, including HVAC systems, lighting controls and any interface with security and communication systems.
      2) Security levels, alarms, system start-up, shut-down, power outage and restart routines, changing setpoints and alarms and other typical changed parameters, overrides, freeze protection, manual operation of equipment, optional control strategies that can be considered, energy savings strategies and set points that if changed will adversely affect energy consumption, energy accounting, procedures for obtaining vendor assistance, etc.
      3) All trending and monitoring features (values, change of state, totalization, etc.), including setting up, executing, downloading, viewing both tabular and graphically and printing trends. Trainees will actually set-up trends in the presence of the trainer.

4) Every screen shall be completely discussed, allowing time for questions.
5) Use of keypad or plug-in laptop computer at the zone level.
6) Use of remote access to the system via phone lines or networks.
7) Setting up and changing an air terminal unit controller.
8) Graphics generation.
9) Point database entry modifications.
10) Understanding DDC field panel operating programming (when applicable).

c. Training – III: The third training will be conducted on-site six months after occupancy and consist of 4 hours of training. The session will be structured to address specific topics that trainees need to discuss and to answer questions concerning operation of the system.

F. TAB The TAB contractor shall have the following training responsibilities:

1. TAB shall meet for 2 hours with facility staff after completion of TAB and instruct them on the following:
   a) Go over the final TAB report, explaining the layout and meanings of each data type.
   b) Discuss any outstanding deficient items in control, ducting or design that may affect the proper delivery of air or water.
   c) Identify and discuss any terminal units, duct runs, diffusers, coils, fans and pumps that are close to or are not meeting their design capacity.
   d) Discuss any temporary settings and steps to finalize them for any areas that are not finished.
   e) Other salient information that may be useful for facility operations, relative to TAB.

3.8. Deferred Testing

A. Deferred Tests. If any check or test cannot be completed due to the building structure, required occupancy condition or other deficiency, execution of performance test may be delayed. These tests will be conducted in the same manner as the seasonal tests as soon as possible. Services of necessary parties will be negotiated.

B. Seasonal Tests. During the warranty period, seasonal testing (tests delayed until weather conditions are closer to the system's design) shall be completed as part of the contract. The commissioning authority shall coordinate this activity. Tests will be executed, documented and deficiencies corrected by the appropriate contractor, with facilities and the commissioning authority witnessing. Any final adjustments to the O&M manuals and as-built drawings due to the testing will be made.

3.9 Written Work Products

A. The commissioning process generates a number of written work products that will be maintained by the commissioning authority in the commissioning plan. The commissioning plan will evolve throughout the construction phase with results added as the project progresses.

B. Written work products of contractors will consist of static tests (pipe and duct leak tests), equipment start-up, pipe flushing and cleaning, water treatment, controls checkout, test and balance.

AIR HANDLING SYSTEM VERIFICATION

Project:
Address:
System No.:
Project No.:

Installation Checks	√	Installation Checks	√
Duct construction		Framing for roof & floor openings	
Duct layout to record drawings		Roof curb & duct flashing	
Discharge duct restrictions/system effect		Housekeeping pads	
Duct/equipment supports		Equipment service access	
Access doors		Heating/cooling coil hook-up	
Test ports		Control valves	
Balancing dampers		Condensate line trap, size & pitch	
Control dampers		Fan cleanliness	
Fire damper, retaining angles, joint, access		Fan pressure test	
Turning vanes		Filters	
Duct sealant		Drive guards	
Duct pressure test		Vibration isolators	
Duct cleaning		Flexible connections	
Thermal insulation		Louvers, grilles & diffusers	
Weatherproof outdoor duct		Automatic control sensors	
Silencers/acoustic lining		High static, high temp & low temp switch(s)	
Flexible ductwork		Humidifier	
Duct identification		Equipment nameplates	
Duct painting		Power & control wiring	
		Sign: Date:	

Operation Checks	√	Operation Checks	√
Initial maintenance procedures completed		Controls setup & checkout	
Equipment startup test(s)		Trend log & alarm setup	
Safeties (lo limit, fire shutdown)		O&M manuals	
Air and water balancing		Record drawings	
Fire dampers		O&M training	
		Sign: Date:	

Performance Tests	Pass	Fail	Note
Shutdown mode			
Time of day schedule			
Fan startup is initiated by opening the outdoor and exhaust air dampers			
Supply air temperature control sequences energy recovery, heating and cooling			
Discharge temperature high limit control			
Discharge temperature low limit control			
Full energy recover is provided when OA-T is less than 4°C and more than RA-T			
Energy recovery frost control maintains EA-T @ -3 °C when OA-T < -15 °C			
Energy wheel stops to allow free cooling when OA-T is between 10°C and RA-T			
Bypass dampers open to divert airflow around wheel when free cooling is enabled			
Humidifier is enabled during winter season when OA-T < 12 °C.			
Humidifier operation requires proof of air flow			
Exhaust air humidity control modulates humidifier output to maintain setpoint			
Supply air humidity control limits capacity of humidifier to prevent saturation			
Alarm tests			
Trend reports			
Sign: Date:			

Comments: * Not Applicable

Test Accepted By: Sign: Date:

COMPRESSED AIR SYSTEM VERIFICATION

Project:
Address:
System No.:
Project No.:

Installation Checks	√	Installation Checks	√
Installation per manufacturers recommendation		Main pipe pressure relief Valve	
Pipe layout per as-built drawings		Main pipe regulator	
Pipe material per specifications		Branch pipe regulators	
Pipe sloped to drip leg		Isolation valves	
Air intake filters		Moisture traps	
After-cooler		Service outlets (regulator, shutoff, drip leg)	
Air dryer		Pressure gauges	
Oil/water separator		Cleaning and flushing	
Drive guards		Pressure test	
Equipment service access		Valve tags	
Housekeeping pad		Equipment nameplates	
Vibration control		Pipe identification	
Pipe/equipment supports		Power wiring	
Pipe sleeves, firestopping, seals, flashing			
Compressor discharge check valve			
Compressor discharge pressure relief valve			
Receiver pressure switch			
Receiver pressure relief valve			
Receiver drain valve			
		Sign: Date:	

Operation Checks	√	Operation Checks	√
Initial maintenance procedures completed		O&M manuals	
Equipment start-up		Record drawings	
Location of intake air (clean)		O&M training	
Safeties (pressure relief)			
TSSA approval			
		Sign: Date:	

Performance Tests	Pass	Fail	Note
Pressure switch maintains tank pressure @ 150 psi			
Main regulator maintains supply air pressure @ 130 psi			
Branch regulators maintain supply air pressure @ 120 psi			
Service outlet regulators maintain supply air pressure @ STPT			
		Sign: Date:	

Comments: * Not Applicable

Test Accepted By: Sign: Date:

COOLING SYSTEM VERIFICATION

Project:
Address:
System No.:
Project No.:

Installation Checks	√	Installation Checks	√
Cooling pipe layout to record drawings		Check valves	
Water make-up c/w BFP		Strainers	
Chillers		Vibration isolators & flexible connections	
Pumps		Gauges	
Expansion tank		Flow switch(s)	
Pot feeder & cartridge filter		Automatic control sensors	
Equipment service access		Pipe/equipment insulation	
Pipe/equipment supports		Low ambient & freeze-up protection	
Pipe flexibility (expansion loops/anchors)		Weather proof outdoor insulation	
Pipe sleeves, firestopping, seals		Pipe painting	
Pipe flashing		Pressure test	
Air vents		Cleaning and flushing	
Air release tank or fitting		Water treatment	
Unions or flanges		Valve tags	
Isolaton valves		Equipment nameplates	
Drain valves		Pipe identification	
Balancing valves		Power & control wiring	
Control valves		Refrigerant piping	
		Sign: Date:	

Operation Checks	√	Operation Checks	√
Initial maintenance procedures completed		Control setup & checkout	
Equipment startup		Trend log & alarm setup	
Water treatment		O&M manuals	
Safeties		Record drawings	
Water balancing		O&M training	
		Sign: Date:	

Performance Tests	Pass	Fail	Note
Cooling system is enabled via time of day schedule			
One cooling system pump runs continuously during system enable			
Failure of cooling system pump starts standby pump			
Cooling system pump lead/lag control			
Variable pump speed maintains differential pressure/stable system water flow			
Cooling system pump continues to run for 30 minutes after sytem disable			
Chiller enable requires proof of cooling system water flow			
Chiller circulating pump(s) run on call for cool, 30 seconds before chiller			
Sequence Chillers from Common Chilled Water Supply Temperature			
Integral chiller capacity control maintains leaving water temperature STPT			
Cooling Reset Control Maintains Low Limit Setpoint @ 7ºC			
Cooling Reset Control Maintains High Limit Setpoint @ 10ºC			
Disable Chiller 1 and 3 when OA Temperature is Below 10ºC			
Disable Chiller 2 when OA temperature is Between 10ºC and 30ºC			
Operator shutdown command disables chiller operation			
Off season pump lubrication			
Alarm Tests			
Trend Reports			
	Sign: Date:		

Comments: * Not Applicable

Test Accepted By: Sign: Date:

DOMESTIC HOT WATER SYSTEM VERIFICATION

Project:
Address:
System No.:
Project No.:

Installation Checks	√	Installation Checks	√
Installation per manufacturers recommendation		Pressure test	
Pipe layout per as-built drawings		Cleaning and flushing	
Pipe material per specifications		Multi-unit controller	
Instantaneous water heaters		Unit controllers	
Recirculating pump		Combustion air supply	
Expansion tank		Venting size, material, flashing, & termination	
Equipment service access		Venting back flow & condensation drain	
Pipe/equipment supports		Equipment nameplates	
Pipe sleeves, firestopping, seals, flashing		Pipe identification	
Pipe/equipment insulation		Power & control wiring	
Pressure relief valves			
Unions or flanges			
Isolaton valves			
Check valves			
Balancing valves			
Strainers			
Drain plug			
Gauges			
Gas pipe (regulator, union, shutoff, drip Leg)			
		Sign: Date:	

Operation Checks	√	Operation Checks	√
Initial maintenance procedures completed		O&M manuals	
Equipment start-up		Record drawings	
Safeties (Temperature, Pressure, Flow)		O&M training	
Controls setup & checkout			
Trend log & alarm setup			
		Sign: Date:	

Performance Tests	Pass	Fail	Note
Recirculating pump is enabled by the BAS (time of day schedule)			
Unit controllers require proof of water flow			
Unit controllers maintain uniform hot water supply temperature			
Multi-unit controller enables unit controllers based on flow rate and temperature			
Multi-unit controller provides rotation and temperature STPT adjustment			
Alarm tests			
Trend reports			
	Sign:	Date:	

Comments: * Not Applicable

Test Accepted By: Sign: Date:

DUCTWORK INSTALLATION CHECKS

Project:
Address:
System No.:
Project No.:

Description of Work / Drawing Reference	Support	Seal	Clean	Layout	Initial
	Yes / No	Yes / No	Yes / No	Yes / No	
	Yes / No	Yes / No	Yes / No	Yes / No	
	Yes / No	Yes / No	Yes / No	Yes / No	
	Yes / No	Yes / No	Yes / No	Yes / No	
	Yes / No	Yes / No	Yes / No	Yes / No	
	Yes / No	Yes / No	Yes / No	Yes / No	
	Yes / No	Yes / No	Yes / No	Yes / No	
	Yes / No	Yes / No	Yes / No	Yes / No	
	Yes / No	Yes / No	Yes / No	Yes / No	
	Yes / No	Yes / No	Yes / No	Yes / No	
	Yes / No	Yes / No	Yes / No	Yes / No	
	Yes / No	Yes / No	Yes / No	Yes / No	
	Yes / No	Yes / No	Yes / No	Yes / No	
	Yes / No	Yes / No	Yes / No	Yes / No	
	Yes / No	Yes / No	Yes / No	Yes / No	
	Yes / No	Yes / No	Yes / No	Yes / No	
	Yes / No	Yes / No	Yes / No	Yes / No	
	Yes / No	Yes / No	Yes / No	Yes / No	
	Yes / No	Yes / No	Yes / No	Yes / No	
	Yes / No	Yes / No	Yes / No	Yes / No	
	Yes / No	Yes / No	Yes / No	Yes / No	
	Yes / No	Yes / No	Yes / No	Yes / No	
	Yes / No	Yes / No	Yes / No	Yes / No	
	Yes / No	Yes / No	Yes / No	Yes / No	
	Yes / No	Yes / No	Yes / No	Yes / No	
	Yes / No	Yes / No	Yes / No	Yes / No	
	Yes / No	Yes / No	Yes / No	Yes / No	
	Yes / No	Yes / No	Yes / No	Yes / No	
	Yes / No	Yes / No	Yes / No	Yes / No	
	Yes / No	Yes / No	Yes / No	Yes / No	
	Yes / No	Yes / No	Yes / No	Yes / No	
	Yes / No	Yes / No	Yes / No	Yes / No	
	Yes / No	Yes / No	Yes / No	Yes / No	
	Yes / No	Yes / No	Yes / No	Yes / No	
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	Yes / No	Yes / No	Yes / No	Yes / No	
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	Yes / No	Yes / No	Yes / No	Yes / No	
	Yes / No	Yes / No	Yes / No	Yes / No	
	Yes / No	Yes / No	Yes / No	Yes / No	
	Yes / No	Yes / No	Yes / No	Yes / No	
	Yes / No	Yes / No	Yes / No	Yes / No	
	Yes / No	Yes / No	Yes / No	Yes / No	
	Yes / No	Yes / No	Yes / No	Yes / No	
	Yes / No	Yes / No	Yes / No	Yes / No	
	Yes / No	Yes / No	Yes / No	Yes / No	
	Yes / No	Yes / No	Yes / No	Yes / No	
	Yes / No	Yes / No	Yes / No	Yes / No	

Support: Ductwork is supported properly.

Seal: All ductwork openings are sealed with plastic or metal cap to keep out dust, dirt, and debris.
All ductwork connections are fastened and sealed with high quality duct sealer.

Clean: All ductwork is free of dust, dirt, and debris.

Layout: The installed ductwork is shown on as-built drawings.

Conflicts: Were any conflicts or potential conflicts with the work of other trades discovered?

Test Accepted By: Sign: Date:

FAN COIL UNIT VERIFICATION					
Project:					
Address:					
System No.:					
Project No.:					
Installation Checks	**FC-**	**FC-**	**FC-**	**FC-**	**FC-**
Room #					
Manufacturer/model					
Serial #					
Volts/phase/amps					
Panel/breaker					
Breaker amps					
Location marker/tag					
Power & control wiring					
Disconnect switch					
Heating coil hook-up					
Cooling coil hook-up					
Condensate trap					
Duct installation					
Dampers (fire & balancing)					
Insulation (thermal & acoustic)					
Filter installation					
Equipment support and vibration isolation					
Equipment access					
Controller access					
	Sign:		Date:		
Operation Checks					
Equipment start-up					
Controls setup & checkout					
Air & water balancing					
Vibration & noise Level					
O&M documentation					
Trend log & alarm setup					
	Sign:		Date:		
Performance Tests					
Shutdown mode					
Time of day schedule					
Override Mode					
Room temperature control - cooling					
Room temperature control - heating					
Room temperature setpoint adjust					
Unoccupied mode - night low limit					
Unoccupied mode - night high limit					
Discharge temperature high limit control					
Discharge temperature low limit control					
Alarm tests					
Trend reports					
	Sign:		Date:		
Comments: * Not Applicable					
Test Accepted By:	Sign:		Date:		

GLYCOL COOLING SYSTEM VERIFICATION

Project:
Address:
System No.:
Project No.:

Installation Checks	√	Installation Checks	√
Pipe layout to record drawings		Balancing valves	
Heat exchanger		Control valves	
Pumps		Strainers	
Expansion tank		Check valves	
Glycol feed equipment		Vibration isolators & flexible connections	
Pot feeder & cartridge filter		Gauges	
Equipment service access		Automatic control sensors	
Housekeeping pads		Pipe insulation	
Pipe/equipment supports		Equipment insulation	
Pipe flexibility (expansion loops/anchors)		Pressure test	
Pipe sleeves, firestopping, seals		Cleaning and flushing	
Pipe flashing		Water treatment	
Air vents		Valve tags	
Air release tank or fitting		Equipment nameplates	
Pressure relief valve		Pipe identification	
Unions or flanges		Power & control wiring	
Isolaton valves			
Drain valves			
		Sign: Date:	

Operation Checks	√	Operation Checks	√
Initial maintenance procedures completed		Control setup & checkout	
Equipment start-up		Trend log & alarm setup	
Water treatment report		O&M manuals	
Safeties		Record drawings	
Water balancing		O&M training	
		Sign: Date:	

Performance Tests	Pass	Fail	Note
Glycol cooling system is enabled when OA temperature is above STPT			
Glycol cooling pump starts via time of day schedule			
Variable pump speed maintains differential pressure/stable water flow			
Hot side temperature Control			
Off season pump lubrication control			
Alarm tests			
Trend reports			
Sign: Date:			

Comments: * Not Applicable

Test Accepted By: Sign: Date:

GLYCOL HEATING SYSTEM VERIFICATION

Project:
Address:
System No.:
Project No.:

Installation Checks	√	Installation Checks	√
Pipe layout to record drawings		Balancing valves	
Heat exchanger		Control valves	
Pumps		Strainers	
Expansion tank		Check valves	
Glycol feed equipment		Vibration isolators & flexible connections	
Pot feeder & cartridge filter		Gauges	
Equipment service access		Automatic control sensors	
Housekeeping pads		Pipe insulation	
Pipe/equipment supports		Equipment insulation	
Pipe flexibility (expansion loops/anchors)		Pressure test	
Pipe sleeves, firestopping, seals		Cleaning and flushing	
Pipe flashing		Water treatment	
Air vents		Valve tags	
Air release tank or fitting		Equipment nameplates	
Pressure relief valve		Pipe identification	
Unions or flanges		Power & control wiring	
Isolaton valves			
Drain valves			
		Sign: Date:	

Operation Checks	√	Operation Checks	√
Initial maintenance procedures completed		Control setup & checkout	
Equipment start-up		Trend log & alarm setup	
Water treatment report		O&M manuals	
Safeties		Record drawings	
Water balancing		O&M training	
		Sign: Date:	

Performance Tests	Pass	Fail	Note
Heating system is enabled when OA temperature is below STPT			
One glycol heating pump runs continuously during heating season			
Glycol heating pumps alternate lead/lag weekly			
Failure of either lead/lag pump starts standby pump			
Variable pump speed maintains differential pressure/stable water flow			
Off season pump lubrication control			
Cold side temperaure control			
Alarm tests			
Trend reports			
	Sign:	Date:	

Comments:

Test Accepted By: Sign: Date:

HEATING SYSTEM VERIFICATION

Project:
Address:
System No.:
Project No.:

Installation Checks	√	Installation Checks	√
Heating pipe layout to drawings		Drain valves	
Gas pipe (regulator, union, shutoff, drip leg)		Balancing valves	
Gas bleed vents piped to outdoors		Control valves	
Water make-up c/w BFP		Check valves	
Boilers		Strainers	
Pumps		Vibration isolators & flexible connections	
Expansion tank		Gauges	
Pot Feeder & cartridge filter		Flow switch, high limit & low water cut-off	
Equipment service access		Automatic control sensors	
Housekeeping pads		Pipe/equipment insulation	
Pipe/equipment supports		Pressure test	
Pipe flexibility (expansion loops/anchors)		Cleaning and flushing	
Pipe sleeves, firestopping, seals		Water treatment	
Pipe flashing		Combustion/ventilation air	
Air vents		Flue venting	
Air release tank or fitting		Valve tags	
Pressure relief valve		Equipment nameplates	
Unions or flanges		Pipe identification	
Isolaton valves		Power & control wiring	
		Sign: Date:	

Operation Checks	√	Operation Checks	√
Initial maintenance procedures completed		Controls setup & checkout	
Equipment start-up		Trend log & alarm setup	
Water treatment report		O&M manuals	
Gas pipe certificate		Record drawings	
Safeties (high limit, flow switch, low water)		O&M training	
Water balancing			
		Sign: Date:	

Performance Tests	Pass	Fail	Note
Heating system is enabled when OA temperature is below STPT			
One secondary & primary pump runs continuously during heating season			
Primary & secondary pumps alternate lead/lag weekly			
Failure of either lead/lag pump starts standby pump			
Variable pump speed maintains differential pressure/stable secondary water flow			
Boiler enable requires proof of both primary & secondary water flow			
Boiler circulating pump(s) run on call for heat			
Boiler circulating pump(s) continue to run for 5 minutes after call for heat			
Boiler staging, rotation and capacity control tracks building heating load			
Boiler reset control maintains low limit setpoint @ 60 ºC			
Boiler reset control maintains high limit setpoint @ 70 ºC (ΔT = 17 ºC)			
Operator shutdown command disables boiler operation			
Off season pump lubrication			
Alarm tests			
Trend reports			
	Sign:	Date:	

Comments: * Not Applicable

Test Accepted By: Sign: Date:

MAKE UP AIR SYSTEM VERIFICATION

Project:
Address:
System No.:
Project No.:

Installation Checks	√	Installation Checks	√
Duct construction		Framing for roof & floor openings	
Duct layout to record drawings		Roof curb & duct flashing	
Discharge duct restrictions/system effect		Equipment service access	
Duct/equipment supports		Gas pipe (regulator, union, shutoff, drip leg)	
Thermal insulation		Refrigerant pipe layouot	
Weather proof exterior duct		Condensate line trap, size & pitch	
Access doors		Fan cleanliness	
Test ports		Fan factory pressure test	
Balancing dampers		Filters	
Control dampers		Drive guards	
Turning vanes		Vibration isolators	
Fire damper, retaining angles, joint, access		Flexible connections	
Duct sleeves		Louvers, grilles & diffusers	
Duct sealant		Automatic control sensors	
Duct pressure test		High temp & low temp switch(s)	
Duct cleaning		Equipment nameplates	
Flexible ductwork		Power & control wiring	
Duct identification		Approved weather-proof disconnect	
Duct painting			
		Sign: Date:	

Operation Checks	√	Operation Checks	√
Initial maintenance procedures completed		Controls setup & checkout	
Equipment startup test(s)		Trend log & alarm setup	
Safeties (low/high temp, fire shutdown)		O&M manuals	
Air balancing		Record drawings	
Fire dampers		O&M training	
		Sign: Date:	

Performance Tests	Pass	Fail	Note
Fan off mode (shutdown)			
Time of day schedule			
Override mode			
Cooling capacity staging			
Compressor lockout when OA-T < 10 ° C			
Burner enable control when OA-T > 16 °C			
Discharge temperature high limit control			
Discharge temperature low limit control			
Alarm tests			
Tend report			
Sign: Date:			

Comments: * Not Applicable

Test Accepted By: Sign: Date:

ROOFTOP AIR CONDITIONER VERIFICATION

Project:
Address:
System No.:
Project No.:

Installation Checks	√	Installation Checks	√
Duct construction		Framing for roof & floor openings	
Duct layout to record drawings		Roof curb & duct flashing	
Discharge duct restrictions/system effect		Equipment service access	
Duct/equipment supports		Gas pipe (regulator, union, shutoff, drip leg)	
Thermal insulation		Condensate trap	
Weather proof exterior duct		Fan cleanliness	
Access doors		Fan pressure test	
Test ports		Filters	
Balancing dampers		Drive guards	
Control dampers		Vibration isolators	
Turning vanes		Flexible connections	
Fire damper, retaining angles, joint, access		Silencers/acoustic lining	
Duct sleeves		Louvers, grilles & diffusers	
Duct sealant		Automatic control sensors	
Duct pressure test		Equipment nameplates	
Duct cleaning		Power & control wiring	
Flexible ductwork		Approved weather-proof disconnect	
Duct identification			
Duct painting			
		Sign: Date:	

Operation Checks	√	Operation Checks	√
Initial maintenance procedures completed		Trend log & alarm setup	
Equipment start-up		O&M manuals	
Safeties (fire shutdown, freeze stat)		Record drawings	
Controls setup & checkout		O&M training	
Air balancing			
		Sign: Date:	

Performance Tests	Pass	Fail	Note
Fan off mode			
Time of day schedule			
Warm-up mode			
Override mode			
Room temperature control			
Cooling capacity staging			
Compressor lockout			
Economizer minimum position & free coolinig			
Demand ventilation control			
Heating capacity staging			
Heating lockout			
Unoccupied mode - night low limit			
Unoccupied mode - night high limit			
Alarm tests			
Trend reports			
Sign: Date:			

Comments: * Not Applicable

Test Accepted By: Sign: Date:

END OF SECTION 15878

Building Automation System

PART 1 - GENERAL

1.0 Section Includes

1.1 Building Automation System - General Description
1.2 Approved Control System Manufacturers
1.3 Quality Assurance
1.4 Codes And Standards
1.5 System Performance
1.6 Submittal Requirements
1.7 Warranty Requirements
1.8 System Maintenance And Remote Analysis
1.9 Ownership Of Proprietary Material
1.10 Definitions

1.1 Building Automation System - General Description

.1 Provide a new Building Automation System (BAS) to integrate and control all mechanical equipment associated with this project.

.1 The Building Automation System shall be as indicated on the drawings and described in these specifications. System must be fully integrated and coordinated with mechanical equipment DDC controllers furnished and installed in the equipment manufacturer's factory as specified in those sections. The intent of the BAS is to integrate all mechanical equipment into one system for global monitoring, control, and alarming associated with the building. It is the BAS manufacturer's responsibility to provide all the design, engineering, and field coordination required to ensure all equipment sequence of operations are met as specified and the designated BAS operators have the capability of managing the building mechanical system to ensure occupant comfort while maintaining energy efficiency.

.2 The BAS shall meet open standard protocol communication standards (As defined in System Communications Section) to ensure the system maintains "interoperability" to avoid proprietary arrangements that will make it difficult for the Owner to consider other BAS manufacturers in future projects.

.3 Direct Digital Control (DDC) technology shall be used to provide the functions necessary for control of mechanical systems and terminal devices on this project.

.4 Approved vendors, products and web services shall comply with SOC2 Type II as defined by the AICPA. SOC2 Type II compliance is a certification that confirms that a service provider has established and implemented effective controls to secure their clients' data in accordance with the Trust Services Criteria (TSC).

.1 SOC2 Type II compliance provides assurance to customers that the service provider has established and implemented effective security controls and is committed to protecting their data.

.2 To achieve SOC2 Type II compliance, the manufacturer shall have completed an independent audit to assess design and implementation of their controls, policies, and procedures.

.5 The BAS shall accommodate simultaneous multiple user operation. Access to the control system data should be limited only by the security permissions of the operator role. Multiple users shall have access to all valid system data. An operator shall be able to log onto any workstation on the control system and have access to all appropriate data.

1.2 Approved Control System Manufacturers

.1 Approved BAS Manufacturers: Trane Tracer®

1.3 Quality Assurance

.1 BAS Manufacturer Qualifications

.1 The BAS manufacturer shall have an established business office within 50.00 miles of the project site and must provide 24 hours/day, 7 days/week response in the event of a customer warranty or service call.

.2 The BAS Manufacturer shall have factory trained and certified personnel providing all engineering, service, startup, and commissioning field labor for the project from their local office location. BAS manufacturer shall be able to provide training certifications for all local office personnel upon request.

.3 The BAS shall be provided by a single manufacturer and this manufacturer's equipment must consist of operator workstation software, Web-based hardware/software, Open Standard Protocol hardware/software, Custom application Programming Language, Graphical Programming Language, Building Controllers, Custom Application Controllers, and Application Specific Controllers. All other products specified herein (i.e., sensors, valves, dampers, actuators, etc.) need not be manufactured by the BAS manufacturer listed in this specification.

.4 Independent representatives of BAS manufacturers are not acceptable. BAS vendor must be corporate owned entity of BAS manufacturer.

1.4 Codes and Standards

.1 Codes and Standards: Meet requirements of all applicable standards and codes, except when more detailed or stringent requirements are indicated by the Contract Documents, including requirements of this Section.

.1 Underwriters Laboratories: Products shall be UL-916-PAZX listed.

.2 National Electrical Code -- NFPA 70.

.3 Federal Communications Commission -- Part J.

.4 ASHRAE/ANSI 135-2012 (BACnet) - (System Level Devices) - Building Controllers shall conform to the listed version of the BACnet specification in order to improve interoperability with various building system manufacturers' control systems and devices.

.5 ASHRAE/ANSI 135-2012 (BACnet) - (Unit Level Devices) - Unit Controllers shall conform to the listed version of the BACnet specification in order to improve interoperability with various building system manufacturers' control systems and devices.

1.5 **System Performance**

.1 Performance Standards. The BAS system shall conform to the following:
- .1 Graphic Display. The system shall display a graphic with a minimum of 20 dynamic points. All current data shall be displayed within 10 seconds of the operator's request.
- .2 Graphic Refresh. The system shall update all dynamic points with current data within 10 seconds.
- .3 Object Command. The maximum time between the command of a binary object by the operator and the reaction by the device shall be 5 seconds. Analog objects shall start to adjust within 5 seconds.
- .4 Object Scan. All changes of state and change of analog values shall be transmitted over the high-speed network such that any data used or displayed at a controller or workstation will be current within the prior 10 seconds.
- .5 Alarm Response Time. The maximum time from when an object goes into alarm to when it is annunciated at the workstation shall not exceed 10 seconds.
- .6 Program Execution Frequency. Custom and standard applications shall be capable of running as often as once every 5 seconds. The Contractor shall be responsible for selecting execution times consistent with the mechanical process under control.
- .7 Programmable Controllers shall be able to execute DDC PID control loops at a selectable frequency from at least once every 5 seconds. The controller shall scan and update the process value and output generated by this calculation at this same frequency.
- .8 Multiple Alarm Annunciations. All workstations on the network shall receive alarms within 5 seconds of each other.

1.6 **Submittal Requirements**

.1 BAS manufacturer shall provide shop drawings and manufacturers' standard specification data sheets on all hardware and software being provided for this project. No work may begin on any segment of this project until the Engineer and Owner have reviewed submittals for conformity with the plan and specifications.
- .1 Provide three (3) printed copies of submittal package for review and approval.

.2 Quantities of items submitted shall be reviewed by the Engineer and Owner. Such review shall not relieve the BAS manufacturer of furnishing quantities required based upon contract documents.

.3 Provide the Engineer and Owner, any additional information or data which is deemed necessary to determine compliance with the specifications or which is deemed valuable in documenting and understanding the system to be installed.

.4 All shop drawings shall be provided to the Owner electronically as .dwg or .dxf file formats once they have been approved and as-built drawings have been completed.

.5 Submit the following within 90 days of contract award:
- .1 A complete bill of materials of equipment to be used indicating quantities, manufacturers and model numbers.
- .2 A schedule of all control valves including the valve size, pressure drop, model number (including pattern and connections), flow, CV, body pressure rating, and location.
- .3 A schedule of all control dampers including damper size, pressure drop, manufacturer, and model number.
- .4 Provide all manufacturers' technical cut sheets for major system components. When technical cut sheets apply to a product series rather than a specific product, the data

specifically applicable to the project shall be highlighted or clearly indicated by other means. Include:

.1 Building Controllers
.2 Custom Application Controllers
.3 Application Specific Controllers
.4 Operator Workstations
.5 Portable Operator Terminals
.6 Auxiliary Control Devices

.5 Provide proposed Building Automation System architectural diagram depicting various controller types, workstations, device locations, addresses, and communication cable requirements

.6 Provide detailed termination drawings showing all required field and factory terminations, as well as terminal tie-ins to DDC controls provided by mechanical equipment manufacturers. Terminal numbers shall be clearly labeled.

.7 Provide a sequence of operation for each controlled mechanical system and terminal end devices.

.8 Provide a BACnet Protocol Implementation Conformance Statement (PICS) for each BACnet system level device (i.e. Building Controller & Operator Workstations) type. This defines the points list for proper coordination of interoperability with other building systems if applicable for this project.

.6 Project Record Documents: Upon completion of installation, submit three (3) copies of record (as-built) documents. The documents shall be submitted for approval prior to final completion and include:

.1 Project Record Drawings - These shall be as-built versions of the submittal shop drawings. One set of electronic media including CAD .dwg and .pdf drawing files shall be provided.

.2 Testing and Commissioning Reports and Checklists signed off by trained factory (equipment manufacturers) and field (BAS) commissioning personnel.

.3 Operating and Maintenance (O & M) Manuals - These shall be as-built versions of the submittal product data. In addition to the information required for the submittals, Operating & Maintenance manual shall include:

.1 Procedures for operating the BAS including logging on/off, alarm management, generation of reports, trends, overrides of computer control, modification of setpoints, and other interactive system requirements.

.2 Explanation of how to design and install new points, new DDC controllers, and other BAS hardware.

.3 Documentation, installation, and maintenance information for all third party hardware/software products provided including personal computers, printers, hubs, sensors, valves, etc.

.4 Original issue media for all software provided, including operating systems, programming language, operator workstation software, and graphics software.

.5 Licenses, Guarantee, and Warranty documents for all equipment and systems.

.7 Training Manuals: The BAS manufacturer shall provide a course outline and copies of training manuals at least two weeks prior to the start of any corporate training class to be attended by the Owner.

1.7 **Warranty Requirements**

.1 Warrant all work as follows:

.1 BAS system labor and materials shall be warranted free from defects for a period of twelve (12) months after final completion acceptance by the Owner. BAS failures during the warranty period shall be adjusted, repaired, or replaced at no charge to the Owner. The BAS manufacturer shall respond to the Owner's request for warranty service within 24 hours of the initiated call and will occur during normal business hours (8AM-5PM).

.2 At the end of the final start-up/testing, if equipment and systems are operating satisfactorily to the Owner and Engineer, the Owner shall sign certificates certifying that the BAS is operational, and has been tested and accepted in accordance with the terms of this specification. The date of Owner's acceptance shall be the start of the warranty period.

.3 To ensure that the owner will have the most current operating system provided by the manufacturer, the BAS manufacturer shall include licensing and labor costs to facilitate software/firmware updates throughout the warranty period at no charge to the owner. These updates shall include upgrades for functional enhancements associated with the following: operator workstation software, project specific software, graphics, database, firmware updates, and all security related service packs. Written authorization by the Owner must be granted prior to the installation of these updates.

.4 The BAS manufacturer shall provide a web-accessible Users Network for the proposed System and give the Owner free access to question/answer forum, user tips, upgrades, and training schedules for a one year period of time correlating with the warranty period.

1.8 **System Maintenance and Remote Analysis**

.1 The BAS Manufacture shall provide Building Automation System remote technical support and system analysis for a period of 1 year (beginning the date of substantial completion).

.2 The BAS manufacturer shall setup a secure remote connection for data collection, analytics and remote technical support for the HVAC systems included in this contract.

.1 Provide technician support during the warranty period to diagnose issues remotely through the secure remote connection.

.2 The building owner is responsible for providing adequate internet access.

.3 Connectivity / Remote Access / Network Security

.1 Provide and maintain secure remote access to the facilities Building Automation System (BAS) or other building systems. Users accessing service through this connection shall not have access to the building owners network. Secure remote access to the BAS shall not require ANY inbound ports on a firewall to be “exposed” or “forwarded”.

.2 Secure remote access to the BAS shall be available anywhere, anytime, using a compatible client device (PC/tablet/phone)

.3 The Owner will provide up to Three (3) IP drops and IP addresses on the owners network to gain access to the internet. The BAS manufacture shall coordinate with the Owners IT team, verify the proposed system shall meet all network security requirements and any other network configuration information necessary to each control contractor for the purpose of configuring each Area Controller on the network. It shall be the responsibility of the BAS manufacture to coordinate with the owner for network connectivity.

.4 The BAS Manufacture shall provide a professional analysis for the facility HVAC systems.
- .1 The analysis shall consist of an evaluation of HVAC systems including charts and graphs which indicate both current building performance and opportunities for building and HVAC system performance improvement.

.5 The following shall be provided after substantial completion of the project:
- .1 Orientation meeting with the building owner's representative to identify the HVAC systems that will be evaluated.
- .2 System setup for data collection and analytics. BAS Manufacture to setup a secure remote data collection and analytics for identified systems.
- .3 Assessment analysis shall be performed by trained personnel with relevant professional credentials in HVAC systems, energy management and building optimization methodologies.
- .4 Consultation meeting with owner to review performance reports and improvement opportunities.

.6 Do not assign or transfer maintenance service to agent or subcontractor without prior written consent of owner.

1.9 **Ownership of Proprietary Material**

.1 Project specific software and documentation shall become the owner's property upon project completion. This includes the following:
- .1 Operator Graphic files
- .2 As-built hardware design drawings
- .3 Operating & Maintenance Manuals
- .4 BAS System software database

1.10 **Definitions**

DDC: Direct digital control
I/O: Input/output.
MS/TP: Manager Subordinate / Token Passing.
POT: Portable Operator's Terminal.
PID: Proportional plus integral plus derivative.
RTD: Resistance temperature detector.
BAS/ATC: Building Automation System/Automatic Temperature Controls.

PART 2 – PRODUCTS

2.0 **Section Includes**

2.1 Materials:
2.2 System Communication:
2.3 Operator Interface:
2.4 Building Controller Software:
2.5 Building / System Controllers:
2.6 Advanced Application Controllers:
2.7 Application Specific Controllers:
2.8 Application Controller For Packaged Rooftop Units
2.9 Input/Output Interface:
2.10 Power Supplies:
2.11 Auxillary Control Devices:
2.12 Wiring And Raceways

2.1 **Materials**

.1 Use new products that the manufacturer is currently manufacturing and that have been installed in a minimum of 25 installations. Do not use this installation as a product test site unless explicitly approved in writing by the owner or the owner's representative. Spare parts shall be available for at least five years after completion of this contract.

2.2 **System Communication**

.1 System Communications
- .1 Each workstation, building controller, and equipment/plant controller communication interface shall utilize the BACnet™ protocol with an Ethernet (IEEE 802.3) or RS485 (EIA-485) physical interface and an appropriate data link technology as defined in ANSI®/ASHRAE® Standard 135-2012. (e.g. BACnet over IP, BACnet over IPv6, BACnet SC, BACnet over MS/TP).
- .2 All system controllers shall be BTL listed as a BACnet Building Controller (B-BC) as defined in ANSI®/ASHRAE® Standard 135-2012.
- .3 All documented status and control points, schedule, alarm, and data-log services or objects shall be available as standard object types as defined in ANSI®/ASHRAE® Standard 135-2012.
- .4 Each System Controller shall communicate with a network of Custom Application and Application Specific Controllers utilizing one or more of the interfaces documented within Field Bus Communications below.
- .5 All Operator Workstations (B-OWS, B-AWS) and Building Controllers (B-BC) shall support BACnet Secure Connect (BACnet SC), a secure and encrypted datalink layer specifically designed for those networks.

.2 Field Bus Communications
- .1 BACnet™
  - .1 All equipment and plant controllers shall be BTL listed as a BACnet Application Specific Controller (B-ASC) or a BACnet Advanced Application Controller (B-AAC) as defined in ANSI®/ASHRAE® Standard 135-2012.
  - .2 All communication shall conform to ANSI®/ASHRAE® Standard 135-2012.
  - .3 System Controller shall function as a BACnet router to each unit controller providing a globally unique BACnet Device ID for all BACnet controllers within the system.
  - .4 Communication between System Controller and equipment/plant controllers shall utilize BACnet MS/TP as defined in ANSI®/ASHRAE® Standard 135-2012.

2.3 **Operator Interface**

.1 Provide Building Operator Web Interface
- .1 Manufacturer shall provide a user interface with time-of-day schedules, data collection, dashboards, reports and building summary, system applications, and self-expiring timed overrides. Manufacturer shall provide a published user and applications guide(s) that detail the system application operation, configuration, setup and troubleshooting.

- .2 The building operator web interface shall be accessible via a web browser without requiring any "plug-ins" (i.e. JAVA Runtime Environment (JRE), Adobe Flash).

.3 User Roles
- .1 The system shall include pre-defined “roles” that allow a system administrator to quickly assign permissions to a user.
- .2 User logon/logoff attempts shall be recorded.
- .3 The system shall protect itself from unauthorized use by automatically logging off following the last keystroke. The delay time shall be user definable.

.4 On-Help and Training
- .1 Provide a context sensitive, on line help system to assist the operator in operation and configuration of the system.
- .2 On-line help shall be available for all system functions and shall provide the relevant data for each particular screen.

.5 Equipment and Application Pages
- .1 The building operator web interface shall include standard pages for all equipment and applications. These pages shall allow an operator to obtain information relevant to the operation of the equipment and/or application, including:
  - .1 Animated Equipment Graphics for each major piece of equipment and floor plan in the System. This includes:
    - .1 Each Chiller, Air Handler, VAV Terminal, Fan Coil, Boiler, and Cooling Tower. These graphics shall show all points dynamically as specified in the points list.
    - .2 Animation capabilities shall include the ability to show a sequence of images reflecting the position of analog outputs, such as valve or damper positions. Graphics shall be capable of launching other web pages.
  - .2 Alarms relevant to the equipment or application without requiring a user to navigate to an alarm page and perform a filter.
  - .3 Historical Data (As defined in Trend Logs section of CONTROLLER SOFTWARE) for the equipment or application without requiring a user to navigate to a Data Log page and perform a filter.

.6 System Graphics. Building operator web interface shall be graphically based and shall include at least one graphic per piece of equipment or occupied zone, graphics for each chilled water and hot water system.
- .1 Graphic imagery – graphics shall use 3D images for all standard and custom graphics. The only allowable exceptions will be photo images, maps, schematic drawings, and selected floor plans.
- .2 Animation. Graphics shall be able to animate by displaying different Image lies for changed object status.
- .3 Alarm Indication. Indicate areas or equipment in an alarm condition using color or other visual indicator.

.7 Graphics Library. Furnish a library of standard HVAC equipment such as chillers, air handlers, terminals, fan coils, unit ventilators, rooftop units, and VAV boxes, in 3-dimensional graphic depictions. The library shall be furnished in a file format compatible with the graphics generation package program.

.8 Manual Control and Override
- .1 Point Control. Provide a method for a user to view, override, and edit if applicable, the status of any object and property in the system. The point status shall be available by menu, on graphics or through custom programs.

.2 Temporary Overrides. The user shall be able to perform a temporary override wherever an override is allowed, automatically removing the override after a specified period of time.
.3 Override Owners. The system shall convey to the user the owner of each override for all priorities that an override exists.
.4 Provide a specific icon to show timed override or operator override, when a point, unit controller or application has been overridden manually.

.9 Scheduling. - The scheduling application shall provide graphical representation of the day, week, month and exception events.

.10 Alarm/Event Notification
.1 Alarm/Event Log. The operator shall be able to view all logged system alarms/events from any building operator web interface.
.1 The operator shall be able to sort and filter alarms from events. Alarms shall be sorted in a minimum of 4 categories based on severity.
.2 The operator shall be able to acknowledge and add comments to alarms
.3 Alarm/event messages shall use full language, easily recognized descriptors.
.2 Alarm Suppression. Alarms shall be able to be suppressed based on load/source relationships to present the likely root cause to the building operator as described in ASHRAE Guideline 36. Load/Source relationships shall be configurable by the user through a web interface.

.11 Reports and Logs.
.1 The building operator web interface shall provide a reporting package that allows the operator to select reports.
.2 The building operator web interface shall provide the ability to schedule reports to run at specified intervals of time.
.3 The following standard reports shall be available without requiring a user to manually configure the report:
.1 All Points in Alarm Report: Provide an on demand report showing all current alarms.
.2 All Points in Override Report: Provide an on demand report showing all overrides in effect.
.3 Commissioning Report: Provide a one-time report that lists all equipment with the unit configuration and present operation.
.4 Points report: Provide a report that lists the current value of all points
.4 The controls vendor shall provide a hardening report that summarizes the port configuration details to ensure sites have not been exposed to the Internet in alignment with Cyber Security best practices.

.2 Provide Mobile App Interface
.1 Provide mobile (smart phone or tablet) interfaces to the building automation system, compatible with iOS and Android™ operating systems.
.2 Controls manufacturer shall provide a phone/tablet interface with the ability to view/override status and setpoints, view/change schedules, view/acknowledge/comment on alarms, and view graphics for all spaces and equipment.
.3 This phone/tablet interface shall resize itself appropriately for the size of the interface (i.e. no "pinching and zooming" required).

.4 This phone/tablet interface shall function remotely from the facility while following IT security best practices (e.g. no ports exposed to the internet).

.5 The operator interface shall support system access on a mobile device via a mobile app to:

.1 Alarm log
.2 System Status
.3 Equipment status
.4 Space Status
.5 Standard Equipment graphics
.6 Override set points
.7 Override occupancy
.8 Acknowledge Alarms
.9 Add Comment(s) to Alarms

2.4 **Building Controller Software**

.1 Manufacturer shall provide standard applications to deliver HVAC system control. Standard applications include Time of Day Scheduling with Optimal Start/Stop, VAV Air Systems Control, Chiller Plant Control, Historical Trend Logs and Trim and Respond. Manufacturer shall provide system optimization strategies for functions such as fan pressure optimization and ventilation optimization.

.2 Furnish the following applications software for building and energy management. All software applications shall reside and run in the system controllers. Editing of applications shall occur at the building operator interface.

.1 Trend Logs

.1 The system shall harvest trend logs for defined key measurements for each controlled HVAC device and HVAC application. Trend logs shall be captured for a minimum of 5 key operating points for each piece of HVAC equipment and HVAC application and stored for no less than 1 year at 15-minute intervals. Data Logs shall be capable of being configured on an interval or change of value basis.

.1 Fan Coil / Cabinet Unit Heater / Unit Ventilator / WSHP Unit

.1 Discharge Air Temperature
.2 Space Temperature Active
.3 Space Temperature Setpoint Active
.4 Air Flow Setpoint Active
.5 Discharge Air Flow

.2 Air Handling Unit/Rooftop (VAV)

.1 Discharge Air Temperature
.2 Discharge Air Temperature Setpoint Active
.3 Space Temperature Active
.4 Cooling Capacity Status
.5 Discharge Air Flow

.3 Air Handling Unit/Rooftop (CV)

.1 Discharge Air Temperature
.2 Space Temperature Active
.3 Space Temperature Setpoint Active
.4 Cooling Capacity Status
.5 Heating Capacity Primary Status
.6 Outdoor Air Damper Position

.4 VAV Terminal Unit

.1 Discharge Air Temperature

.2 Space Temperature Active
.3 Space Temperature Setpoint Active
.4 Air Flow Setpoint Active
.5 Discharge Air Flow

.5 Variable Air System (VAS)
.1 VAS Operating Mode
.2 Duct Static Optimization Duct Static Setpoint
.3 Duct Pressure Optimization Maximum
.4 Space Temperature Average
.5 Ventilation Optimization Air Setpoint

2.5 Building / System Controllers

.1 There shall be one or more independent, standalone microprocessor based System Controllers to manage the global strategies described in CONTROLLER SOFTWARE section.
.1 The controller shall provide a USB communications port for connection to a PC.
.2 The operating system of the Controller shall manage the input and output communications signals to allow distributed controllers to share real and virtual point information and allow central monitoring and alarms.
.3 All System Controllers shall have a real time clock and shall be able to accept a BACnet time synchronization command for automatic time synchronization.
.4 Data shall be shared between networked System Controllers.
.5 Serviceability – The System Controller shall have a display on the main board that indicates the current operating mode of the controller.

.2 Controls manufacturer shall provide secure remote access to the Building Automation System (BAS). Secure remote access shall not require IP ports to be "exposed" (i.e. port-forwarded or external public IP addresses) to the Internet. Controls manufacturer shall update secure remote access software as necessary to follow cyber security best practices and respond to cyber security events.

2.6 Advanced Application Controllers

.1 Advance Application Controllers shall be used to control all equipment or applications of medium and high complexity, including but not limited to Air Handlers, Boiler Plants and Chiller Plants.

.2 The Advanced Application Controller shall be capable of operating as a stand-alone controller or as a member of a Building Automation System (BAS).

.3 When the Advanced Application Controller is operating as a member of a Building Automation System (BAS), the application controller shall operate as follows:
.1 Application Controller will receive operation mode commands from the BAS network controller. The BAS commands shall include but not be limited to the follow: Occupied Heat/Cool, Unoccupied Heat/Cool, Morning Warm-up, / Pre-cool, Occupied Bypass).
.2 Application Controller will provide equipment status parameters to the BAS through BACnet communication.
.3 Application Controller will operate as a stand-alone controller in the event of communication failure with the BAS.
.4 In case of communications failure, stand-alone operation shall use default values or last known values for remote sensors read over the network such as outdoor air temperature.

.4 For Stand-Alone Operation of Advanced Application Controllers:
- .1 Shall operate a schedule in a standalone application using a Real Time Clock with a 7 day power backup.
  - .1 The Controller shall have a built in schedule (assessable with or without a display)
  - .2 Support will be for at least 3 schedules with up to 10 events for each day of the week.
  - .3 Each of the 3 schedules can be Analog, Binary or Multi-State
  - .4 The controller shall support a minimum of 25 exceptions each with up to 10 events.

.5 For ease of troubleshooting, the Controller shall support data trend logging.
- .1 With a minimum of 20,000 trending points total on a controller
- .2 Trends shall be capable of being collected at a minimum sample rate of once every second
- .3 Shall be capable of trending all BACnet points used by controller
- .4 Trends shall be capable of being scheduled or triggered.

.6 To meet the sequence of operation for each application, the Controller shall use library programs provided by the controller manufacturer that are either factory loaded or downloaded with service tool to the controller.

.7 Environment. Controller hardware shall be suitable for the anticipated ambient conditions.
- .1 Operating conditions:
  - .1 Temperature: -40°F to 158°F (-40°C to 70°C)
  - .2 Relative Humidity: 5% to 100% RH (non-condensing)
- .2 Controllers used indoors shall be mounted in a NEMA 1 enclosure at a minimum.
- .3 Controllers used outdoors and/or in wet ambient shall be mounted within NEMA 4 type waterproof enclosures, and shall be rated for operation at -40° F to 158° F [-40° C to 70° C].

.8 Input/Output: The Controller shall have on board or through expansion module all I/O capable of performing all functionality needed for the application. Controls provided by the equipment manufacture must supply the required I/O for the equipment. In addition other controls must meet the following requirements:
- .1 Shall support flexibility in valve type, the controllers shall be capable of supporting the following valve control types: 0-10VDC, 0-5VDC, 4-20mA, 24VAC - 2 position.
- .2 Shall support flexibility in sensor type, the Controller shall be capable of reading sensor input ranges of 0 to10V, 0 to 20mA, 50ms or longer pulses, 200 to 20Kohm and RTD input.
- .3 Shall support flexibility in sensor type, all Analog Outputs shall have the additional capability of being programmed to operate as Universal Inputs or Pulse Width Modulation Outputs.
- .4 Shall support flexibility in sensor type, the Controller and/or expansion modules shall support dry and wetted (24VAC) binary inputs.
- .5 The controller shall support pulse accumulator for connecting devices like energy meters.
- .6 In order to support a wide range of devices, the Controller’s binary output shall be able to drive at least 10VA each.
- .7 For future needs, any unused I/O that is not needed for the functionality of the equipment shall be available to be used by custom programs on the Controller and by any other controller on the network.

.8 The Controller shall provide 24VAC and 24VDC power terminals sensors and other devices required.
.9 The Controller shall provide a dedicated static pressure input.

.9 Input/Output Expandability – The Controller shall provide the following functionality in order to meet current and future application needs:
.1 For the application flexibility, the Controller shall be capable of expanding to a total of at least 100 hardware I/O terminations.
.2 Expansion I/O can be mounted up to 650 ft. (200m) from control.
.3 For optimized system operation, expansion I/O must communicate via an internal controller communication bus (point expansion via the BACnet MS/TP network is not allowed).

.10 Serviceability – The Controller shall provide the following in order to improve serviceability of the Controller.
.1 Diagnostic LEDs for power/normal operation/status, BACnet communications, sensor bus communications, and binary outputs. All wiring connections shall be clearly labeled and made to be field removable.
.2 Binary and analog inputs and outputs shall use removable connectors or be connected to terminal strip external to the control box.
.3 Software service tool connection through the following methods: direct cable connection to the Controller, connection through another controller on BACnet link
.4 For safety purposes, the controller shall be capable of being powered by a portable computer's USB port for the purposes of configuration, programming and testing programs so that this work can be accomplished with the power off to the associated equipment.
.5 The Controller software tool service port shall utilize standard off-the-shelf USB printer cable.
.6 Capabilities to temporarily override the BACnet point values with built-in time expiration in the Controller.
.7 To aid in service replacement, the Controller shall easily attached to standard DIN rail mounting.
.8 For future expansion, the Controller shall be capable of adding sequence of operation programming utilizing service tools software with a graphical programming interface (editing or programming in line code is not permissible).
.9 To aid in service replacement, the Controller shall allow for setting its BACnet address via controller mounted rotary switches that correspond to the numerical value of the address. (DIP switch methodologies are not allowed). Setting of the address shall be accomplished without the need of a service tool or power applied to the controller.
.10 Controller data shall be maintained through a power failure.

.11 Software Retention: All Controller operating parameters, setpoints, BIOS, and sequence of operation code must be stored in non-volatile memory in order to maintain such information for months without power.

.12 Controller must meet the following Agency Compliance:
.1 UL916 PAZX, Open Energy Management Equipment
.2 UL94-5V, Flammability
.3 FCC Part 15, Subpart B, Class B Limit
.4 BACnet Testing Laboratory (BTL) listed as BACnet Advanced Application Controller (B-AAC)

2.7 **Application Specific Controllers**

.1 General Description
- .1 Application Specific Controllers (ASC) shall be microprocessor-based DDC controllers which, through hardware or firmware design, control specified equipment. They are not user programmable, but are customized for operation within the confines of the equipment they are designed to serve.
- .2 Zone Controllers are controllers that operate equipment that control the space temperature of single zone. Examples are controllers for VAV, Fan coil, Blower Coils, Unit Ventilators, Heat Pumps, and Water Source Heat Pumps.

.2 The Application Specific Controller shall be capable of operating as a stand-alone controller or as a member of a Building Automation System (BAS).

.3 When the Application Specific Controller is operating as a member of a Building Automation System (BAS), the application controller shall operate as follows:
- .1 Application Controller will receive operation mode commands from the BAS network controller. The BAS commands shall include but not be limited to the follow: Occupied Heat/Cool, Unoccupied Heat/Cool, Morning Warm-up, / Pre-cool, Occupied Bypass).
- .2 Application Controller will provide equipment status parameters to the BAS through BACnet communication.
- .3 Application Controller will operate as a stand-alone controller in the event of communication failure with the BAS.
- .4 In case of communications failure stand-alone operation shall use default values or last known values for remote sensors read over the network such as outdoor air temperature.

.4 Stand-Alone Operation: Each piece of equipment specified in section “A” shall be controlled by a single controller and provide stand-alone control in the event that a BAS is not present.

.5 Software
- .1 To meet the sequence of operation for each zone control, the controller shall use programs developed and tested by the controller manufacturer that are either factory loaded or downloaded with service tool to the controller.
- .2 For controlling ancillary devices and for flexibility to change the sequence of operation in the future, the controller shall be capable running custom programs written in a graphical programming language.

.6 Environment: Controller hardware shall be suitable for the anticipated ambient conditions.
- .1 Storage: -55° to 203° F (-48° to 95° C) and 5 to 95% Rh, non-condensing.
- .2 Operating: -40° to 158° F (-40 to 70° C) and 5 to 95% Rh, non-condensing.
- .3 Controllers used indoors shall be mounted in a NEMA 1 enclosure at a minimum.
- .4 Controllers used outdoors and/or in wet ambient shall be mounted within NEMA 4 type waterproof enclosures, and shall be rated for operation at -40° to 158° F [-40° to 70° C].

.7 Input/Output:
- .1 For flexibility in selection and replacement of valves, the controllers shall be capable of supporting all of the following valve control types 0-10VDC, 0-5VDC, 4-20mA, 24VAC floating point, 24VAC - 2 position (Normally Open or Normally Closed).
- .2 For flexibility in selection and replacement of sensors, the controllers shall be capable of reading sensor input ranges of 0 to10V, 0 to 20mA, pulse counts, and 200 to 20Kohm.

.3 For flexibility in selection and replacement of binary devices, the controller shall support dry and wetted (24VAC) binary inputs.

.4 For flexibility in selection and replacement devices, the controller's shall have binary output which are able to drive at least 12VA each.

.5 For flexibility in selection and replacement of motors, the controller shall be capable of outputting 24VAC (binary output), DC voltage (0 to 10VDC minimum range) and PWM (in the 80 to 100 Hz range).

.6 For future needs, any I/O that is unused by functionality of equipment control shall be available to be used by custom program on the controller and by another controller on the network.

.7 For future expansion and flexibility, the controller shall have either on board or through expansion, 20 hardware input/output points. Expansion points must communicate with the controller via an internal communications bus. Expansion points must be capable of being mounted up to 650ft. (200 m) from the controller. Expansion points that require the BACnet network for communication with the controller are not allowed.

.8 Serviceability – The controller shall provide the following in order to improve serviceability of the controller.

.1 Diagnostic LEDs shall indicate correct operation or failures/faults for all of the following: power, sensors, BACnet communications, and I/O communications bus.

.2 All binary output shall have LED's indicating the output state.

.3 All wiring connectors shall removable without the use of a tool.

.4 Software service tool connection through all of the following methods: direct cable connection to the controller, connection through another controller on BACnet link

.5 For safety purposes, the controller shall be capable of being powered by a portable computer for the purposes of configuration, programming, and testing programs so that this work can be accomplished with the power off to the equipment.

.6 Capabilities to temporarily override of BACnet point values with built-in time expiration in the controller.

.7 BACnet MAC Address shall be set using decimal (0-9) based rotary switches.

.1 Configuration change shall not be made in a programming environment, but rather by a configuration page utilizing dropdown list, check boxes, and numeric boxes.

.8 For ease of troubleshooting, the Controller shall support BACnet data trend logging.

.1 With a minimum of 20,000 trending points total on controller

.2 Trends shall be capable of being collected at a minimum sample rate of once every second.

.3 Shall be capable of trending all BACnet points used by controller

.4 Trends shall be capable of being scheduled or triggered

.9 Software Retention: All Zone Controller operating parameters, setpoints, BIOS, and sequence of operation code must be stored in non-volatile memory in order to maintain such information for months without power.

.10 Application controller shall meet the following Agency Compliance:

.1 UL916 PAZX, Open Energy Management Equipment

.2 UL94-5V, Flammability

.3 FCC Part 15, Subpart B, Class B Limit

.4 BACnet Testing Laboratory (BTL) listed as BACnet Application Specific Controller (B-ASC)

2.8 **Application Controller For Packaged Rooftop Units**

.1 The Rooftop Unit (RTU) Application Controller shall be a microprocessor-based DDC controller which, through hardware or firmware design, controls specified equipment. The controller is not user programmable, but is customized for operation within the confines of the equipment it is designed to serve.

.2 The Application Controller shall be capable of operating as a stand-alone controller or as a member of a Building Automation System (BAS).

.3 When the Application Controller is operating as a member of a Building Automation System (BAS), the application controller shall operate as follows:
- .1 Application Controller will receive operation mode commands from the BAS network controller. The BAS commands shall include but not be limited to the follow: Occupied Heat/Cool, Unoccupied Heat/Cool, Morning Warm-up, / Pre-cool, Occupied Bypass).
- .2 Application Controller will provide equipment status parameters to the BAS through BACnet communication.
- .3 Application Controller will operate as a stand-alone controller in the event of communication failure with the BAS.
- .4 In case of communications failure stand-alone operation shall use default values or last known values for remote sensors read over the network such as outdoor air temperature.

.4 Software
- .1 To meet the sequence of operation for each zone control, the controller shall use programs developed and tested by the controller manufacturer that are either factory loaded or customized with use of service tool native to the controller.

.5 Environment: Controller hardware shall be suitable for the anticipated ambient conditions.
- .1 Storage: -55° to 203° F (-48° to 95° C) and 5 to 95% Rh, non-condensing.
- .2 Operating: -40° to 158° F (-40 to 70° C) and 5 to 95% Rh, non-condensing.
- .3 Controllers used indoors shall be mounted in a NEMA 1 enclosure at a minimum.
- .4 Controllers used outdoors and/or in wet ambient shall be mounted within NEMA 4 type waterproof enclosures, and shall be rated for operation at -40° to 158° F [-40° to 70° C].

.6 Controller Input/Output: The controller shall have on board capable of performing all functionality needed for the application. Controls provided by the equipment manufacture must supply the required I/O for the equipment.
- .1 For flexibility in selection and replacement of valves, the controllers shall be capable of supporting all of the following output types; 0-10VDC, 0-5VDC, 4-20mA, Binary.
- .2 For flexibility in selection and replacement of sensors, the controllers shall be capable of reading sensor input ranges of 0 to10V, 0 to 20mA, Pulse counts, and 200 to 20Kohm.

.7 Serviceability – The controller shall provide the following in order to improve serviceability of the controller.
- .1 Diagnostic LEDs shall indicate correct operation or failures/faults for all of the following: power, sensors, BACnet communications, and I/O communications bus.
- .2 All binary output shall have LED’s indicating the output state.
- .3 All wiring connectors shall removable without the use of a tool.
- .4 Software service tool connection through the following methods: direct cable connection to the controller, connection through another controller on BACnet link.

.8 Software Retention: All Zone Controller operating parameters, setpoints, BIOS, and sequence of operation code must be stored in non-volatile memory in order to maintain such information for months without power.

.9 Controller shall meet the following Agency Compliance:
- .1 UL916 PAZX, Open Energy Management Equipment
- .2 UL94-5V, Flammability
- .3 FCC Part 15, Subpart B, Class B Limit
- .4 BACnet Testing Laboratory (BTL) listed

2.9 **Input/Output Interface**

.1 Hardwired inputs and outputs may tie into the system through building, custom application, or ASCs.

.2 All input points and output points shall be protected such that shorting of the point to itself, to another point, or to ground will cause no damage to the controller. All input and output points shall be protected from voltage up to 24V of any duration, such that contact with this voltage will cause no damage to the controller.

.3 Binary inputs shall allow the monitoring of on/off signals from remote devices. The binary inputs shall provide a wetting current of at least 12 mA to be compatible with commonly available control devices and shall be protected against the effects of contact bounce and noise. Binary inputs shall sense “dry contact” closure without external power (other than that provided by the controller) being applied.

.4 Pulse accumulation input objects. This type of object shall conform to all the requirements of binary input objects and also accept up to 10 pulses per second for pulse accumulation.

.5 Analog inputs shall allow the monitoring of low voltage (0 to 10 VDC), current (4 to 20 mA), or resistance signals (thermistor, RTD). Analog inputs shall be compatible with and field configurable to commonly available sensing devices.

.6 Binary outputs shall provide for on/off operation or a pulsed low-voltage signal for pulse width modulation control. Binary outputs on building and custom application controllers shall have status lights. Outputs shall be selectable for either normally open or normally closed operation.

.7 Analog outputs shall provide a modulating signal for the control of end devices. Outputs shall provide either a 0 to 10VDC or a 4 to 20 mA signal as required to provide proper control of the output device. Analog outputs shall not exhibit a drift of greater than 0.4% of range per year.

.8 Tri-State Outputs. Provide tri-state outputs (two coordinated binary outputs) for control of three-point floating type electronic actuators without feedback. Use of three-point floating devices shall be limited to zone control and terminal unit control applications (VAV terminal units, duct-mounted heating coils, zone dampers, radiation, etc.). Control algorithms shall run the zone actuator to one end of its stroke once every 24 hours for verification of operator tracking.

.9 System Object Capacity. The system size shall be expandable to at least twice the number of input/ output objects required for this project. Additional controllers (along with associated devices and wiring) shall be all that is necessary to achieve this capacity requirement. The operator interfaces installed for this project shall not require any hardware additions or software revisions in order to expand the system.

2.10 **Power Supplies**

.1 Control transformers shall be UL listed. Furnish Class 2 current-limiting type or furnish overcurrent protection in both primary and secondary circuits for Class 2 service in accordance with NEC requirements. Limit connected loads to 80% of rated capacity.

.1 DC power supply output shall match output current and voltage requirements. Unit shall be full-wave rectifier type with output ripple of 5.0 mV maximum peak-to-peak. Regulation shall be 1.0% line and load combined, with 100-microsecond response time for 50% load changes. Unit shall have built-in overvoltage and overcurrent protection and shall be able to withstand a 150% current overload for at least three seconds without trip-out or failure.

.1 Unit shall operate between 0°C and 50°C (32°F and 120°F). EM/RF shall meet FCC Class B and VDE 0871 for Class B and MIL-STD 810C for shock and vibration.

.2 Line voltage units shall be UL recognized and CSA approved.

2.11 **Auxillary Control Devices**

.1 Motorized dampers, unless otherwise specified elsewhere, shall be as follows:

.1 Damper frames shall be 16 gauge galvanized sheet metal or 1/8" extruded aluminum with reinforced corner bracing.

.2 Damper blades shall not exceed 8" in width or 48" in length. Blades are to be suitable for medium velocity performance (2,000 fpm). Blades shall be not less than 16 gauge.

.3 Damper shaft bearings shall be as recommended by manufacturer for application.

.4 All blade edges and top and bottom of the frame shall be provided with compressible seals. Side seals shall be compressible stainless steel. The blade seals shall provide for a maximum leakage rate of 10 CFM per square foot at 2.5" w.c. differential pressure.

.5 All leakage testing and pressure ratings will be based on AMCA Publication 500.

.6 Individual damper sections shall not be larger than 48" x 60". Provide a minimum of one damper actuator per section.

.2 Control dampers shall be parallel or opposed blade types as scheduled on drawings.

.3 Electric damper/valve actuators

.1 The actuator shall have electronic overload or digital rotation sensing circuitry to prevent damage to the actuator throughout the rotation of the actuator.

.2 Where shown, for power-failure/safety applications, an internal mechanical, spring return mechanism shall be built into the actuator housing.

.3 All rotary spring return actuators shall be capable of both clockwise or counter clockwise spring return operation. Linear actuators shall spring return to the retracted position.

.4 Proportional actuators shall accept a 0-10 VDC or 0-20 ma control signal and provide a 2-10 VDC or 4-20 ma operating range.

.5 All non-spring return actuators shall have an external manual gear release to allow manual positioning of the damper when the actuator is not powered. Spring return actuators with more than 60 in-lb. torque capacity shall have a manual crank for this purpose.

.6 Actuators shall be provided with a conduit fitting and a minimum 1m electrical cable and shall be pre-wired to eliminate the necessity of opening the actuator housing to make electrical connections.

.7 Actuators shall be Underwriters Laboratories Standard 873 listed.

.8 Actuators shall be designed for a minimum of 60,000 full stroke cycles at the actuator's rated torque.

.4 Control Valves
- .1 Control valves shall be two-way or three-way type for two-position or modulating service as scheduled or shown.
- .2 Close-off (differential) Pressure Rating: Valve actuator and trim shall be furnished to provide the following minimum close-off pressure ratings:
  - .1 Water Valves:
    - .1 Two-way: 150% of total system (pump) head.
    - .2 Three-way: 300% of pressure differential between ports A and B at design flow or 100% of total system (pump) head.
  - .2 Steam Valves: 150% of operating (inlet) pressure.

.5 Water Valves
- .1 Body and trim style and materials shall be in accordance with manufacturer's recommendations for design conditions and service shown, with equal percentage ports for modulating service.
- .2 Sizing Criteria:
  - .1 Two-position service: Line size.
  - .2 Two-way modulating service: Pressure drop shall be equal to twice the pressure drop through heat exchanger (load), 50% of the pressure difference between supply and return mains, or 34.5 kPa (5 psi), whichever is greater.
  - .3 Three-way modulating service: Pressure drop equal to twice the pressure drop through the coil exchanger (load), 34.5 kPa (5 psi) maximum.
  - .4 Valves DN 15 (1/2 in.) through DN 50 (2 in.) shall be bronze body or cast brass ANSI Class 250, spring-loaded, PTFE packing, quick opening for two-position service. Two-way valves to have replaceable composition disc or stainless steel ball.
  - .5 Valves DN 65 (2 1/2 in.) and larger shall be cast iron ANSI Class 125 with guided plug and PTFE packing.
- .3 Water valves shall fail normally open or closed, as scheduled on plans, or as follows:
  - .1 Water zone valves—normally open preferred
  - .2 Heating coils in air handlers - normally open
  - .3 Chilled-water control valves - normally closed
  - .4 Other applications—as scheduled or as required by sequences of operation
- .4 Zone valves shall be sized to meet the control application and they shall maintain their last position in the event of a power failure.

.6 Steam Valves
- .1 Body and trim materials shall be in accordance with manufacturer's recommendations for design conditions and service with linear ports for modulating service.
- .2 Sizing Criteria:
  - .1 Two-position service: pressure drop 10% to 20% of inlet psig
  - .2 Modulating service: 100 kPa (15 psig) or less; pressure drop 80% of inlet psig
  - .3 Modulating service: 101 to 350 kPa (16 to 50 psig); pressure drop 50% of inlet psig
  - .4 Modulating service: over 350 kPa (50 psig); pressure drop as scheduled on plans

.7 Binary Temperature Devices
- .1 Low-voltage space thermostat shall be 24 V, bimetal-operated, mercury-switch type, with either adjustable or fixed anticipation heater, concealed setpoint adjustment, 13°C to 30°C (55°F to 85°F) setpoint range, 1°C (2°F) maximum differential, and vented ABS plastic cover.

.2 Line-voltage space thermostat shall be bimetal-actuated, open contact type, or bellows-actuated, enclosed, snap-switch type or equivalent solid-state type, with heat anticipator, UL listed for electrical rating, concealed setpoint adjustment, 13°C to 30°C (55°F to 85°F) setpoint range, 1°C (2°F) maximum differential, and vented ABS plastic cover.

.3 Low-limit thermostats. Low-limit airstream thermostats shall be UL listed, vapor pressure type, with an element of 6 m (20 ft) minimum length. Element shall respond to the lowest temperature sensed by any 30 cm (1 ft) section. The low-limit thermostat shall be manual reset only.

.8 Wired Temperature Sensors

.1 Temperature sensors shall be RTD or thermistor.

.2 Duct sensors shall be single point or averaging as shown. Averaging sensors shall be a minimum of 1.5 m (5 ft) in length per 1 m2 (10 ft2) of duct cross section.

.3 Immersion sensors shall be provided with a separable stainless steel well. Pressure rating of well is to be consistent with the system pressure in which it is to be installed. The well must withstand the flow velocities in the pipe.

.4 Space sensors shall be equipped with setpoint adjustment, override switch, display, and/or communication port as shown on plans.

.5 Provide matched temperature sensors for differential temperature measurement.

.9 Wired Humidity Sensors

.1 Duct and room sensors shall have a sensing range of 20% to 80%.

.2 Duct sensors shall be provided with a sampling chamber.

.10 Static Pressure Sensors

.1 Sensor shall have linear output signal. Zero and span shall be field-adjustable.

.2 Sensor sensing elements shall withstand continuous operating conditions plus or minus 50% greater than calibrated span without damage.

.3 Water pressure sensor shall have stainless steel diaphragm construction, proof pressure of 150 psi minimum. Sensor shall be complete with 4-20 ma output, required mounting brackets, and block and bleed valves. Mount in location accessible for service.

.4 Water differential pressure sensor shall have stainless steel diaphragm construction, proof pressure of 150 psi minimum. Over-range limit (DP) and maximum static pressure shall be 3,000 psi. Transmitter shall be complete with 4-20 ma output, required mounting brackets, and five-valve manifold. Mount in a location accessible for service.

.11 Low Limit Thermostats

.1 Safety low limit thermostats shall be vapor pressure type with an element 6m [20 ft] minimum length. Element shall respond to the lowest temperature sensed by any one foot section.

.2 Low limit shall be manual reset only.

2.12 **Wiring and Raceways**

.1 General: Provide copper wiring, plenum cable, and raceways as specified in the applicable sections of this specification.

.2 All insulated wire to be copper conductors, UL labeled for 90°C (194°F) minimum service.

.3 Fiber Optic Cable. Optical cables shall be duplex 900 mm tight-buffer construction designed for intra-building environments. The sheath shall be UL Listed OFNP in accordance with NEC Article 770. The optical fiber shall meet the requirements of FDDI, ANSI X3T9.5 PMD for 62.5/125 µm.

PART 3 - EXECUTION

3.00 **Sections Include**

3.01 Examination:
3.02 Protection:
3.03 Coordination:
3.04 General Workmanship:
3.05 Field Quality Control:
3.06 Communication Wiring:
3.07 Fiber Optic Cable:
3.08 Installation Of Sensors:
3.09 Flow Switch Installation:
3.10 Warning Labels:
3.11 Identification Of Hardware And Wiring:
3.12 Controllers:
3.13 Programming:
3.14 Control System Checkout And Testing:
3.15 Cleaning:
3.16 Training:

3.01 **Examination:**

.1 The Contract Documents shall be thoroughly examined for coordination of control devices, their installation, wiring, and commissioning. Coordinate and review mechanical equipment specifications, locations, and identify any discrepancies, conflicts, or omissions that shall be reported to the Architect/Engineer for resolution before rough-in work is started.

.2 The BAS manufacturer shall inspect the jobsite in order to verify that control equipment can be installed as required, and any dis¬crepancies, conflicts, or omissions shall be reported to the Architect/Engineer for resolution before rough-in work is started.

3.02 **Protection:**

.1 The BAS installation contractor shall protect all work and material from damage by their work or personnel, and shall be liable for all damage thus caused.

.2 The BAS manufacturer shall be responsible for their work and equipment until final inspection, testing, and acceptance. The BAS installing contractor shall protect their work against theft or damage, and shall carefully store material and equipment received on site that is not immediately installed. The Contractor shall close all open ends of work with temporary covers or plugs during storage and construction to prevent entry of foreign objects.

3.03 **Coordination:**

.1 Site

.1 Where the mechanical work will be installed in close proximity to, or will interfere with, work of other trades, the contractor shall assist in working out space conditions to make a satisfactory adjustment. If the contractor installs his/her work before coordinating with

other trades, so as to cause any interference with work of other trades, the contractor shall make the necessary changes in his/her work to correct the condition without extra charge.

.2 Coordinate and schedule work with all other work in the same area, or with work that is dependent upon other work, to facilitate mutual progress.

.2 Submittals. Refer to the “Submittals,” section of this specification for requirements.

.3 Test and Balance

.1 The contractor shall furnish a single set of all tools necessary to interface to the control system for test and balance purposes.

.2 The contractor shall provide training in the use of these tools. This training will be planned for a duration of 4 hours.

.3 In addition, the contractor shall provide a qualified technician to assist in the test and balance process, until the first 20 terminal units are balanced.

.4 The tools used during the test and balance process shall be returned to the contractor at the completion of the testing and balancing.

.4 Life Safety

.1 Duct smoke detectors required for air handler shutdown shall be supplied under Section 26100 of this specification. The contractor shall interlock smoke detectors to air handlers for shutdown as described in the Sequences of Operation for this project.

.2 Smoke dampers and actuators required for duct smoke isolation are provided under Section 26100. The contractor shall interlock these dampers to the air handlers as described in the Sequences of Operation for this project as applicable.

.3 Fire/smoke dampers and actuators required for fire rated walls are provided under another Section 26100. Control of these dampers shall be by 26100

5 Coordination with Controls Specified in Other Sections or Divisions. Other sections and/or divisions of this specification include controls and control devices that are to be part of or interfaced to the control system specified in this section. These controls shall be integrated into the system and coordinated by the contractor as follows:

.1 All communication media and equipment shall be provided as specified in the “Communication” section of this specification.

.2 Each supplier of a controls product is responsible for the configuration, programming, start-up, and testing of that product to meet the sequences of operation described in this section.

.3 The Contractor shall coordinate and resolve any incompatibility issues that arise between the control products provided under this section and those provided under other sections or divisions of this specification.

3.04 **General Workmanship**:

.1 Install equipment, piping, wiring/conduit, parallel to building lines (i.e. horizontal, vertical, and parallel to walls) wherever possible.

.2 Provide sufficient slack and flexible connections to allow for vibration of piping and equipment.

.3 Install all equipment in readily accessible locations as defined by National Electric Code (NEC). Control panels shall be attached to structural walls or properly supported in a free-standing configuration, unless mounted in equipment enclosure specifically designed for that purpose. Panels shall be mounted to allow for unobstructed access for service.

.4 Verify integrity of all control wiring to ensure continuity and freedom from shorts and grounds prior to commencing the startup and commissioning procedures.

.5 All control device installation and wiring shall comply with Contract Documents, acceptable industry specifications, and industry standards for performance, reliability, and compatibility. Installation and wiring shall be executed in strict adherence to local codes and standard practices referenced in Contract Documents.

3.05 **Field Quality Control**:

.1 All work, materials, and equipment shall comply with the rules and regulations of applicable local, state, and federal codes and ordinances as identified in Contract Documents.

.2 BAS manufacturer shall continually monitor the field installation for building code compliance and quality of workmanship. All visible piping and or wiring runs shall be installed parallel to building lines and properly supported.

.3 BAS installing Contractor(s) shall arrange for field inspections by local and/or state authorities having jurisdiction over the work.

3.06 **Communication Wiring**:

.1 All cabling shall be installed in a neat and workmanlike manner. Follow manufacturer's installation recommendations for all communication cabling.

.2 Do not install communication wiring in raceway and enclosures containing Class 1 or other Class 2 wiring.

.3 Maximum pulling, tension, and bend radius for cable installation, as specified by the cable manufacturer shall not be exceeded during installation.

.4 Contractor shall verify the integrity of the entire network following cable installation. Use appropriate test measures for each particular cable.

.5 When a cable enters or exits a building, a lighting arrestor must be installed between the line and ground.

.6 All runs of communication wiring shall be unspliced length when the length is commercially available.

.7 All communication wiring shall be labeled to indicate origin and destination.

3.07 **Fiber Optic Cable**:

.1 All cabling shall be installed in a neat and workmanlike manner. Minimum cable and unjacketed fiber bend radii as specified by cable manufacturer shall be maintained.

.2 Maximum pulling tensions as specified by the cable manufacturer shall not be exceeded during installation. Post installation residual cable tension shall be within cable manufacturer's specifications.

.3 Fiber optic cabinets, hardware, and cable entering the cabinet shall be installed in accordance with manufacturers' instructions. Minimum cable and unjacketed fiber bend radii as specified by cable manufacturer shall be maintained.

3.08 **Installation Of Sensors**

.1 Sensors required for mechanical equipment operation shall be factory installed and wired as specified in mechanical equipment specifications. BAS manufacturer shall be responsible for coordinating these control devices and ensuring the sequence of operations will be met. Installation and wiring shall be in accordance with the BAS manufacturer's recommendations.

.2 Sensors that require field mounting shall meet the BAS manufacturer’s recommendations and be coordinated with the mechanical equipment they will be associated.

.3 Mount sensors rigidly and adequately for the environment the sensor will operate.

.4 Room temperature sensors shall be installed on concealed junction boxes properly supported by the block wall framing. For installation in dry wall ceilings, the low voltage sensor wiring can be installed exposed and must meet applicable National and Local Electrical Codes.

.5 All wires attached to wall mounted sensors shall be sealed off to prevent air from transmitting in the associated conduit and affecting the room sensor readings.

.6 Install duct static pressure tap with tube end facing directly down-stream of air flow.

.7 Install space static pressure sensor with static sensing probe applicable for space installation where applicable.

.8 Sensors used in mixing plenums, and hot and cold decks shall be of the averaging type. Averaging sensors shall be installed in a serpentine manner horizontally across duct. Each bend shall be supported with a capillary clip.

.9 All pipe mounted temperature sensors shall be installed in matched thermowells. Install all liquid temperature sensors with heat conducting fluid in thermal wells for adequate thermal conductance.

.10 Wiring for space sensors shall be concealed in building drywall. EMT conduit is acceptable within mechanical equipment and service rooms.

.11 Install outdoor air temperature sensors on north wall complete with sun shield at manufacturer’s recommended location and coordinated with Engineer.

3.09 **Flow Switch Installation**

.1 Coordinate installation of flow switch with Mechanical Contractor who will be responsible for installing a thread o let in steel piping applications. Copper pipe applications will require the use CxCxF Tee, and no pipe extensions or substitutions will be allowed.

.2 Mount a minimum of 5 pipe diameters upstream and 5 pipe diameters downstream, or two feet, whichever is greater, from pipe fittings and other inline potential obstructions.

.3 Install in accordance with manufacturers' instructions, which will require proper flow direction, horizontal alignment with flow switch mounting on the top of pipe.

3.10 **Warning Labels**:

.1 Permanent warning labels shall be affixed to all equipment that can be automatically started by the BAS system.

.2 Permanent warning labels shall be affixed to all motor starters and all control panels that are connected to multiple power sources utilizing separate disconnects.

3.11 **Identification Of Hardware and Wiring**

.1 All field wiring and cabling, including that within factory mounted, and wired control panels and devices for mechanical equipment, shall be labeled at each end within 2" of termination with a cable identifier and other descriptive information for troubleshooting, maintenance, and service purposes. BAS manufacturer to coordinate this labeling requirement with mechanical equipment manufacturer as it relates to controls.

.2 Permanently label or code each point of field terminal strips to show the instrument or item served and correlate them to the BAS design drawings.

.3 Identify control panels with minimum 1-cm letters on laminated plastic nameplates.

.4 Identifiers shall match record documents. All plug-in components shall be labeled such that removal of the component does not remove the label.

3.12 **Controllers**

.1 Provide a separate DDC Controller for individual HVAC mechanical equipment. BAS manufacturer shall furnish and coordinate DDC controllers and control devices and ensure that installation and wiring adhere to BAS manufacturer's design recommendations. For those mechanical equipment units that do not have factory installed controls specified, the BAS manufacturer shall field mount controls and coordinate all installation and termination information to ensure the specified sequence of operations are met.

.2 Building Controllers and Custom Application Controllers shall be selected to provide a minimum of 15% spare I/O point capacity for each point type (analog or digital) found at each location. If input points are not universal, 15% of each type is required. If outputs are not universal, 15% of each type is required. A minimum of one spare is required for each type of point used in each controller.

.1 Future use of spare I/O point capacity shall require providing the field instrument and control device, field wiring, engineering, programming, and commissioning. No additional Controller boards or point modules shall be required to implement use of these spare points.

3.13 **Programming**

.1 Provide sufficient internal memory for all controllers to ensure specified sequence of operations, alarming, trending, and reporting requirements are achieved. BAS manufacturer shall provide a minimum of 25% spare memory capacity for future use.

.2 Point Naming: System point names shall be modular in design, allowing easy operator interface without the use of a written point index.

.3 Software Programming

.1 Provide programming for individual mechanical systems to achieve all aspects of the sequence of operation specified. It is the BAS manufacturer's responsibility to ensure all mechanical equipment functions and operates as specified in sequence of operations. Provide sufficient programming comments in controller application software to clearly describe each section of the program. The comment statements shall reflect the language used in the sequence of operations.

.4 BAS Operator's Interface

.1 When Operator Workstation is specified, provide color graphics for each piece of mechanical equipment depicting sufficient I/O to monitor and troubleshoot operation. Operator color graphics shall include Chiller Plant, Cooling Tower System, Boiler Plant, Air Handling Units, Rooftop Units, VAV Terminal Boxes, Fan Coil Units, Unit Ventilators, Heat Exchangers, Exhaust Fans, etc. These standard graphics shall depict all points dynamically as specified in the points list and/or indicated in sequence of operation.

.2 The BAS manufacturer shall provide all the labor necessary to install, initialize, start up, and trouble-shoot all operator interface software and their functions as described in this section. This includes any operating system software, the operator interface data base, and any third party software installation and integration required for successful operation of the operator interface.

.3 As part of this execution phase, the BAS manufacturer shall perform a complete test of the operator interface.

3.14 **Control System Checkout and Testing**

.1 Start-up testing. All testing in this section shall be performed by the contractor and shall make up part of the necessary verification of an operating control system. This testing shall be completed before the owner's representative is notified of the system demonstration.

.1 The contractor shall furnish all labor and test apparatus required to calibrate and prepare for service all of the instruments, controls, and accessory equipment furnished under this specification.

.2 Verify that all control wiring is properly connected and free of all shorts and ground faults. Verify that terminations are tight.

.3 Enable the control systems and verify calibration of all input devices individually. Perform calibration procedures according to manufacturer's recommendations.

.4 Verify all binary output devices (relays, solenoid valves, two-position actuators and control valves, magnetic starter, etc.) operate properly and normal positions are correct.

.5 Verify all analog output devices (I/Ps, actuators, etc) are functional, that startand span are correct, and that direection and normal positions are correct. The contractor shall check all control valves and autoatic dampers to ensure proper action and closure. The contractor shall make any necessary adjustments to valve stem and damper blade travel.

.6 Verify the system operation adheres to the sequences of operation. Simulate and observe all modes of operation by overriding and varying inputs and schedules. Tune all DDC loops and optimal start/stop routimes.

.7 Alarms and Interlocks

.1 Check each alarm separately by including an appropriate signal at a value that will trip the alarm.

.2 Interlocks shall be tripped using field contacts to check the logic, as well as to ensure that the fail-safe condition for all actuators is in the proper direction.

.3 Interlock actions shall be tested by simulating alarm conditions to check the initiating value of the variable and interlock action.

.8 Complete all control systems hardware and software systems startup with close coordination with the commissioning agent under Section 15878. Cooperate with the demands and reporting requirements of Section 15878.

3.15 **Cleaning**

.1 The BAS manufacturer's installing contractor(s) shall clean up all debris resulting from their installation activities on a daily basis. The installation contractors shall remove all cartons, containers, crates, etc. under his control as soon as their contents have been removed. Waste shall be collected and placed in a location designated by the Owner, Construction Manager, General Contractor, and/or Mechanical Contractor.

.2 At the completion of work in any area, the installation contractor shall clean all of their work, equipment, etc., making it free from dust, dirt and debris.

.3 At the completion of work, all equipment furnished under this Section shall be checked for paint damage. Any factory finished paint that has been damaged shall be repaired to match the adjacent areas. Any metal cabinet or enclosure that has been deformed shall be replaced with new material and repainted to match the adjacent areas.

3.16 **Training**

.1 Provide minimum of (4) hours of operator training throughout the contract period. The training will be provided for personnel designated by the Owner.

.2 These objectives will be divided into logical groupings; participants may attend one or more of these, depending on level of knowledge required:
.1 Day-to-day BAS Operators
.2 BAS Troubleshooting & Maintenance

3.17 **Points Lists**

Refer to the BAS Points Lists on the drawings.

END OF SECTION 15900

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1 GENERAL

1.01 REFERENCES

.1 The General Conditions of the Contract, the Supplementary Conditions, and all Sections of Division 01 apply to and are a part of this Section of the Specification.

1.02 APPLICATION

.1 This Section specifies requirements that are common to electrical work Sections of the Specification and it is a supplement to each Section and is to be read accordingly.

1.03 NOTE RE: BOLD LETTERING

.1 "**Bold**" type lettering is used throughout this Specification in an attempt to enhance the readability of the text. The use of "**bold**" lettering does not indicate a greater level of importance.

1.04 SUBMITTALS

.1 As specified in this Section, submit the following to the Consultant:

.1 **project close-out documentation:** O & M Manuals, record as-built drawings, and all associated data

.2 **progress payment breakdown:** a detailed breakdown of the electrical work cost

.3 **Contractor's P. Eng. Documentation:** the name, qualifications, and evidence of current liability insurance for all professional engineers to be retained by the Contractor to perform work associated with the Contract

.4 **Extended Warranties:** copies of all extended warranties specified, and in the name of the Owner

.5 **O & M Training Schedules & Manual:** a proposed schedule of demonstration and training dates and times, and a preliminary copy of the training manual developed for operational and maintenance training

1.05 DEFINITIONS

.1 The following are definitions of words found in electrical work Sections of the Specification and on associated drawings:

.1 "concealed" – means work hidden from normal sight in furred spaces, shafts, tunnels, ceiling spaces, walls and partitions

.2 "exposed" – means work normally visible, including work in electrical and equipment rooms and similar spaces

.3 "provide" (and tenses of provide) – means supply and install complete

.4 "install" (and tenses of install) – means install and connect complete

.5 "supply" – means supply only

.6 "finished area" - means any area or part of an area which receives a finish such as paint, or is factory finished

.7 "governing authority" and/or "regulatory authority" and/or "Municipal authority" – means all government departments, agencies, standards, rules and regulations that apply to and govern the electrical work and to which the work must adhere

.8 "Consultant" – means the Architect or Consulting Engineer who has prepared the Contract Documents on behalf of the Owner

.2 Wherever the words "indicated", "shown", "noted", "listed", or similar words or phrases are used in the specification they are understood, unless otherwise defined, to mean that the product referred to is "indicated", "shown", "listed", or "noted" on the drawings.

.3 Wherever the words "approved", "satisfactory", "as directed", "submit", "permitted", "inspected" or similar words or phrases are used in the specification or on the drawings they are understood, unless otherwise defined, to mean that work or product referred to is "approved by", "inspected by", etc., the Consultant.

.4 In the electrical specification, singular may be read as plural, and vice-versa.

1.06 QUALITY ASSURANCE

.1 All electrical work is to be done by journeyman tradesmen who perform only the work that their certificates permit, or by apprentice tradesmen under direct on-site supervision of an experienced journeyman tradesman. The use of apprentice tradesmen is to be limited and the journeyman/apprentice ratio is subject to the Consultant’s approval.

.2 An experienced and qualified superintendent is to be on-site at all times when electrical work is being performed.

1.07 CODES, REGULATIONS, AND STANDARDS

.1 All Codes, Regulations, and Standards referred to in this Section and in Sections to which this Section applies are the latest edition of the Codes, Regulations, and Standards in effect at the time of bidding on this Project.

.2 All electrical items are to be certified and bear the stamp or seal of a recognized testing agency such as CSA, UL, ULC, ETL, etc., or bear a stamp to indicate special electrical utility approval.

.3 Requirements of the Contract Documents are to take precedence when they are more stringent than codes, ordinances, standards, and statutes.

1.08 IMPERIAL AND METRIC MEASUREMENTS

.1 Conform to requirements of CAN/CSA-Z234.1, Canadian Metric Practice Guide.

.2 Both Metric and Imperial units of measurement are indicated in the electrical Specification. Metric measurements are "soft" and have been rounded off.

1.09 EXAMINATION OF SITE AND DOCUMENTS

.1 When estimating the cost of the work and prior to submitting a bid for the work carefully examine all of the bid documents and visit the site to determine and review all existing site conditions that will or may affect the work, and include for all such conditions in the bid price.

.2 Report to the Consultant, prior to bid submittal, any existing site condition that will or may affect performance of the work as per the drawings and specifications. Failure to do so will not be grounds for additional costs.

1.10 DRAWINGS AND SPECIFICATION

.1 Read the electrical work drawings in conjunction with all other structural, architectural, sprinkler, mechanical, etc., drawings.

.2 The electrical drawings are performance drawings, diagrammatic, and show approximate locations of equipment and connecting services. Any information regarding accurate measurement of the building are to be taken at the site. Do not scale the drawings, and do not use the drawings for prefabrication work.

.3 The drawings are intended to convey the scope of work and do not show architectural and structural details. Provide, at your cost, all offsets, fittings, transformations, and similar products required as a result of obstructions and other architectural and structural details but not shown on the drawings.

.4 The locations of equipment and materials shown may be altered, when reviewed by the Consultant, to meet requirements of the equipment and/or materials, other equipment or systems being installed, and of the building, all at your cost.

.5 Sections of the electrical specification are not intended to delegate functions nor to delegate work and supply of materials to any specific trade, but rather to generally designate a basic unit of work, and the Sections are to be read as a whole.

.6 The electrical specification does not generally indicate the specific number of items or extent of material required. The specification is intended to provide product data and installation requirements. It is necessary to refer to drawing schedules, layouts, schematic diagrams, riser diagrams, and details to determine correct quantities.

.7 The electrical drawings and specification are intended to be cooperative. Perform all work that is shown, specified, or reasonably implied on the drawings but not mentioned in the specification, or vice-versa, as though fully covered by both.

.8 When the scale and date of the drawings are the same, or when the discrepancy exists within the specification, the most costly arrangement will take precedence.

.9 In the case of discrepancies or conflicts between the drawings and specification, the documents will govern in the following order:

.1 the specification

.2 drawings of larger scale

.3 drawings of smaller scale

.4 drawings of later date when the scale of the drawings is the same

.10 In the case of discrepancies between the drawings and specifications, the documents will govern in the order specified in the General Conditions, however, when the scale and date of the drawings are the same, or where the discrepancy exists within the specification, the costliest arrangement will take precedence.

1.11 PLANNING AND LAYOUT OF THE WORK, AND ASSOCIATED DRAWINGS

.1 Properly plan, coordinate, and establish the locations and routing of services with all subcontractors affected prior to installation such that the services will clear each other as well as any obstructions, including structural components of the building. Unless otherwise specified, the order of right-of-way for services is to be as follows:

.1 piping requiring uniform pitch

.2 piping 100 mm (4") dia. and larger

.3 large ducts (main runs)

.4 electrical cable tray and bus duct

.5 conduit 100 mm (4") dia. and larger

.6 piping less than 100 mm (4") diameter

.7 smaller branch ductwork

.8 conduit less than 100 mm (4") diameter

.2 Unless otherwise shown or specified, conceal all work in finished areas, and conceal work in partially finished or unfinished areas to the extent made possible by the area construction. Install conduit, raceway, and similar services as high as possible to conserve headroom and/or ceiling space. Notify the Consultant where headroom or ceiling space appears to be inadequate prior to installation of the work.

.3 Revise or alter the arrangement of work that has been installed without proper coordination, study and review, even if it was completed in accordance with the Contract Documents, in order to conceal the work behind finishes, or to allow the installation of other work, at no additional cost. In addition, pay for the cost of alterations in other work required by the alterations to your work.

.4 All junction boxes, equipment and similar products, particularly such products located above suspended ceilings must be located for easy access for servicing and/or removal. Products which do not meet this location requirement are to be relocated to an accessible location at no additional cost.

1.12 COORDINATION OF THE WORK

.1 Review all the Contract Documents and coordinate the work with the work of all subcontractors. Coordination requirements are to include, but not be limited to, the following:

.1 written notifications of all concrete work such as housekeeping pads, bases, etc., required for electrical work, and including required dimensions, operating weight of equipment, location, etc.

.2 depth and routing of excavation required for electrical work, and requirements for bedding and backfill

1.13 GENERAL RE: INSTALLATION OF EQUIPMENT

.1 Unless otherwise specified all equipment is to be installed in accordance with the equipment manufacturer's recommendations and instructions, and requirements of governing Codes, Standards, and Regulations. Governing Codes, Standards, and Regulations take precedence over manufacturer's instructions.

.2 Ensure that proper access and service clearances are maintained around equipment, and, where applicable, access space for future equipment removal or replacement is not impeded. Remove and replace any equipment which does not meet this requirement.

1.14 PERMITS, FEES, AND CERTIFICATES

.1 Apply for, obtain and pay for all permits required to complete the electrical work.

.2 Submit to the Consultant, all approval/inspection certificates issued by governing authorities to confirm that the work as installed is in accordance with the rules and regulations of the governing authorities. Pay any costs associated with issue of the certificates.

.3 Include a copy of all approval/inspection certificates in each operating and maintenance manual.

1.15 WORKPLACE SAFETY

.1 Comply with requirements of the Workplace Hazardous Materials Information System (WHMIS) regarding the use, handling, storage and disposal of hazardous materials. Submit WHMIS MSDS (Material Safety Data Sheets) for all products where required, and maintain one copy at the site in a visible and accessible location available to all personnel.

.2 Comply with all requirements of Occupational Health and Safety Regulations and all other regulations pertaining to health and safety, including worker's compensation/ insurance board and fall protection regulations.

.3 **Asbestos, Mould, Lead Paint, Etc.:** If at any time during the course of the work asbestos containing materials, black mould, lead paint, or any other such materials are encountered or suspected, immediately report the discovery to the Consultant and cease all work in the area in question. Do not resume work in affected areas until the situation has been properly corrected and without written approval from the Owner.

1.16 SHOP DRAWINGS AND PRODUCT DATA SHEETS

.1 Prior to supplying any products to the site, submit for review, shop drawings and/or product data sheets indicating in detail the design, construction, and performance of products as requested in Sections of this Specification. The number of copies of shop drawings and/or product data sheets will be as later directed.

.2 Shop drawings are those prepared specifically for the Project. Product data sheets are copies of manufacturer's standard catalogue, etc., literature.

.3 Unless otherwise specified or required, submit shop drawings/product data sheets via email in AutoCAD or PDF format only.

.4 Wherever possible, shop drawings and/or product data sheets are to be 215 mm x 280 mm (8½" x 11"), 215 mm x 356 mm (8½" x 14"), or 356 mm x 432 mm (11" x 17") single side white bond paper with sufficient clear space for review stamps, comments, and identification as specified below.

.5 Shop drawings and product data sheets must confirm that the product proposed meets all requirements of the Contract Documents.

.6 Each shop drawing or product data sheet is to be properly identified with the project name and the product drawing or specification reference, i.e. "Lighting Fixture F1", and all shop drawing or product data sheet dimensions are to be either SI or Imperial to match dimensions on the drawings.

.7 Carefully review each shop drawing and product data sheet prior to submittal to ensure that the proposed product is correct and meets with all requirements of the Project. Endorse each copy of each shop drawing or product data sheet "Correct for Review By Consultant", or "Certified to Be In Accordance With All Requirements" and include your company name, the submittal date, and the signature of an officer of your company to indicate your review and approval as above.

.8 The Consultant will review shop drawings and product data sheets and will indicate the review status by stamping the shop drawings and product data sheets as follows:

.1 "**Reviewed**" **or** "**Reviewed As Noted**" to indicate that his review is final and no re-submittal is required

.2 "**Returned For Correction**" to indicate that the submission is rejected and is to be revised in accordance with comments marked on the shop drawings and product data sheets by the Consultant and re-submitted

.9 The Consultant will retain one or two copies of each shop drawing or product data sheet submission.

.10 The following is to be read in conjunction with the wording on the Consultant's review stamp applied to each and every electrical work shop drawing or product data sheet submitted:

"This review is for the sole purpose of ascertaining conformance with the general design concept. This review does not approve the detail design inherent in the product data/shop drawings, responsibility for which remains with the Contractor, and such review does not relieve the Contractor of the responsibility for errors or omissions in the product data/shop drawings or of his responsibility for meeting all requirements of the Contract Documents. Be responsible for dimensions to be confirmed and correlated at the job site, for information that pertains solely to fabrication processes or to techniques of construction and installation, and for coordination of the work of all sub-trades."

1.17 CHANGES OR REVISIONS TO THE WORK

.1 Whenever the Consultant proposes in writing to make a change or revision to the design, arrangement, quantity or type of any work from that required by the Contract Documents, prepare and submit to the Consultant for approval, a quotation being your proposed cost for executing the change or revision.

.2 Your quotation is to be a detailed and itemized estimate of all products, material, labour, and equipment costs associated with the change or revision, plus overhead and profit percentages and all applicable taxes and duties.

.3 Unless otherwise stated in the Contract Documents, the following requirements apply to all quotations submitted:

.1 when the change or revision involves deleted work as well as additional work, the cost of the deleted work (less overhead and profit percentages but including taxes and duties) is to be subtracted from the cost of the additional work before overhead and profit percentages are applied to the additional work

.2 material costs are not to exceed those published in local estimating price guides such as Allpriser, less applicable trade discounts

.3 costs for journeyman and apprentice labour must not exceed prevailing rates at the time of execution of the Contract and must reflect the actual personnel performing the work

.4 cost for the site superintendent must not exceed 10% of the total hours of labour estimated for the change or revision, and the change or revision must be such that the site superintendent’s involvement is necessary

.5 costs for rental tools and/or equipment are not to exceed local rental costs

.6 if overhead and profit percentages are not specified in the General Conditions of the Contract, Supplementary Conditions, or elsewhere in preceding Sections of the Specification, but allowable under the Contract, then allowable percentages for mark-up and overhead and profit are to be 10% and 5% respectively

.7 the overhead percentage will be deemed to cover all quotation costs other than actual site labour, product and materials, and rentals

.8 all quotations, including those for deleted work, must include a figure for any required change to the Contract time

.4 Quotations submitted that are not in accordance with requirements specified above will be rejected and returned for re-submittal. Failure to submit a proper quotation to enable the Consultant to expeditiously process the quotation and issue a Change Order will not be grounds for any additional change to Contract time.

.5 If, in your opinion, changes or revisions to the work should be made, inform the Consultant in writing and, if the Consultant agrees a Notice of Change will be issued.

.6 Do not execute any change or revision until written authorization for the change or revision has been obtained

1.18 SCAFFOLDING, RIGGING, AND HOISTING

.1 Unless otherwise specified or directed, supply, erect and operate all scaffolding, rigging, hoisting equipment and associated hardware required for your work. Immediately remove from the site all scaffolding, rigging, and hoisting equipment when no longer required.

1.19 PROJECT CLOSEOUT SUBMITTALS

.1 Prior to application for Substantial Performance, submit all required items and documentation specified, including the following:

.1 Operating and Maintenance Manuals

.2 as-built record drawings and associated data

.3 extended warranties for equipment as specified

.4 all operating test certificates, i.e. Fire Alarm System Test Certificate

.5 identified keys for electrical equipment and/or panels for which keys are required, and all other items required to be submitted

.6 other data or products specified

.2 **Operating and Maintenance Manuals:** Submit three hard copies of operating and maintenance manuals consolidated in hardcover three "D" ring binders, each binder sized to include approximately 25% spare space for future data, and identified permanently with the Project name, "ELECTRICAL OPERATING AND MAINTENANCE MANUAL" wording, and the date. Manuals are to include the following:

.1 an Introduction sheet listing the Consultant’s, Contractor’s, and Subcontractor names, street addresses, telephone and fax numbers, and e-mail addresses

.2 a Table of Contents sheet, and corresponding index tab sheets

.3 a copy of each "Reviewed" or "Reviewed As Noted" shop drawing or product data sheet, with manufacturer’s/supplier’s name, telephone and fax numbers, email address, and the email address for local source of parts and service

.4 test reports, and certificates issued by governing authorities

.5 **Operating Data:** Operating data is to include:

.1 a description of each system and its controls

.2 operation instruction for each system and each component

.3 description of actions to be taken in event of emergencies and/or equipment failure

.6 **Maintenance Data:** Maintenance data is to include:

.1 servicing maintenance, operation and trouble-shooting instructions for each item of equipment and each system

.2 schedules of tasks, frequency, tools required, and estimated task time

.3 complete parts list with numbers

.7 **Performance Data:** Performance data is to include:

.1 equipment and system start-up data sheets

.2 equipment performance verification test results, and final commissioning report

.8 **Review Submittal:** Assemble one copy of the O & M Manual and submit to the Consultant for review prior to Owner training and instructions, and assembling the remaining copies. Incorporate all comments into the final submission.

.9 **Digital O & M Manuals:** Submit four digital versions of the hard copy manual using the latest version of Adobe Acrobat Portable Document Format and enhanced with bookmarks, internet links, and internal document links. The digital copies are to be copied to CDR with custom labels which indicate the project name, date, the Consultant’s name, and "Operating & Maintenance Manual for Electrical Systems".

.3 **Record "As-Built" Drawings and Data:** As work progresses at the site, clearly mark in red in a neat and legible manner on a set of white prints of the Contract Drawings, all significant changes and deviations from the routing of services and locations of equipment shown on the Contract Drawings and resulting from the issue of Addenda, Site Instructions, Change Orders, and job conditions. Use notes marked in red as required. Maintain the white print red line as-built set at the site for the exclusive use of recording as-built conditions, keep the set up-to-date at all times, and ensure that the set is always available for periodic review. The as-built set is also to include the following:

.1 the dimensioned location of all inaccessible concealed work

.2 the locations of control devices with identification for each

.3 the location of all junction boxes, terminal cabinets, etc.

.4 for underground conduit, ducts, etc., record dimensions, invert elevations, all offsets, fittings, and accessories if applicable, and locate dimensions from benchmarks that will be preserved after construction is complete

.5 the location of all concealed services terminated for future extension

.6 **Digital Record "As-Built" Drawings:** When work on site is complete, transfer all the as-built red line information from the site as-built drawings to a recordable and identified CAD disc with CAD work of equal quality to the Contract Drawings. Obtain a CAD disc as described below.

.7 **Obtaining CAD Discs:** The electrical drawings have been prepared on a CAD system using the latest Release of AutoCad software. For the purpose of producing final as-built drawings, discs of the Contract Drawings will be supplied free of charge by the Consultant.

.8 **Review and Submittal:** Prior to inspection for Substantial Performance of the work, submit for review, the red line site as-built white prints, a CAD disc of the as-built drawings, and a bound set of white prints (of equal quality to the Contract Drawings) made from the disc. The Consultant will review the drawings and, if necessary, return the disc and the marked-up white prints for corrections or further revisions, in which case complete the corrective and/or revision work and resubmit the disc and white prints until they are determined to be acceptable, all prior to issue of a Certificate of Substantial Performance.

1.20 PROGRESS PAYMENT BREAKDOWN

.1 Submit, prior to submittal of the first progress payment draw, a breakdown of the cost of the electrical work to assist the Consultant in reviewing and approving monthly progress payment claims.

.1 Submit a breakdown of the tender price into separate classifications and totalling the total contract amount. Each item is to be broken into material and labour costs.

.2 Breakdown shall follow, but not be limited to;

.1 Permits and fees
.2 Mobilization
.3 Demolition
.4 Distribution equipment (i.e. Switchboards, panelboards, etc.)
.5 Incoming feeders and conduits
.6 Branch wiring and conduits
.7 Branch wiring
.8 Mechanical equipment wiring
.9 Fire alarm devices
.10 Fire alarm wiring
.11 Fire alarm verification and certification
.12 Exit and Emergency lighting
.13 Lighting
.14 Lighting controls
.15 Voice and Communication conduits
.16 Voice and Communication wiring and terminations
.17 Access Control and Security
.18 Miscellaneous and Speciality Equipment (i.e. Public Address, Sound, etc.)

.2 The payment breakdown is subject to the Consultant's approval and progress payments will not be processed until an approved breakdown is in place. The breakdown is to include one-time claim items such as mobilization and demobilization, insurance, bonds (if applicable), shop drawings and product data sheets, commissioning, and project closeout submittals.

.3 Progress draws, when submitted, are to be itemized against each of the draw breakdowns and shall be in table form identifying contract amount, amount of this draw, total to date, percentage complete and balance.

1.21 REQUIREMENTS FOR CONTRACTOR RETAINED ENGINEERS

.1 All professional engineers retained by you to perform consulting services with regard to your work, i.e. structural engineer, are to be members in good standing with the local Association of Professional Engineers, and are to carry and pay for errors and omissions professional liability insurance in compliance with requirements of the governing authorities in the locale of the work.

.2 Your engineer's professional liability insurance is to protect your Consultants and Sub-Consultants, and their respective servants, agents, and employees against any loss or damage resulting from the professional services rendered by your Consultants, Sub-Consultants, and their respective servants, agents, and employees in regards to the work of this Contract.

.3 Liability insurance requirements are as follows:

.1 coverage is to be a minimum of $1,000,000.00 inclusive of any one occurrence

.2 the insurance policy is not to be cancelled or changed in any way without the insurer giving the Owner a minimum of thirty days written notice

.3 liability insurance is to be obtained from an insurer registered and licensed to underwrite such insurance in the location of the work

.4 evidence of the required liability insurance in such form as may be required is to be issued to the Owner, the Owner's Consultant, and Municipal Authorities as required prior to commencement of your Consultant's services

1.22 EXTENDED WARRANTIES

.1 Unless otherwise specified, all extended warranties specified in electrical work Sections of the Specification are to be full parts and labour warranties, at the site, and in accordance with requirements of the Contract warranty, but direct from the equipment manufacturer/supplier to the Owner. Submit signed and dated copies of extended warranties which clearly state requirements specified above.

1.23 EQUIPMENT AND MATERIAL MANUFACTURER REQUIREMENTS

.1 Equipment and materials scheduled or specified on the drawings or in the Specification have been selected to establish a performance and quality standard.

.2 In most cases acceptable equipment and material manufacturers are listed for any product specified by manufacturer's name and model number. Unless otherwise stated the bid price may be based on products supplied by any of the manufacturers named as acceptable for the particular product. If acceptable manufacturers are not listed for a particular product, base the bid price on the products supplied by the specified manufacturers.

.3 If products supplied by a manufacturer named as acceptable are used in lieu of the products specified by manufacturer's name and model number, ensure that the product is equivalent in performance and operating characteristics (including energy efficiency if applicable) to the specified product. Pay for any additional costs and changes to associated or adjacent work resulting from the use of products supplied by a manufacturer other than the specified manufacturer. In addition, in equipment spaces where products named as acceptable are used in lieu of the specified products and the dimensions of such products differ from the specified products prepare and submit for review, if requested, accurately dimensioned layouts of the rooms affected to prove that all the equipment in the room will fit properly.

1.24 LIST OF ACCEPTABLE MANUFACTURERS AND SUPPLIERS

.1 Within one day after award of a Contract, submit to the Consultant for review, a list to indicate the name of the manufacturers/suppliers you propose to use for each item of equipment, material, or service listed, except for items such as conduit, branch circuit conductors, and similar products. Manufacturers and/or suppliers on the list must be named in the Specification or on the drawings.

.2 If the List of Acceptable Manufacturers and Suppliers is not submitted within one day after award of a Contract, the products specified and scheduled by manufacturer's name and model number and on which the Project is based are to be supplied. No substitutions whatsoever will be accepted unless previously approved in writing by the Consultant.

.3 If a Supplementary Bid Form is issued with the Bid Documents and requests the list of acceptable manufacturers and suppliers, the completed Supplementary Bid Form is to submitted within one day after the date for bid closing.

1.25 SUBSTITUTED OR ALTERNATIVE PRODUCTS

.1 Products supplied by a manufacturer/supplier other than a manufacturer specified as acceptable may be considered for acceptance by the Consultant if requested in writing a minimum of five full working days prior to the bid closing date. Requests may be made by letter, or by email. Telephone requests will not be considered.

.2 Each request for acceptance of a proposed substitution or alternative product must be accompanied by detailed catalogue and engineering data, fabrication information, and performance characteristics to permit the Consultant to make an informed decision.

.3 Pay for any additional costs and changes to associated or adjacent work resulting from the use of products supplied by a substituted or alternative manufacturer. In addition, in equipment spaces where substituted or alternative products are used in lieu of the specified or acceptable products and the dimensions of such products differ from the specified or acceptable products, prepare and submit for review, if requested, accurately dimensioned layouts of the rooms affected to prove that all the equipment in the room will fit properly.

.4 The Consultant's decision regarding any proposed substitution or alternative product is final.

1.26 IDENTIFIED PRICES

.1 Identified prices for work consist of alternative prices, separate prices, and itemized prices. Definitions of these prices are as follows:

.1 **Alternative Price(s):** An alternative price the difference in the bid amount (plus or minus) for substituting specified work or products for alternative work or products.

.2 **Separate Price(s):** A separate price is the amount of money to be added to the bid amount for new work not included as part of the Bid Documents.

.3 **Itemized Price(s):** An itemized price is the amount of money included in the bid amount for work as described.

1.27 PHASING OF THE WORK

.1 Phasing of the work is required to maintain the existing building in operation, all as specified in Division 01. Include all costs for phasing the work including all required "off hours" premium time labour costs.

1.28 EQUIPMENT AND SYSTEM MANUFACTURER'S CERTIFICATION

.1 When equipment/system installation is complete, but prior to start-up procedures, arrange and pay for the equipment/system manufacturer's authorized representative to visit the site to examine the installation, and when any required corrective measures have been made, to certify in writing to the Consultant that the equipment/system installation is complete and in accordance with the equipment/system manufacturer's instructions.

1.29 EQUIPMENT AND SYSTEM START-UP

.1 When installation of equipment/systems is complete but prior to commissioning, perform start-up for equipment/systems as specified in electrical work Sections in accordance with the following requirements:

.1 submit a copy of each equipment/system manufacturer's start-up report sheet to the Consultant for review, and incorporate any comments

.2 under direct on-site supervision and involvement of the equipment/system manufacturer's representative, start-up the equipment/systems, make any required adjustments, document the procedures, leave the equipment/systems in proper operating condition, and submit a complete set of start-up documentation sheets signed by the manufacturer/supplier and the Contractor

1.30 EQUIPMENT AND SYSTEM COMMISSIONING

.1 After successful start-up and prior to Substantial Performance, commission the electrical work using approved commissioning sheets. Submit final commissioning data sheets. Include for equipment manufacturer's representation at the site to assist in the commissioning process

1.31 EQUIPMENT AND SYSTEM O & M DEMONSTRATION & TRAINING

.1 Refer to equipment and system operational and maintenance training requirements specified in Division 01.

.2 Train the Owner's designated personnel in all aspects of operation and maintenance of equipment and systems as specified in electrical work Sections of the Specification. All demonstrations and training are to be performed by qualified technicians employed by the equipment/system manufacturer/supplier.

.3 For each item of equipment and for each system for which training is specified, prepare training modules as specified below. Operating and Maintenance Manuals are to be used during the training sessions, and training modules are to include:

.1 **Operational Requirements and Criteria:** requirements and criteria are to include but not be limited to equipment function, stopping and starting, safeties, operating standards, operating characteristics, and limitations

.2 **Troubleshooting:** troubleshooting is to include but not be limited to diagnostic instructions, test and inspection procedures

.3 **Documentation:** documentation is to include but not be limited to equipment/system warranties, and manufacturer's/supplier's parts and service facilities, telephone numbers, email addresses, and the like

.4 **Maintenance:** maintenance requirements are to include but not be limited to inspection instructions, types of cleaning agents to be used as well as cleaning methods, preventive maintenance procedures, and use of any special tools

.5 **Repairs:** repair requirements are to include but not be limited to diagnostic instructions, disassembly, component removal and repair instructions, instructions for identifying parts and components, and review of any spare parts inventory

.4 Assemble the training modules into a training manual and submit a copy to the Consultant for review prior to scheduling training. Ensure that each participant in each training session has all required training material.

.5 Schedule demonstrations and training at mutually agreed to times with a minimum of 7 working days' notice.

.6 **Demonstration and Training Confirmation:** Obtain a list of personnel to receive demonstration and training from the Consultant, and have each participant sign the list to confirm that he/she understood the demonstration and training session.

END OF SECTION

1 GENERAL

1.01 APPLICATION

.1 This Section specifies products, common criteria and characteristics, and methods and execution that are common to one or more electrical work Sections of the Specification, and it is intended as a supplement to each Section and is to be read accordingly.

1.02 SUBMITTALS

.1 Submit the following for review:

.1 **product data sheets:** submit for:

.1 firestopping and smoke seal products

.2 waterproofing seal assemblies

.3 electrical work identification products

.2 **access door locations:** submit white prints of architectural reflected ceiling plan drawings and elevation drawings to indicate proposed access door locations in walls and ceilings in finished areas

.3 **samples:** submit a sample of each proposed type of access door, and samples of materials and any other items as specified in electrical work Sections of the Specification

.4 **list of equipment nameplates:** submit a list of equipment identification nameplates indicating proposed wording and sizes

.5 **conduit & conductor identification:** submit a list of conduit and conductor identification colour coding and wording

.6 **sleeve and formed opening location drawings:** submit, prior to concrete pours, accurately dimensioned drawings to locate all required sleeves, formed openings, and recesses required in poured concrete

.7 **waste management and reduction plan:** submit a waste management and reduction plan prior to commencing work and as per requirements specified in this Section

.8 **additional submittals:** submit any other submittals specified in this Section or other electrical work Sections of the Specification

2 PRODUCTS

2.01 SLEEVES

.1 **Galvanized Sheet Steel:** Minimum #16-gauge galvanized steel with an integral flange at one end to secure the sleeve to formwork construction.

.2 **Polyethylene:** Factory fabricated, flanged, high density polyethylene sleeves with reinforced nail bosses.

.3 **Waterproof Sleeves:** Schedule 40 mild galvanized steel pipe with a welded-on square steel anchor and water stop plate at the sleeve midpoint, or PSI-Thunderline “Century-Line” Model CS HDPE sleeves.

.4 **Galvanized Steel:** Schedule 40 mild galvanized steel.

2.02 MULTI-CABLE TRANSITS

.1 UL/ULC listed and labelled multi-cable transits sized to suit the fire barrier opening and the number of cables/conduits involved and to facilitate a minimum 2-hour water-tight fire and smoke seal. Each assembly is to be complete with a stainless-steel frame, cadmium plated compression bolts, proper end packing, compression plates, steel stay plates, and fire rated neoprene insert blocks.

2.03 FIRESTOPPING AND SMOKE SEAL MATERIALS

.1 Firestopping and smoke seal system materials for electrical penetrations through fire rated construction are specified in Division 07 and the work will be done as part of the work of Division 07.

.2 Firestopping and smoke seal system materials for electrical penetrations through fire rated construction are specified in the electrical work Section entitled Firestopping and Smoke Seal Systems and the work is to be done as part of the electrical work.

2.04 WATERPROOFING SEAL MATERIALS

.1 Modular, mechanical seal assemblies consisting of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe and the pipe sleeve or wall opening, assembled with stainless steel bolts and pressure plates and designed so that when the bolts are tightened the links expand to seal the opening watertight. The seal assemblies are to be selected to suit the pipe size and the sleeve size or wall opening size. Acceptable products are:

.1 Thunderline Corp. (Power Plant Supply Co.) "LINK SEAL" Model S-316;

.2 The Metraflex Co. "MetraSeal" type ES.

2.05 ESCUTCHEON PLATES

.1 One-piece chrome plated brass or #4 finish type 302 stainless steel plates with matching screws for attachment to the building surface, each plate sized to completely cover the conduit/cable sleeve or building surface opening, and to fit tightly around the conduit or cable.

2.06 ACCESS DOORS

.1 Prime coat painted steel (unless otherwise specified) flush access doors, each complete with a minimum #16-gauge frame, minimum #18-gauge door panel, heavy-duty rust-resistant concealed hinges, a positive locking screwdriver lock, and mounting and finishing features to suit the particular construction in which it is to be installed.

.2 Access door sizes are to suit the concealed work for which they are supplied, and wherever possible they are to be of a standard size for all applications, but in any case they are to be minimum 300 mm x 300 mm (12" x 12") for hand entry and 600 mm x 600 mm (24" x 24") for body entry.

.3 Access doors in fire rated construction are to be ULC listed and labelled and of a rating to maintain the fire separation integrity.

.4 Where access doors are located in surfaces where special finishes are required, they are to be of a recessed door type capable of accepting the finish in which they are to be installed so as to maintain the final building surface appearance throughout, and constructed of stainless steel with a #4 finish.

2.07 IDENTIFICATION MATERIALS

.1 **Equipment Nameplates:** Minimum 1.6 mm (1/16") thick 2-ply laminated coloured plastic plates, minimum 12 mm x 50 mm (½" x 2") for smaller items such as single phase starters and switches, minimum 25 mm x 65 mm (1" x 2½") for equipment, and minimum 50 mm x 100 mm (2" x 4") for control panels and similar items. Additional requirements are as follows:

.1 unless otherwise specified or required, each nameplate is to be white, complete with bevelled edges and black engraved capital letter wording to completely identify the equipment and its use with no abbreviations;

.2 wording is generally to be as per the drawings, i.e. Lighting Panel A, and is to include equipment service and building area/zone served, but must be reviewed prior to engraving;

.3 supply stainless steel screws for securing nameplates in place

.4 nameplates for equipment suspended above floor level or generally not within easy viewing from floor level are to be increased in size so as to be easily readable from floor level

.2 **Self-Adhesive Labels:** Equal to Brother “P-Touch” or Thomas & Betts Canada Ltd. “EZCODE” Model EZL500 electronic labelling system self-adhesive labels with size and colour as directed, and permanently printed circuit identification nomenclature which is to be approved by the Consultant prior to producing the labels.

.3 **Warning Signs:** Equal to Thomas & Betts Canada Ltd. “BP” Series 250 mm x 355 mm (10” x 14”) semi-rigid vinyl signs with corner screw holes, the required printed wording (generally red on a white background with black trim), pressure sensitive adhesive on the back, and stainless-steel screws.

.4 **Conduit and Armoured Cable Identification:** Equal to Brady Canada minimum 50 mm (2”) wide self-adhesive coloured vinyl tape.

.5 **Conductor Terminations:** Equal to Electrovert Ltd. Slip-on “Z” type

.6 **Conductor Colour Coding:** As specified with the conductors.

2.08 ELECTRICAL ENCLOSURES

.1 Unless otherwise specified electrical enclosure are to be wall mounting NEMA/EEMAC/CSA enclosures as follows:

.1 indoor in sprinkler protected areas, Type 2

.2 indoor in high humidity/washdown areas, Type 4

.3 indoor in corrosive environments, Type 4X, 316 stainless steel

.4 indoor explosion-proof, Class 1, Groups C & D, Type 7

.5 outdoor, Type 3R

.6 indoor in non-hazardous areas except as noted above, Type 1

2.09 ENCLOSURE BACKBOARDS

.1 Construction grade Fir plywood, G1S, 20 mm (¾") thick with width and length to suit enclosure dimensions, coated on all surfaces with a ULC listed water based latex intumescent flame-retardant paint, ASTM E-84 Class A rated.

3 EXECUTION

3.01 GENERAL ELECTRICAL WORK INSTALLATION REQUIREMENTS

.1 Unless otherwise specified, locate and arrange horizontal conduits, raceways, and conductors above or at the ceiling on floors on which they are shown, arranged so that under consideration of all other work in the area, the maximum ceiling height and/or usable space is maintained.

.2 Unless otherwise specified, install all conduits and conductors concealed in finished spaces, and concealed to the degree possible in partially finished and unfinished spaces. Refer to and examine the Architectural drawings and room finish schedules to determine finished, partially finished, and unfinished areas. Note that walls which are painted are considered finished.

.3 Unless otherwise specified conduits and main distribution conductors may be exposed in equipment rooms.

.4 Install all exposed conduits, raceways, and conductors parallel to building lines and to each other.

.5 Do not install conduit, raceway, or conductors within 150 mm (6") of "hot" piping or equipment.

.6 All conduit, raceway, conductors, etc., must be supported from the structure, not from ceiling hangers, piping, ductwork, cable tray, and similar mechanical or electrical products.

.7 Neatly group and arrange all exposed work. Do not install conduit to prevent access into equipment.

.8 **Access:** Locate all work to permit easy access for service or maintenance as required and/or applicable. Locate all products which will or may need maintenance or repairs and which are installed in accessible construction so as to be easily accessible from access doors. Where such products occur in vertical services in shafts, pipe spaces or partitions, locate the accessories at the floor level.

.9 **Manufacturer's Instructions:** Ensure that equipment and material manufacturer's installation instructions are followed unless otherwise specified herein or on the drawings, and unless such instructions contradict governing codes and regulations.

.10 **Cleaning:** Carefully clean all conduits, raceway, fittings prior to installation. Temporarily cap or plug ends of conduit which are open and exposed during construction.

.11 **Surfaces To Receive Your Work:** Inspect surfaces and structure prepared by other trades before performing your work. Verify that surfaces or the structure to receive your work have no defects or discrepancies which could result in poor application or cause latent defects in installation and workmanship. Report defects in writing. Installation of your work will constitute acceptance of such surfaces as being satisfactory.

.12 **Repair of Finished Surfaces:** For factory applied finishes, repaint or refinish all surfaces damaged during shipment and installation. The quality of the repair work is to match the original finish. This requirement also applies to galvanized finishes.

.13 **Work In High Humidity Areas:** Where electrical work is located in high humidity areas where ferrous metal products will be subject to corrosion and protection for such products is not specified, provide finishes on the products to protect against corrosion or provide products which will not corrode in the environment.

.14 **Work In Health Care Facility Patient Care Areas:** Provide conduit, conductors, and similar work in health care facility patient care areas in accordance with the Ontario Electrical Safety Code, including amendments, and test branch circuits in accordance with CAN/CSA Z32, Electrical Safety and Essential Electrical Systems in Health Care Facilities.

3.02 INSTALLATION OF SLEEVES

.1 Where conduits, round ducts, and armoured cable pass through concrete and/or masonry surfaces provide sleeves as follows:

.1 **in poured concrete slabs:** unless otherwise specified - minimum 16 gauge flanged galvanized steel or, where permitted by governing authorities, factory fabricated plastic sleeves

.2 **in concrete or masonry walls:** Schedule 40 galvanized steel pipe

.2 **Waterproof Sleeves:** Provide waterproof sleeves in the following locations:

.1 in mechanical room floor slabs, except where on grade

.2 in slabs over mechanical, fan, electrical and telephone equipment rooms or closets

.3 in all floors equipped with waterproof membranes

.4 in the roof slab

.5 in waterproof walls

.3 Size sleeves, unless otherwise specified, to leave 12 mm (½") clearance around the conduit, duct, cable, etc.

.4 Pack and seal the void between the sleeves and the conduit, duct, cable, etc., in non-fire rated construction for the length of the sleeves as follows:

.1 **interior construction:** pack sleeves in interior construction with mineral wool and seal both ends of the sleeves with non-hardening silicone base caulking compound

.2 **exterior walls above grade:** pack sleeves in exterior walls above grade with mineral wool and seal both ends of the sleeves water-tight with approved non-hardening silicone base caulking compound unless mechanical type seals have been specified

.3 **exterior walls below grade:** seal sleeves in exterior walls below grade (and any other wall where water leakage may be a problem) with link type mechanical seals as specified below.

.5 Where sleeves are required in masonry work, accurately locate and mark the sleeve location, and hand the sleeves to the mason for installation.

.6 Terminate sleeves that will be exposed so that the sleeve is flush at both ends with the building surface concerned so that the sleeve may be completely covered by an escutcheon plate, except for sleeves in waterproof floors which are to terminate 100 mm (4") above the finished floor.

.7 "Gang" type sleeving will not be permitted.

.8 Where sleeves are provided in non-fire rated construction for future services, or where conduit, ducts, cable, etc., has been removed from existing sleeves, cap and seal both ends of the sleeved opening.

3.03 RECTANGULAR OPENINGS

.1 Rectangular openings for cable tray, raceways, multiple conduits and/or cables and similar rectangular openings will be provided in new poured concrete work, masonry, drywall and other building surfaces by the trade responsible for the particular construction in which the opening is required.

.2 **Waterproof Openings:** Provide watertight link type mechanical seals in exterior wall openings where shown or specified. Assemble and install each mechanical seal in accordance with the manufacturer's instructions. After installation, periodically check each mechanical seal installation for leakage and, if necessary, tighten link seal bolts until the seal is completely watertight.

.3 **Openings In Non-Fire Rated Construction:** For all rectangular openings in non-fire rated construction pack and seal the space between the conduits, ducts, cables, etc., with mineral wool for the full thickness of the building surface penetrated, and seal both ends.

.4 **Openings In Fire Rated Construction:** Provide multi-cable transits in all fire rated openings and install in accordance with the manufacturer’s instructions.

3.04 SLEEVE AND FORMED OPENING LOCATION DRAWINGS

.1 Prepare and submit for review, white print drawings indicating the size and location of all required sleeves, recesses and formed openings in poured or precast concrete work.

.2 Such drawings are to be completely and accurately dimensioned and relate sleeve, recesses, and formed openings to suitable grid lines and elevation datum, and are to take into account structural items such as grade beams, column caps, and column drop slabs

.3 Begin to prepare such drawings immediately upon notification of acceptance of bid and award of Contract.

3.05 INSTALLATION OF ESCUTCHEON PLATES

.1 Provide escutcheon plates suitable secured over all exposed conduits, ducts, armoured cable, etc., passing through finished building surfaces. A finished building surface is any surface with a factory finish or that receives a site applied finish.

.2 Install the plates so that they are tight against the building surface concerned, and ensure that the plates completely cover sleeves and/or openings, except where waterproof sleeves extend above floors, in which case the plate is to fit tightly around the sleeve.

3.06 INSTALLATION OF FASTENING AND SECURING HARDWARE

.1 Provide fastening and securing hardware required for electrical work to maintain installations attached to the structure or to finished floors, pads, walls, and ceilings in a secure and rigid manner capable of withstanding the dead loads, live loads, superimposed dead loads, and any vibration of the installed products.

.2 Use fasteners compatible with structural requirements, finishes and types of products to be connected. Do not use materials subject to electrolytic action or corrosion where conditions are liable to cause such action.

.3 Where floor, wall, or ceiling construction is not suitable to support the loads, provide additional framing or special fasteners to ensure proper securement to the structure. Provide reinforcing or connecting supports where required to distribute loading to structural components.

.4 Obtain written consent before using explosive actuated fastening devices. If consent is given comply with requirements of CAN3-Z166.1 and .2.

.5 Do not attach fasteners to steel deck without written consent from the Consultant.

3.07 SUPPLY OF ACCESS DOORS

.1 Supply access doors to give access to all electrical work which may need maintenance or repair but which is concealed in inaccessible construction, except as otherwise specified herein or on the drawings.

.2 Locate access doors as inconspicuously as possible in walls and partitions and arrange electrical work such that it is clearly within view and accessible for inspection and servicing, and to suit access door locations shown on the reviewed and approved white prints of reflected ceiling plan and elevation drawings submitted as per Part 1 of this Section.

.3 Group services to ensure the minimum number of access doors is required. Access doors will be installed by the trades responsible for the particular type of construction in which the doors are required.

.4 Submit a sample of each proposed access door for review prior to ordering.

3.08 ELECTRICAL WORK IDENTIFICATION

.1 Identify all new/relocated electrical work in accordance with existing identification standards at the site.

.2 Identify all electrical work, including conduit systems and wiring, as follows:

.1 the size and wording of identification nameplates must be approved by the Consultant

.2 identification wording for equipment is to follow drawing nomenclature unless otherwise specified

.3 secure nameplates to equipment with stainless steel screws unless such a practice is prohibitive, in which case use epoxy cement applied to cleaned surfaces

.4 locate nameplates in the most conspicuous and readable location

.5 for multi-cell or multiple component equipment provide a main nameplate and a smaller nameplate for each cell or component

.6 where electrical work is to be identified in conjunction with mechanical work, coordinate with the mechanical trades to ensure identical tagging

.7 all identification wording is to be in English

.8 all identification and colour coding are to be indicated on “as-built” record drawings

.2 **Terminal Cabinets, Pull Boxes, Junction Boxes, Etc.:** Clearly identify terminal cabinets, main pull and junction boxes by neatly spray painting the outside surface of the cover with a paint colour as specified below for conduit and conductor identification. Provide a nameplate on terminal boxes, main pull and junction boxes in communication systems specified in Division 27.

.3 **Transformers:** Transformer nameplated must identify the transformer capacity as well as primary and secondary voltages.

.4 **Branch Circuit Panelboards:** Panelboard nameplates must identify the electrical source connected to the panelboard, each circuit breaker, and, neatly typed on the door directory card, the load connected to each breaker.

.5 **Motor Starters and Disconnect Switches:** Provide nameplates for each motor starter and disconnect located in a motor control centre or on a motor starter panel, and on each individually mounted starter and disconnect provided as part of the electrical work. Nameplates must also indicate the voltage and phase.

.6 **Luminaires On Emergency Circuits:** Identify all luminaires on emergency circuit be means of a 15 mm (½") diameter self-adhesive red label secured to the T-bar ceiling component adjacent to the luminaire, or if not in a T-bar ceiling, to the frame of the luminaire.

.7 **Lighting Switches & Receptacles:** Identify each lighting switch and each receptacle by means of a permanent self-adhesive label indicating the source panelboard and circuit number and secured to the device faceplate.

.8 **Communication Equipment/Systems:** Identify all "head end" equipment with nameplates and all "downstream" devices with self-adhesive labels indicating circuit numbers.

.9 **Warning Signs:** Provide appropriately worded warning signs secured in place with stainless steel hardware in locations as follows:

.1 on all doors into transformer vaults

.2 on all doors into high voltage switchgear rooms

.3 on all collector bus enclosures

.4 on pad mounted transformer enclosures

.5 wherever else required by Code

.10 **Conduit & Armoured Cable:** Colour code conduit and armoured cable by means of 25 mm (1") wide primary colour plastic adhesive backed tape or neatly applied suitable paint with, where scheduled, a 20 mm (¾") wide auxiliary colour at all points where the conduit or cable penetrates a wall, ceiling, floor, at 6 m (20') intervals or at least once in each room or accessible ceiling space, at each access door location, and elsewhere at 15 m (45') intervals. Unless otherwise indicated/specified, colours are to be as follows:

Service	Primary Colour	Secondary Colour
up to 250 volts	yellow	
250 to & including 600 volts	yellow	green
above 600 volts to 5 kV	yellow	blue
above 5 kV to 28 kV	yellow	red
telephone	green	
fire alarm	red	
emergency voice	red	blue
security systems	red	yellow
other communication systems	green	
isolated power	orange	

.11 **Wire & Cable Terminations:** Identify both end of wire and cable terminations with the same unique number. Where numbers are not indicated or specified, assign a number and record them.

.12 **Buried Cable/Duct Runs:** Identify buried cable/duct runs under paved and landscaped areas with appropriate concrete markers, flush with grade at each change in direction, at least twice on runs less than 60 m (200') and on 60 m (200') centres on longer runs.

.13 **Overhead Wiring Service Poles:** Unless otherwise indicated on the drawings identify poles with wording such as “HV#1”. For wooden poles use 50 mm (2”) high non-corrosive embossed aluminium pole markers. For concrete poles use non-corrosive metal plated secured to the pole with metal strapping.

.14 **Health Care Patient Care Area Circuits:** For dedicated circuits provide identification as previously specified plus engraved “Dedicated Circuit” nameplates on the device faceplate, or provide faceplates with “Dedicated Circuit” engraved wording. For 20 ampere corridor housekeeping receptacles provide “20A Housekeeping” nameplates on the device faceplate.

.15 **Distribution System Schematic Diagrams:** Prepare AutoCAD, coloured, 1200 mm x 900 mm (48” x 36”) schematic diagrams of electrical distribution systems to identify all equipment and circuits. Install framed and glazed diagrams in electrical rooms housing the system equipment. Confirm location prior to installation. Include reduced size copies of the diagrams in each copy of the O & M Manuals.

3.09 INSTALLATION OF TERMINAL BACKBOARDS

.1 Provide properly sized plywood backboards for wiring terminals in terminal cabinets and enclosures where shown/specified/required.

3.10 GENERAL ELECTRICAL WORK TESTING

.1 Perform testing in accordance with the Electrical Work Testing Section, and, in addition, any tests required by governing Codes, Standards.

3.11 BRANCH CIRCUIT BALANCING

.1 Connect all branch circuits to panelboards so as to balance the actual loads (wattage) to within 5%. If required, transpose branch circuits to achieve this requirement.

.2 After the building is occupied and if requested by the Consultant, demonstrate that branch circuit balancing has been achieved.

3.12 FINISH PAINTING OF ELECTRICAL WORK

.1 Finish paint exposed electrical work as specified and/or scheduled in accordance with requirements of the painting Section in Division 09.

.2 Touch-up paint all damaged factory applied finishes on electrical work products.

.3 Finish painting of exposed electrical work is specified in Division 09 and is part of the work of Division 09.

3.13 SUPPLY OF MOTOR STARTERS AND ACCESSORIES

.1 Motor starters for mechanical equipment will be supplied as part of the mechanical work.

3.14 ELECTRICAL WIRING WORK FOR MECHANICAL WORK

.1 Unless otherwise specified or indicated, the following electrical wiring work for mechanical equipment is to be done as part of the electrical work:

.1 "line" side power wiring to motor starters or disconnect switches in motor control centres and starters or disconnects on motor starter panels, and "load" side wiring from the starters or disconnects to the equipment

.2 mounting of individual starters, "line" side power wiring to individual wall mounted starters, and "load" side wiring from the starters to the equipment

.3 "line" side power wiring to pre-wired power and control panels and variable frequency drives, and "load" side power wiring from the panels and VFD's to the equipment

.4 provision of receptacles for plug-in equipment

.5 provision of disconnect switches for all motors that are in excess of 10 m (30') from the starter location, or that cannot be seen from the starter location, and all associated power wiring

.6 all motor starter interlocking in excess of 24 volts

.7 wiring from motor winding thermistors in motors 30 HP and larger to motor starter contacts

.8 provision of dedicated 120 volt, 15A-1P circuits terminated in junction boxes in mechanical equipment rooms for automatic control and building automation system wiring connections to be made as part of the automatic controls work

.9 120-volt power connections to electrical receptacles integral with small ceiling exhaust fans, including wiring through light switches or speed controllers;

.10 120 volt wiring connections to lighting fixture/switch combinations integral with air handling units

.11 120 volt wiring connections to duplex receptacles integral with air handling unit control panels

.2 Mechanical wiring work not listed above or specified herein or on the drawings will be done as part of the mechanical work in accordance with wiring requirements specified for the electrical work.

3.15 INTERRUPTION TO AND SHUT-DOWN OF ELECTRICAL SERVICES AND SYSTEMS

.1 Co-ordinate all shut-down and interruption to existing electrical systems with the Owner. Generally, shut-downs may be performed only between the hours of 12:00 midnight Friday until 6:00 a.m. Monday morning.

.2 Upon award of a Contract, submit a list of anticipated shut-down times and their maximum duration.

.3 Prior to each shut-down or interruption, inform the Owner and Consultant in writing seventy-two hours in advance of the proposed shut-down or interruption and obtain written approval to proceed. Do not shut-down or interrupt any system or service without such written approval.

.4 Perform work associated with shut-downs and interruptions as continuous operations to minimize the shut-down time and to reinstate the systems as soon as possible, and, prior to any shut-down, ensure that all materials and labour required to complete the work for which the shut-down is required are available at the site.

3.16 EQUIPMENT BASES AND SUPPORTS

.1 **Concrete Housekeeping Pads:** Unless otherwise specified or required, set all floor mounted equipment on minimum 100 mm (4") high reinforced concrete housekeeping pads 200 mm (8") clear of the equipment on each side and end, or a minimum of 200 mm (8") from the centreline of equipment anchor bolts to the edge of the base, whichever is larger. Conform to the following requirements:

.1 supply dimensioned drawings and equipment base templates, and provide anchor bolts for proper setting and securing of equipment on pads

.2 place anchor bolts during the concrete pour and be responsible for all required levelling, alignment, and grouting of the equipment

.3 as a minimum, use wire mesh reinforcement, however, for pads for large heavy equipment, use reinforcement as per structural drawing details

.2 **Structural Steel Stands/Supports:** For equipment not designed for base mounting, where required, provide welded, cleaned and prime coat painted structural steel stands or supports conforming to the following requirements:

.1 all stands and supports, except those for small equipment, are to be designed by a structural engineer registered in the jurisdiction of the work, and stamped and signed design drawings with calculations are to be submitted as shop drawings for review

.2 all steel stands are to be flange bolted to concrete housekeeping pads

.3 all stands and supports are to be seismically restrained in accordance with applicable requirements

3.17 CONCRETE WORK FOR EQUIPMENT BASES/PADS

.1 All concrete work required for electrical equipment bases/pads will be provided as part of the concrete work of Division 03.

.2 Exactly locate bases/pads at the site and be present during the concrete pour to ensure that anchor bolts, inserts, plates and similar hardware are not damaged or dislodged.

.3 Coordinate base/pad installations with the concrete trade and ensure that bases and pads are keyed into the structure to meet seismic restraint requirements.

3.18 CONCRETE WORK FOR EQUIPMENT BASES/PADS

.1 Provide all poured concrete work, including reinforcing and formwork, required for electrical equipment bases/pads. Perform concrete work in accordance with requirements specified in Division 03.

.2 Concrete is to be minimum 20,700 kPa ready-mix concrete in accordance with CAN/CSA-A23.1 and the Building Code.

.3 Ensure that bases and pads are keyed into the structure to meet seismic restraint requirements.

3.19 EXCAVATION AND BACKFILL WORK

.1 Excavation, backfill and related work such as dewatering required for electrical work will be performed as part of the excavation and backfill work, except for final hand grading work which is to be done as part of the electrical work.

.2 Accurately mark-out the location and routing of excavation required for your work, as well as the required depth.

3.20 EXCAVATION AND BACKFILL WORK

.1 Do all excavation, backfill and related work required for your work. Perform such work in accordance with requirements of the Excavation and Backfill Section, except as modified by this Article. Obtain a copy of the soil test report and review during the bidding period.

.2 Grade the bottom of trench excavations as required.

.3 In firm, undisturbed soil, lay ducts, conduits, etc., directly on the soil, unless otherwise directed.

.4 Unless otherwise specified, backfill trenches within the building with clean sharp sand in individual layers of maximum 150 mm (6”) thickness compacted to a density of 100% Standard Proctor. Hand compact the first layers up to a compacted level of minimum 300 mm (12") above the top of the service. Hand or machine compact the balance up to grade.

.5 Unless otherwise specified, backfill trenches outside the building (not under roads, parking lots or traffic areas), up to a compacted level of 450 mm (18") thick above the service, hand compacted to a density of 95% Standard Proctor, using granular "A" gravel. Backfill the balance in 150 mm (6") layers with approved excavated material, compacted to 95% Standard Proctor density.

.6 Unless otherwise specified, backfill trenches outside the building under roads, parking lots or traffic areas with crushed stone or granular "A" gravel in layers not exceeding 150 mm (6") thickness, compacted to 100% Standard Proctor density up to grade level.

.7 The location and inverts of existing underground site services shown on the drawings are based on available information and are assumed to be correct, however, prior to excavation, carefully check inverts and locations and report any serious discrepancy, and contact Utilities to accurately locate their services.

.8 You will be held responsible for any damage done to existing underground services caused by neglect to determine and mark out the location of such services prior to excavation work commencing.

.9 After the first lift of backfill has been compacted, mark the entire path of pipe using continuous 75 mm (3") wide detectable identified marking tape equal to SMS Ltd. D-UGMT.

.10 Engage the services of an independent soils testing agency to test the final backfill compaction density of each backfilled location. Compact the backfill to the satisfaction of the testing agency and in accordance with the Specification. Submit a copy of the testing agency's report to the Consultant for review.

3.21 CUTTING, DRILLING, AND PATCHING

.1 All cutting and patching of existing building surfaces required for electrical work, including core drilling walls and slabs for piping, will be done as part of another Division of the work and is excluded from the electrical work.

.2 Accurately and carefully mark out the location and extent of cutting or drilling required and co-ordinate with the trade(s) performing the work. Note that the location and size of cut or drilled openings must be approved by the Consultant before the work commences, and all cut or drilled openings must not be larger than is absolutely necessary.

3.22 CUTTING, DRILLING, AND PATCHING

.1 Do all cutting, drilling and patching of the existing building for the installation of your work. Perform all cutting and drilling with proper tools and equipment. Confirm the exact location of cutting and drilling with the Consultant prior to commencing the cutting and/or drilling work.

.2 Patch surfaces, where required, to exactly match existing finishes using tradesmen skilled in the particular trade or application worked on.

.3 Where new conduits, conductors, etc., pass through existing construction, core drill an opening. Size openings to leave 12 mm (½") clearance around the product involved.

.4 Prior to drilling or cutting an opening in poured concrete construction, determine the location, if any, of existing services concealed in the construction to be drilled or cut. X-ray or Ferro Scan Test the walls or slabs if required.

.5 You will be responsible for the repair of any damage to existing services, exposed or concealed, caused as a result of your cutting or drilling work.

.6 Where drilling is required in waterproof slabs, size the opening to permit snug and tight installation of a sleeve which is sized to leave 12 mm (½") clearance around the product involved. Provide a sleeve in the opening. Sleeves are to be Schedule 40 galvanized steel pipe with a flange at one end and a length to extend 100 mm (4") above the slab. Secure the flange to the underside of the slab and caulk the void between the sleeve and slab opening with proper non-hardening silicone base caulking compound to produce a water-tight installation.

3.23 PACKING AND SEALING CORE DRILLED OPENINGS

.1 Pack and seal the void between the core drilled opening and the service insulation for the length of the opening as follows:

.1 **non-fire rated interior construction:** pack openings in non-fire rated interior construction with mineral wool and seal both ends of the opening with non-hardening silicone base caulking compound to produce a water-tight seal;

.2 **exterior walls above grade:** pack sleeves in exterior walls above grade with mineral wool and seal both ends of the sleeves water-tight with approved non-hardening silicone base caulking compound unless mechanical type seals have been specified;

.3 **exterior walls below grade:** seal sleeves in exterior walls below grade (and any other wall where water leakage may be a problem) with link type mechanical seals as specified below.

3.24 FLASHING FOR ELECTRICAL WORK PENETRATING THE ROOF

.1 Do all required flashing work, including counter-flashing, for electrical work penetrating and/or set in the roof.

.2 Perform flashing work in accordance with requirements of drawing details, and requirements specified in Division 07.

3.25 CLEANING ELECTRICAL WORK

.1 Refer to cleaning requirements specified in Division 01.

.2 Clean **all** electrical work prior to application for Substantial Performance of the work.

3.26 MAINTAINING EQUIPMENT PRIOR TO ACCEPTANCE

.1 Maintain all equipment in accordance with the manufacturer's printed instructions prior to start-up, testing and commissioning.

3.27 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with requirements specified in Division 01.

.2 Separate and recycle waste materials in accordance with requirements of Canadian Construction Association Standard Document CCA 81, A Best Practices Guide to Solid Waste Reduction.

.3 Prepare a waste management and reduction plan and submit a copy for review prior to work commencing at the site.

.4 Place materials defined as hazardous or toxic waste in designated containers.

.5 Ensure emptied containers are sealed and stored safely for disposal.

3.28 SEISMIC RESTRAINT ANCHOR POINTS FOR EQUIPMENT

.1 All electrical equipment requiring seismic restraint (see the electrical work Section entitled Seismic Control and Restraint) is to be complete with manufacturer designed and rated seismic restraint anchor points and attachments, certified by the equipment manufacturers, so that the equipment may be bolted down or restrained in the field.

.2 The equipment to be restrained must be designed such that the strength and anchorage of the internal components of the equipment exceeds the force level used to restrain and anchor the equipment itself to the supporting structure.

3.29 REQUIREMENTS FOR BARRIER-FREE ACCESS

.1 Include for all applicable requirements for barrier-free access to electrical devices in accordance with governing Codes and Regulations, whether shown on the drawings, specified, or not

END OF SECTION

1 GENERAL

1.01 APPLICATION

.1 This Section specifies seismic control and restraint requirements that are common to electrical work Sections of the Specification and it is a supplement to each Section and is to be read accordingly.

1.02 SEISMIC CONSULTANT

.1 Retain and pay for the services of an experienced Seismic Consultant who is a registered professional engineer licensed in the area of the work and a member in good standing of a Professional Engineers Association in the area of the work.

.2 The Seismic Consultant is to:

.1 determine the proper seismic hazard level, design, recommend, and review all proposed electrical work seismic restraint shop, placement and securing drawings, and sign and stamp all drawings prior to submittal for review as specified below

.2 supervise installation of all electrical work seismic restraint and, when work is complete, certify in writing that the seismic restraint work has been installed in accordance with signed, stamped and reviewed drawings

.3 prepare and submit to the Municipality and authorities having jurisdiction, on a form approved by the Municipality and authorities having jurisdiction, at the beginning of seismic restraint work and when the work is complete, original signed and sealed Letters of Assurance for the design, installation and field review of all seismic restraint work

1.03 SUBMITTALS

.1 **Shop Drawings/Product Data Sheets:** Obtain all required equipment information and submit manufacturer's shop drawings/product data sheets for all restraining devices and steel bases. Include placement data, and details of attachment to both the equipment and the structure meeting requirements of the forces involved. All product data sheets and drawings are to be signed and stamped by the Seismic Consultant referred to above.

.2 **Seismic Consultant's/Seismic Control Product Manufacturer's Certification Letters:** Submit copies of the Seismic Consultant's Letters of Assurance as specified above. Submit copies of the Seismic Consultant and seismic control manufacturer's certification letters as specified in Part 3 of this Section.

.3 **Samples:** If requested, submit samples of seismic restraint materials for review.

1.04 QUALITY ASSURANCE

.1 Seismic restraints are to be designed by a Seismic Consultant as specified above, and are to be installed by qualified tradesmen under the supervision of and to the approval of the Seismic Consultant.

.2 Unless otherwise specified seismic control and restraints are to be designed in accordance with

.1 National Building Code of Canada

.2 CAN/CSA-S832, Seismic Risk Reduction of Operational and Functional Components (OFC's) of Buildings

.3 local Code requirements

.3 All restraint products must be tested in an independent testing laboratory, or certified by the Vibration Isolation and Seismic Control Manufacturer's Association and Seismic Consultant, to confirm that the restraint products meet all requirements of this Section, i.e. dynamic ultimate limit load state as required by the Code, "Fail Safe" design, etc. If particular tests are carried out to represent a restraint type, the test is to be valid for the full load range of the restraint. Submit such tests or certification when requested.

.4 Seismic control and restraint product manufacturers are to provide all required assistance during the installation, and, when the installation is complete, submit written reports from the manufactures listing any deficiencies to the installation.

2 PRODUCTS

2.01 GENERAL

.1 Isolation, anchors, bolts, bases, restraints, etc., are to be designed to withstand without failure or yielding, the dynamic G load as specified in the Code for the seismic zone in which the building is located. Design loads are ultimate limit state loads (1.5 times working load) acting through the centre of gravity of the anchored or restrained equipment. "Fail Safe" designs are acceptable.

.2 For both isolated and non-isolated floor mounted equipment, design and provide anchors and bolts to withstand, without failure or yielding, a dynamic ultimate limit state load as defined in the Code, of the greater of 0.3 g or as required by the Code, applied horizontally through the centre of gravity.

.3 Where impact forces may be significant, use ductile materials.

.4 Seismic restraining devices which are factory supplied with equipment are to meet all requirements of this Section.

2.02 ACCEPTABLE MANUFACTURERS

.1 Acceptable seismic restraint product manufacturers are:

.1 Mason Industries Inc.

.2 Kinetics Noise Control

.3 Vibro-Acoustics Ltd.

.4 The VCM Group

2.03 SLACK CABLE RESTRAINTS

.1 Galvanized steel aircraft cable slack cable restraints meeting all current requirements of the Building Code, sized to suit the application and complete with all required cable ties, anchor hardware (selected for a load equal to twice the weight of the equipment), and similar connection accessories.

2.04 ANCHOR BOLTS

.1 Equal to Mason Industries type SAB seismic anchor bolts.

3 EXECUTION

3.01 INSTALLATION OF SEISMIC RESTRAINT MATERIALS

.1 Provide seismic restraint for all electrical equipment, conduit, raceways, lighting fixtures, etc., as per the requirements of the current edition of the Building Code and this Section of the Specification.

.2 Provide structural steel bases for all equipment unless the equipment manufacturer certifies direct attachment capabilities.

.3 Space restraints under equipment so that the minimum distance between adjacent corner restraints is at least equal to the height of the centre of gravity of the equipment. Include the height of the centre of gravity on shop drawings, otherwise, design for increased forces on the supports and submit design calculations with shop drawings.

.4 Floor mounted isolated equipment is to be installed on concrete housekeeping pads (design and thickness as selected by the Seismic Consultant) with at least 200 mm (8") clearance between drilled inserts and the edges of the pads. Ensure that all housekeeping pads are keyed to the structure to resist seismic displacement.

.5 Requirements pertaining to seismic control work are as follows:

.1 execute seismic control and restraint work in accordance with drawing details and reviewed product data and shop drawings

.2 seismic control systems are to work in all directions

.3 fasteners and attachment points are to resist the same maximum load as the seismic restraint

.4 drilled or power-driven anchors and fasteners are not permitted

.5 no equipment, equipment supports or mounts are to fail before failure of the structure

.6 seismic control measures are not to interfere with the integrity of firestopping

.7 all equipment is to be bolted to the structure, and all bolts are to fitted with isolation washers

.8 the number, size, type, and installation of anchor bolts are to be as recommended by the anchor bolt manufacturer and the Seismic Design Consultant

.9 where more than a 3 mm (1/8") differential exists between an anchor or attachment bolt diameter, an anchor and attachment point hole, or an isolator gap attachment bolt and equipment anchor attachment hole, pack the air gap with Mason type 0.5 FastSteel reinforced epoxy putty

.10 all hung equipment and hangers are to be fitted with a means of preventing upward movement, and non-isolated equipment and hanger rods are to be fitted with oversized steel washers and nuts above and below the hanger or equipment attachment point, locked tight to prevent uplift of the equipment or hanger

.11 where suspended equipment hanger rod length exceeds 50 rod diameters between the structure and the equipment attachment point, reinforce the rods with angle iron to prevent bending due to uplift forces

.12 seismic control measures are not to jeopardize noise and vibration isolation systems, and 6 mm (¼") to 9 mm (3/8") clearance during normal operation of equipment and systems is to be provided between seismic restraint and equipment

.13 where hold-down bolts for seismic restraint equipment penetrate roofing membranes coordinate with roofing trade for installation of pitch pockets/"gum cups" and sealing compound to maintain the water-tight integrity of the roof

.14 where friction type clamps are used for support of equipment and connecting services, secure clamps to steel work by means of welding or other positive means to prevent slippage or loosening of the clamps due to seismic force

3.02 SITE INSPECTION AND LETTERS OF CERTIFICATION

.1 When all seismic control products have been installed, arrange for the seismic control product manufacturer and Seismic Consultant to examine the installation of all seismic control products and to certify in writing (separate letters) that the products have been properly installed in accordance with governing Codes and Regulations, and recommendations and instructions. The Seismic Consultant is to apply his signed and dated professional stamp to the letter.

END OF SECTION

1 GENERAL

1.01 APPLICATION

.1 This Section specifies fire stopping and smoke seal requirements that are common to electrical work Sections of the Specification and it is a supplement to each Section and is to be read accordingly.

1.02 SUBMITTALS

.1 **Firestop & Smoke Seal System Samples:** At least four weeks prior to work commencing, submit a sample of each type of firestop and smoke seal system in applied form, for approval. Identify each system with the manufacturer's name and type, the ULC designation, and the proposed use. When the samples are approved, all work is to conform to the approved samples.

.2 **Product Data & WHMIS Sheets:** Submit a product data sheet and a WHMIS sheet for each firestopping and smoke seal product.

.3 **Name & Experience of Proposed Applicator:** Submit for approval the full company name and experience of the proposed firestopping and smoke seal system applicator.

.4 **Letter of Certification:** Submit a letter of proper firestopping and smoke seal certification as specified in Part 3 of this Section.

1.03 QUALITY ASSURANCE

.1 **Applicator:** The applicator is to have a minimum of three years of successful experience on projects of similar size and complexity, and is to be approved by the Consultant.

.2 **Environment Conditions:** Comply with the firestopping and smoke seal product manufacturer's recommendations regarding suitable environment conditions for product installation.

2 PRODUCTS

2.01 FIRESTOPPING AND SMOKE SEAL SYSTEM MATERIALS

.1 Asbestos-free elastomeric materials tested, listed and labelled by ULC in accordance with CAN4-S115, Standard Method of Fire Tests of Firestop Systems and CAN/ULC-S101, Standard Method of Fire Endurance Tests of Building Construction and Materials for installation in ULC designated firestopping and smoke seal systems to provide a positive fire, water and smoke seal, and a fire-resistance rating (flame, hose stream and temperature) not less than the fire resistance rating of surrounding fire rated construction.

.2 Materials are to be compatible with abutting dissimilar materials and finishes and complete with primers, damming and back-up materials, supports, and anchoring devices in accordance with the firestopping manufacturer's recommendations and the ULC tested assembly.

2.02 ACCEPTABLE MANUFACTURERS

.1 Acceptable firestop and smoke seal manufacturers are:

.1 A/D Fire Protection Systems "FIREBARRIER"

.2 Tremco Inc. Fire Protection Systems Group "TREMstop"

.3 3M Canada “Fire Barrier”

.4 Hilti (Canada) Ltd. Firestop Systems

.5 Specified Technologies Inc.

3 EXECUTION

3.01 INSTALLATION OF FIRESTOPPING AND SMOKE SEAL MATERIALS

.1 Where electrical work penetrates fire rated construction, provide ULC listed and labelled firestopping and smoke seal materials installed in accordance with requirements of CAN4-S115 (ratings F, FT, FH, and FTH as required), CAN/ULC-S101, and all other governing authorities to seal the penetrations.

.2 **Preparation:** Abide by the following requirements:

.1 examine substrates, openings, voids, adjoining construction and conditions under which the firestop and smoke seal system is to be installed, and confirm compatibility of surfaces

.2 verify penetrating items are securely fixed and properly located with the proper space allowance between penetrations and surfaces of openings

.3 report any unsuitable or unsatisfactory conditions to the Contractor and Consultant in writing, prior to commencement of work, and note that commencement of work will mean acceptance of conditions and surfaces

.4 mask where necessary to avoid spillage and over coating onto adjoining surfaces, and remove stains on adjacent surfaces

.3 **Application:** Conform to the following application requirements:

.1 use an experienced applicator approved by the manufacturer of the firestopping material manufacturer

.2 prime substrates in accordance with the product manufacturer’s written instructions

.3 provide temporary forming as required and remove only after materials have gained sufficient strength and after initial curing

.4 tool or trowel exposed surfaces to a neat, smooth, consistent finish

.5 remove excess compound promptly as work progresses and upon completion

.6 at all cable transit locations, seal the perimeter of the angle iron framing on both sides of the wall or slab with ULC listed and labelled sealant materials to provide a positive smoke seal

.4 **Inspection:** Notify the Consultant when the work is complete and ready for inspection, and prior to concealing or enclosing firestopping and smoke seal materials and service penetration assemblies. Arrange for final inspection of the work by the Municipal Building Inspector prior to concealing or enclosing work. Make any corrections required.

.5 **Certification:** On completion of the firestopping and smoke sealing installation submit a letter of assurance to the Consultant certifying that the firestopping and smoke sealing installation has been carried out throughout the building to all electrical service penetrations and that the installation has been done in strict accordance with the requirements of the Provincial Building Code, any applicable local Municipal Codes, ULC requirements, and the manufacturer's instructions.

END OF SECTION

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1 GENERAL

1.01 APPLICATION

.1 This Section specifies requirements, criteria, methods and execution for electrical demolition work that are common to one or more electrical work Sections, and it is intended as a supplement to each Section and is to be read accordingly.

1.02 SUBMITTALS

.1 Submit documentation to confirm that all PCB material and/or equipment containing PCB material has been properly removed and disposed of as applicable.

1.03 REFERENCE STANDARD

.1 Perform demolition work in accordance with requirements of CAN/CSA-S350, Code of Practice for Safety in Demolition of Structures.

2 PRODUCTS

Not Applicable

3 EXECUTION

3.01 DISCONNECTION AND REMOVAL OF EXISTING ELECTRICAL WORK

.1 Where indicated on the drawings, disconnect and remove existing electrical work, including hangers, supports, etc. Disconnect at the point of supply, remove obsolete connecting services and make the system safe. Cut back obsolete conduit behind finishes and cap unless otherwise specified.

.2 The scope and extent of the demolition or revision work is only generally indicated on the drawings. Estimate the scope, extent and cost of the work at the site during the bidding period scheduled site visit(s).

.3 Where deemed necessary by the Owner and Consultant, existing shafts, walls, and inaccessible ceilings will be opened by the Owner to permit site visit inspection of services to be removed/revised as part of the work but usually concealed behind such construction.

.4 Claims for extra costs for demolition work not shown or specified but clearly visible or ascertainable at the site during bidding period site visits will not be allowed.

.5 If any re-design is required due to discrepancies between the electrical drawings and site conditions, notify the Consultant who will issue a Site Instruction. If, in the opinion of the Consultant, discrepancies between the electrical drawings and actual site conditions are of a minor nature, the required modifications are to be done at no additional cost.

.6 Where existing electrical services extend through, or are in an area to serve items which are to remain, maintain the services in operation. Include for rerouting existing services concealed behind existing finishes and which become exposed during the renovation work, so as to be concealed behind new or existing finishes.

.7 Unless otherwise specified, remove from the site and dispose of all existing materials which have been removed and are not to be relocated or reused.

.8 Unless otherwise specified, remove from the site and dispose of all existing materials which have been removed and are not to be relocated or reused

3.02 HAZARDOUS MATERIALS AND WASTE

.1 If hazardous materials and/or waste not listed in the Specification is found, stop the associated work and notify the Owner and Consultant immediately and await directions.

3.03 INTERRUPTION TO AND SHUT-DOWN OF ELECTRICAL SERVICES AND SYSTEMS

.1 Co-ordinate all shut-down and interruption to existing electrical systems with the Owner. Generally, shut-downs may be performed only between the hours of 12:00 midnight Friday until 6:00 a.m. Monday morning.

.2 Upon award of contract, submit a list of anticipated shut-down times and their maximum duration.

.3 Prior to each shut-down or interruption, inform the Owner in writing seventy-two hours in advance of the proposed shut-down or interruption and obtain written approval to proceed. Do not shut-down or interrupt any system or service without such written approval.

.4 Perform work associated with shut-downs and interruptions as continuous operations to minimize the shut-down time and to reinstate the systems as soon as possible, and, prior to any shut-down, ensure that all materials and labour required to complete the work for which the shut-down is required are available at the site.

3.04 ROOFING WORK

.1 Where roof revisions and/or replacements are part of the project, include for disconnecting, lifting, or temporarily removing electrical equipment and electrical connections to other roof mounted equipment as required to permit completion of the roofing work, and for re-installing/re-connecting the equipment when the roofing work is complete.

END OF SECTION

1 GENERAL

1.01 SUBMITTALS

.1 **Test Reports:** Submit signed test reports for all testing work specified.

.2 **Approval Certificates:** Submit Certificates of Approval as issued by governing authorities.

.3 **Electrical Distribution System Coordination Study:** Submit copies of the electrical distribution system protective device coordination study specified in Part 3 of this Section, prior to energizing the electrical distribution equipment.

2 PRODUCTS

NOT APPLICABLE

3 EXECUTION

3.01 GENERAL ELECTRICAL WORK TESTING REQUIREMENTS

.1 Satisfactorily perform all testing required by governing authorities, Codes, Regulation and the Specification, including general testing specified below. Prepare and sign test reports to confirm satisfactory completion of testing and submit as specified in Part 1 of this Section.

.2 Perform testing to suit phasing of the work, as applicable.

.3 **Leaks, Grounds, and Crosses:** After luminaries, switches, receptacles, motors, signals, and similar equipment has been installed, whether or not the work has been installed as part of the work of this Division of the Specification or by other Divisions (telephone system excepted), test the work to ensure that there are no leaks, grounds, or crosses.

.4 **Motor Operation:** Test and establish proper motor rotation, measure full load running currents, and check overload elements. Report to the Consultant any discrepancies that are found. Existing motors that have been disconnected and reconnected as part of the electrical work must be checked with rotation meter, and be responsible for any damage caused by reverse rotation.

.5 **Branch Circuit Voltage Drop:** Demonstrate to the Consultant that branch circuit voltage drop is within specified limits.

3.02 HEALTH CARE FACILITY ELECTRICAL WORK TESTING

.1 Perform inspection and testing of all electrical work in all patient care areas in accordance with requirements of CAN/CSA Z32, Electrical Systems In Health Care Facilities, and any other governing Codes and Regulations. Prepare and sign test reports to confirm satisfactory completion of testing and submit as specified in Part 1 of this Section. Inspection and testing is to be done by one of the following:

.1 G.T. Wood Co. Ltd.

.2 Brosz and Associates Ltd.

.3 Rondar Inc.

.4 Haronitis & Associates Ltd.

.2 Perform testing to suit phasing of the work, as applicable.

.3 Inspection and testing work is to include electrical devices and communication system components installed in patient service consoles, headwalls, furniture systems, etc., whether or not the devices were provided as Part of the electrical work, isolated power centres including remote alarm stations and panels, and the grounding system.

.4 Testing is to be witnessed by the Owner and Consultant. Give the Owner a minimum of five working days notice of date(s) and time(s) for the tests.

3.03 GROUNDING AND BONDING SYSTEM

.1 Provide visual and mechanical inspection of the grounding and bonding system and verify that the system is in compliance with all requirements.

3.04 DISTRIBUTION SYSTEM TESTING AND COORDINATION STUDY

.1 The electrical distribution system protective devices have been selected such that protection is adequate and proper coordination is possible, however, since differences do exist between manufacturers of equipment, some changes in trip ratings or relay settings may be necessary and are to be performed as part of the work, prior to energizing the electrical distribution system. To determine the above, a testing and coordination study of the electrical distribution system equipment is to be performed by one of the following companies:

.1 G.T. Wood Co. Ltd.

.2 Brosz and Associates Ltd.

.3 Spark Power (Rondar Inc.)

.4 EnKompass

.2 Conform to requirements of CAN/CSA Z32, Electrical Safety and Essential Systems in Health Care Facilities.

.3 **Short Circuit and Coordination Study:** Immediately upon notification of award of Contract, arrange for the testing company to perform the following:

.1 cooperate with and obtain from manufacturers of the distribution system equipment a list of equipment5 requiring protective devices to be used, and along with the manufacturers, ensure that proper control and protective devices are selected such that they can be properly coordinated

.2 prepare, as soon as possible, a set of coordination curves on proper time current characteristic graph paper and submit to the Consultant, accompanied by supporting symmetrical as well as asymmetrical fault current calculation data with tabulations to very protection of the various distribution system elements under maximum and minimum fault conditions at the various points in the system

.3 plot the time current characteristic curves for the following:

.1 main and feeder protective devices at voltage levels used in the distribution system

.2 protective devices associated with the largest motor in each motor control centre, the refrigeration machine compressors (as applicable), and the largest lead fed from each distribution panelboard

.3 emergency power engine generator set protective devices, damage curves, and current decrement curves

.4 where relays, breakers, etc., do not perform to approved coordination curves they are to be revised at no cost as part of the work

.4 Review the existing distribution equipment and, where possible, obtain the existing distribution system coordination study to determine the best coordination between the existing and new equipment. If an existing coordination study is not available, survey the existing equipment and prepare calculations of proper coordination between the new and existing equipment. Where defective or incorrectly applied relays or breakers are found, clearly identify the problem on curves submitted with the report and suggest a recommended course of action.

.5 The on-site test and coordination study of distribution system protective devices is to include, as applicable:

.1 testing, cleaning when necessary, and calibrating relays and circuit breaker trip devices (calibration) of protective devices is to conform to requirements of approved coordination (curves).

.2 a function test of associated control device

.3 replacement of any fuses destroyed during tests

.4 an acceptance test in the presence of and to the satisfaction of the Consultant

.5 the presence at the site, for the length of time required, of qualified equipment manufacturer’s representatives

.6 an insulation resistance test of “load” side feeders with respect to ground

.7 testing of motor control centres, motor starters, and where supplied as part of the electrical work, viable speed drives

.8 witnessing EMI testing and signing test reports as verification of result

.6 **Arc Flash Hazard Analysis:** Perform an arc hazard analysis and prepare and submit a report with calculations to determine the flash protection boundary and the incident energy at locations in the electrical distribution system (switchboards, switchgear, motor control centres, distribution panelboards, bus duct, splitters), and other equipment where work could be performed on energized equipment. Include significant locations in systems fed from transformers 125 kVa and greater, and specify safe working distances for calculated fault locations based on the calculated arc flash boundary considering an incident energy of 1.2 cal/cm². Provide minimum 90 mm x 125 mm (3½" x 5") thermal transfer type high adhesion polyester warning labels at each work location and piece of equipment analyzed. Labels are to have an orange header with machine printed wording warning, ARC FLASH HAZARD, and the following information:

.1 nominal voltage

.2 flash protection boundary

.3 hazard risk category

.4 incident energy

.5 working distance

3.05 ELECTROMAGNETIC INTERFERENCE TESTING

.1 Using the services of a specialist testing company approved by the Consultant, and single axis or tri-axis probers with an appropriate electrical meter, a frequency response of 40 to 400 Hz, ad an overall accuracy of 1% or better, measure the magnetic field throughout the entire areas where magnetic field may be present in excess of acceptable limits. Take special care in all patient areas, including operating room, intensive care diagnostic rooms, and the like above or in close proximity to substations, main electrical rooms, and main power feeders such as bus duct and cable. The acceptance criteria is 5 mG (RMS) at measuring points.

.2 Electromagnetic interference testing EMI is to be done at a time when the building is operating under maximum electrical load and when approved by the Consultant, and is to be done in accordance with requirements of ICES-003, Digital Apparatus, and IEE644, Standard Procedures for Measurement of Power Frequency Electric and Magnetic Fields from AC Power Lines.

.3 Ensure that the company performing the distribution system test and coordination study witnesses the EMI tests and co-signs the test report.

END OF SECTION

1 GENERAL

1.01 APPLICATION

.1 This Section specifies mounting height requirements that are common to electrical work Sections of the Specification and it is a supplement to each Section and is to be read accordingly.

.2 Reference 26 05 00 – ELECTRICAL WORK GENERAL INSTRUCTIONS

2 PRODUCTS

2.01 MOUNTING HEIGHTS

.1 Mounting height of equipment is from finished floor to centreline of equipment unless specified or indicated otherwise.

.2 If mounting heights of equipment are not specified or indicated, verify with the Consultant prior to rough-in and installation.

.3 Unless indicated otherwise on the drawings or within the specifications, install electrical equipment at following heights;

- .1 Local switches – no lower than 900mm and no higher than 1100mm
- .2 Wall receptacles:
  - .1 General – 400mm (to bottom of receptacle)
  - .2 Above top of continuous baseboard heater – 200mm
  - .3 Above top of counters or counter splash backs – 175mm
  - .4 In mechanical rooms – 1000mm
  - .5 In equipment storage rooms – 1000mm
- .3 Panelboards – 2000mm to top of panel and as required by Electrical Safety Code
- .4 Telephone and interphone outlets – 400mm (to bottom of receptacle)
- .5 Wall mounted telephone and interphone outlets – no lower than 900mm and no higher than 1100mm
- .6 Thermostats – 1200mm to the point of controls
- .7 Fire Alarm stations – 1200mm to the top of point of operating action
- .8 Wall Mounted Fire Alarm Audible Devices – 2300mm
- .9 Television outlets not mounted behind a wall mounted television – 400mm (to bottom of receptacle)
- .10 Wall mounted speakers – 2100mm
- .11 Clocks – 2100mm
- .12 Handicap pushbuttons – no lower than 900mm and no higher than 1100 mm
- .13 Wall mounted Exit Signs
  - .1 For ceilings up to 2500mm height – 2100mm
  - .2 For all ceilings greater than 2500mm – 2400mm
- .14 Wall mounted Battery Packs and Emergency Heads

.1 For ceiling up to 2500mm height – 2100mm

.2 For all ceilings greater than 2500mm – 2400mm

.15 Wall mounted occupancy sensors – no lower than 900mm and no higher than 1100mm

.16 Wall mounted visible signal devices – entire lens shall be no less than 2000mm and no more than 2400mm

Note: In all applications the visible signal device shall be located to provide optimal viewing by the occupants. There may be applications where mounting heights outside of the range described would be more suitable and should be reviewed based on space layout and brought up to Engineer as construction progresses.

.17 Top of remote annunciator and passive graphic panels shall be no more than 1800mm above finished floor

3 EXECUTION

3.01 NOT USED

END OF SECTION

1 GENERAL

1.01 SUBMITTALS

.1 **Product Data**: Submit product data sheets for all products specified in Part 2 of this Section except for copper wire/cable conductors.

1.02 QUALITY ASSURANCE

.1 Grounding and bonding work is to be in accordance with requirements of the following:

.1 CSA C22.2 No. 41, Grounding and Bonding Equipment (Tri-National Standard with UL 467)

.2 CSA C22.2 No. 0.4, Grounding and Bonding of Electrical Equipment

.3 requirements of the Electrical Safety Authority and any other governing authority

.4 CAN/CSA Z32, Electrical Safety and Essential Electrical Systems in Health Care Facilities

1.03 COORDINATION

.1 Coordinate the installation of grounding hardware and conductors associated with concrete with the trades providing the concrete work.

1.04 FIELD QUALITY CONTROL REPORT

.1 Submit written and signed report(s) indicating successful results of the ground continuity tests specified in Part 3.

1.05 GROUND POTENTIAL RISE STUDY REPORT

.1 Submit a written and signed report indicating the results of the ground potential rise study specified in Part 3.

2 PRODUCTS

2.01 GROUND RODS

.1 Copper clad solid steel round rods, 20 mm (¾") diameter, 3 m (10') long, each complete with driving cap, pointed bronze tip, and a #14 gauge hot dipped galvanized steel or PVC, 250 mm (10") diameter, 300 mm (12") long ground rod box with a vandal-proof removable identified cover.

2.02 GROUND PLATES

.1 Copper plates, 1 m² (11 ft.² surface area, 6 mm (¼") thick.

2.03 GROUND MAT

.1 Copper mesh gradient control mat, 1.5 m (5') square, 2 mm (3/32") thick, 50 x 50 mesh.

2.04 GROUND BUS

.1 Solid electrical grade copper, minimum 50 mm x 6 mm (2" x ¼), minimum 600 mm (24") long but with lengths as required (continuous lengths for health care and data centre projects), predrilled for two-hole lug connections, suitable for wall or backboard mounting and complete with corner angles, tamper-proof stainless steel hex head bolts, nuts, and spring lock washers, standoff insulators, and all connection hardware.

2.05 GROUND PIT

.1 Cast iron or precast concrete pit with a removable identified cast concrete cover with recessed lifting handle to set flush with grade, a ground rod with clamps and grounding conductors as indicated, and a bottom section of clay sewer tile filled with clean crushed stone or gravel for pit drainage.

2.06 FLEXIBLE GROUND BRAID

.1 Flat 98% conductivity tinned copper grounding braid with dimensions to suit the application.

2.07 GROUND CONDUCTORS

.1 Unless otherwise specified and/or shown. Stranded un-tinned soft annealed copper wire, bare or green PVC insulated conforming to requirement of the Section entitled Wire and Box Connectors (0-1000volts).

2.08 GROUNDING AND BONDING CONNECTIONS

.1 **Below Grade:** Equal to Erico International Corp. "CADWELD" exothermic welded connections.

.2 **Above Grade:** Compression type connectors with zinc-plated fasteners and external tooth lock washers, or, if approved by the Consultant, exothermic Erico International Corp. "CADWELD" welded connections.

2.09 COMMUNICATIONS, ACCESS CONTROL, & ELECTRONIC SAFETY SYSTEM GROUND BUS

.1 Solid electrical grade copper bus bars, minimum 6 mm x 20 mm (¼" x ¾") designed for mounting on the framework of open or cabinet enclosed equipment racks.

2.10 LAN ROOM GROUND BUS

.1 Solid electrical Grade copper bus bars, 300 mm x 50 mm x 9 mm (12" x 2" x ⅜") with 8 drilled holes, suitable for wall mounting and equipped with standoff insulators.

3 EXECUTION

3.01 GENERAL RE: GROUNDING AND BONDING

.1 Perform all required grounding and bonding work in accordance with the Contract Documents and requirements of governing Codes and Standards, including the Electrical Safety Authority.

.2 Bond metallic conduits, boxes, cable tray, ducts, and non-current carrying metal parts of equipment together to form a continuous ground system. In electrical equipment rooms, solidly bond circuits, panelboards, conduits, equipment enclosures, and other equipment to perimeter ground bus using bronze connectors and hardware.

.3 Protect exposed conductors from injury. Install underground conductors a minimum of 450 mm (18”) below grade.

.4 Use tinned copper conductors for aluminium structures.

.5 Do not use bare copper conductors adjacent to un-jacketed lead sheath cables.

3.02 GROUND POTENTIAL RISE STUDY

.1 Perform a ground potential rise study at the location of the substation ground grid to determine a measurement expressed in ohm-meters as per IEEE 80-2000, IEEE Guide For Safety in A. C. Substation Grounding. The test is to be performed in accordance with requirements specified in the electrical work Section entitled Electrical Work Testing and Commissioning.

3.03 GENERAL PRIMARY GROUNDING AND BONDING REQUIREMENTS

.1 Grounding and bonding work associated with primary electric service work is to be performed only by qualified journeyman electricians employed by the subcontractor doing the primary electric service work.

.2 Provide a separate ground conductor in all PVC conduits.

3.04 INSTALLATION OF GROUND ROD GRIDS

.1 Construct ground rod grids consisting of copper clad steel ground rods as indicated/specified where indicated, each consisting of the number of rods shown, driven into the earth a minim of 300 mm (12”) below grade and terminated with a galvanized steel box enclosing the ground conductor clamp, and interconnected with minimum #3/0 AWG bare copper conductor. Flush with grade at each ground rod, provide an identification monument.

3.05 INSTALLATION OF PLATE ELECTRODE GRID

.1 Provide e plate electrode ground grid where indicated/specified.

.2 Bury the plate electrode level a minimum of 765 mm (30”) below grade and connect with minimum #3/0 AWG bare copper conductor. Flush with grade at each plate electrode, provide an identification monument.

3.06 INSTALLATION OF GROUND BUS

.1 Provide ground bus where shown/specified. Wall mount 300 mm (12”) above finished floor level on standoff insulators and follow the outline of door frames and room corners using 90º bus angles to form continuous bus. Connect the ground bus to the ground rod grid by means of two minimum #3/0 copper conductors terminated with approved fittings.

.2 Provide flexible braided copper ground straps from the ground bus to each steel door frame and door in the room, each securely bolted in place.

.3 Tighten all bus bar joint connection bolts and lug using a torque wrench to the bus manufacturer’s prescribed tension, then coat the bus with two 100% covering coats of shellac to prevent copper oxidization.

3.07 NEUTRAL GROUNDING

.1 Connect transformer neutral and distribution neutral together using 1000 volt insulated conductor to one side of a ground test link, the other side of the test link being connected directly to the main station ground. Ensure that distribution neutral and neutrals of potential transformers and service banks are bonded directly to the transformer neutral and not to the station ground.

.2 Connect the neutral of the station transformer to the main neutral bus with a tap pf the same size as the secondary neutral.

.3 Ground the transformer tank with a continuous conductor from the tank ground lug through the connector on the ground bus to the primary neutral. Connect the neutral bushing at the transformer to the primary neutral in the same manner.

3.08 POLE MOUNTED SWITCHING DEVICE GROUNDING

.1 Provide 4 ground rods at the base of each pole on which a group-operated line switching device is mounted. Locate the ground rods in a square grid formation such that the person operating the switch must stand within the formation.

.2 Interconnect the ground rods with #2/0 AWG copper conductor and join to the switch operating handle ground wires.

.3 Connect the operating handle of the switch to the handle base with #3/0 AWG extra-flexible copper conductor.

3.09 POLE MOUNTED TRANSFORMER GROUNDING

.1 Provide ground rods at the base of each pole on which transformers are mounted and interconnect the rods with the transformers, system neutrals, and lightning arrestors.

3.10 ELECTRICAL MANHOLE GROUNDING

.1 Provide a conveniently located ground stud, electrode, and ground conductor in each electrical manhole. Install the ground rod with the lug for the ground connection so that the top of the rod projects through the bottom of the manhole.

3.11 CABLE SHEATH GROUNDING

.1 Bond single conductor metallic sheathed cables together at on end only. Break the sheath continuity in an approved manner, and provide #6 AWG flexible copper ground conductor soldered (not clamped) to the cable sheath.

3.12 HEALTH CARE PROJECT GROUNDING

.1 Perform grounding work for health care projects, including isolated power system grounding, in accordance with requirements of CAN/CSA-Z32.

.2 Refer to testing requirements in the electrical work Section entitled Electrical Work Testing.

3.13 LOCAL AREA NETWORK (LAN) ROOM GROUNDING

.1 Provide minimum 3/0 AWG insulated copper ground conductors and wall mounted copper ground bus in each LAN Room. Connect the ground bus to computer equipment racks and to the building ground system.

3.14 TELECOMMUNICATIONS SYSTEMS GROUNDING

.1 Provide all required conductors and hardware to properly ground and bond communication system raceways, cable tray, metallic cable shields, and equipment to a ground source in accordance with requirements of TIA/EIA-607, Commercial Building Grounding and Bonding Requirements for Telecommunications.

END OF SECTION

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1 GENERAL

1.01 SUBMITTALS

.1 **Product Data**: If requested, submit product data sheets for products specified in this Section.

.2 **Samples:** If requested, submit samples of products specified in this Section.

2 PRODUCTS

2.01 SPLITTER TROUGH

.1 Formed #16 gauge steel Type 1 splitter trough in accordance with CSA C22.2 No. 76, Splitters, finished inside and outside with ANSI 61 gray heat cured powder epoxy paint, and complete with welded seams ground smooth, various size knockouts on each side, back mounting holes, removable doors with stainless steel hinges and hinge pins, terminal blocks for conductor connections, a single point ground lug

.2 **Enclosures:** Unless otherwise specified, enclosures are to be in accordance with the following NEMA/EEMAC ratings:

.1 all enclosures located in sprinklered areas – Type 2

.2 all enclosures except as noted above – Type 1

2.02 PULL BOXES AND JUNCTION BOXES

.1 Each box is to be CSA certified, sized to suit the number and size of conduit and conductors, and complete with connecting and securing facilities. Unless otherwise specified, pull boxes and junction boxes are to be as follows:

.1 galvanized or prime coat plated steel, suitable in all respects for the application and complete with screw-on or hinged covers as required and connectors suitable for the connected conduit

.2 “Condulet”, threaded galvanized cast iron or cast aluminium pull boxes ad junction boxes of an exact type to suit the application, each complete with screw-on gasketed cover

.3 rigid plastic (PVC), junction boxes and access fittings with solvent weld type joints and screw-on PVC covers

.4 equal to Square D (Schneider Canada) Catalogue No. 970 cast bronze water-proof junction box for underwater lighting

3 EXECUTION

3.01 INSTALLATION OF SPLITTER TROUGH

.1 Provide all required splitter trough in accordance with drawing plans, schedules, details, and requirements of the Specification.

.2 Rigidly secure that the splitter trough in place, level and plumb.

.3 Ensure that the splitter trough itself, and all branch circuits are properly identified.

3.02 INSTALLATION OF PULL BOXES AND JUNCTION BOXES

.1 Provide pull boxes in conduit systems wherever shown on the drawings, and/or wherever necessary to facilitate conductor installations. Generally, conduit runs exceeding 30 m (100') in length, or with more than three 90° bends, are to be equipped with a pull box installed at a convenient and suitable intermediate accessible location.

.2 Provide junction boxes wherever required and/or indicated on the drawings.

.3 Unless otherwise specified, boxes are to be as follows:

.1 in rigid conduit and EMT inside the building – stamped galvanized or prime coated steel

.2 in exterior rigid conduit – "Condulet" cast aluminium gasketted boxes unless otherwise noted

.3 in plastic conduit – rigid PVC boxes

.4 in bronze underwater conduit – cast bronze boxes

.4 All pull boxes and junction boxes must be accessible after the work is complete.

.5 Accurately locate and identify all concealed pull boxes and junction boxes on "as-built" record drawings.

.6 Cover boxes in fire walls with aluminium tape and seal with caulking.

END OF SECTION

1 GENERAL

1.01 SUBMITTALS

.1 **Product Data**: If requested, submit product data sheets for products specified in this Section.

.2 **Samples**: If requested, submit samples of products specified in this Section.

2 PRODUCTS

2.01 OUTLET BOXES

.1 Each box is to be CSA certified, suitable in all respects for the application, and be complete with suitable securing lugs, connectors suitable for the connected conduit, knockouts, and, where necessary, suitable plaster rings, concrete rings, covers and any other required accessory. Unless otherwise specified, outlet boxes are to be as follows:

.1 stamped, electro-galvanized steel outlet boxes

.2 zinc coated cast malleable iron or cast aluminum “FS and “FD” boxes with threaded inlet/outlet hubs

.3 rigid PVC outlet boxes

.4 equal to Hubbell Canada Inc. UL/ULC or ETL or listed fully adjustable both vertical and angular, formed galvanized cast iron, round, rectangular, or square as required flush concrete floor boxes complete with adjustable collars and brass screw-on hinged flip-open cover with provisions for installation of duplex power receptacles, telephone data jacks, and, for boxes containing both power and communication system outlets, proper barriers are to be provided

.5 Hubbell or Legrand-Wiremold flush, fire rated “poke-through” box assemblies to suit the devices required, with gray, black or brass flanges and covers as selected by the Consultant.

3 EXECUTION

3.01 INSTALLATION OF OUTLET AND CONDUIT BOXES

.1 Provide an outlet box or back box for each luminaire, wiring device, telephone outlet, fire alarm system component, communications systems components, and all other such outlets.

.2 **Stamped Galvanized Steel:** Outlet boxes flush mounted in interior construction, surface mounted in concealed interior locations, and surface mounted in exposed interior locations where the connecting conduit is EMT are to be stamped galvanized steel outlet boxes unless otherwise noted.

.3 **"FS" and "FD" Series Boxes:** Outlet boxes for surface mounted for exterior lighting, receptacles, and other device outlets, boxes flush mounted in exterior building surfaces, and boxes mounted in interior device locations where the connecting conduit is rigid, and for boxes in perimeter walls where insulation and vapour barrier is present, are to be "FS" or "FD" Series cast boxes unless otherwise noted, cast iron inside the building, cast aluminium outside the building.

.4 **Rigid PVC Boxes In New Concrete Slabs:** Provide rigid PVC outlet boxes in locations as follows:

.1 in underground polyethylene conduit systems

.2 for devices connected to isolated power system panelboards

.3 for rigid PVC conduit systems where permitted

.5 **Flush Floor Boxes:** Provide water-tight flush floor boxes where shown, installed in accordance with the manufacturer's instructions, and ensure that the boxes are not dislodged during the concrete pour.

.6 **Flush Floor Boxes In Existing Concrete Slabs:** Flush "poke-through" box assemblies installed in 75 mm (3") diameter core drilled openings and connected with conduit at the underside of the slab.

.7 Outlet boxes for special wiring devices, for special equipment and special applications if required, are specified hereinafter in other Sections or on the drawings.

.8 The size and arrangement of outlet boxes are to suit the device which they serve.

.9 Generally, mounting heights and locations for outlets are indicated on the drawings, however, confirm the exact location and arrangement of all outlets prior to roughing-in. Architectural drawings and the Consultant's instructions have precedence over electrical drawing diagrammatic layouts and specified mounting height and locations. In addition, abide by the following requirements:

.1 locate flush mounting boxes in masonry walls to require cutting of the masonry unit corner only, and coordinate masonry cutting to achieve a neat opening

.2 position outlet boxes to locate luminaires as shown on reflected ceiling plans

.3 coordinate mounting heights and locations of outlets mounted above counters, benches and backsplashes

.10 Do not install outlet or back boxes "back-to-back" in walls and partitions. Stagger such outlets and seal against noise transmission with acoustic insulation. "Thru-wall" type boxes will not be permitted for any application.

.11 Where boxes ae multi-ganged or grouped together, mount boxes level and spaced consistently.

.12 Temporarily pack all open boxes located in concrete and masonry to prevent debris from entering the box.

.13 Include all costs for installed boxes that have not been covered by wall/ceiling finishes, to be relocated up to 1 m (3') to suit final device location coordination.

.14 Provide blank coverplates over all boxes left empty for future installation of devices. Clearly identify each box as to its intended use to the Consultant's approval. Generally, blank overplates are to be stainless steel.

END OF SECTION

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1 GENERAL

1.01 SUBMITTALS

.1 **Product Data**: Submit product data sheets for all products where submittal is specified in Part 2 or Part 3 of this Section.

.2 **Colour Coated EMT Colour Chart:** Submit the colour coated EMT manufacturer's standard colour chart for colour selection(s) by the Consultant.

.3 **Drawing(s) of Conduit Locations/sizes In Structural Poured Concrete:** As specified in Part 3 of this Section, submit drawings to indicate the proposed location, size, and length of run for conduit proposed to be installed in structural poured concrete work.

2 PRODUCTS

2.01 EMT

.1 Galvanized steel to CSA C22.2 No. 83, Electrical Metallic Tubing, complete with factory made bends where site bending is not possible, and joints and terminations made with steel couplings and set screw type connectors, concrete tight where required.

2.02 RIGID GALVANIZED STEEL CONDUIT

.1 Rigid galvanized steel to CSA C22.2 No. 45, Rigid Metal Conduit, with an enamel interior coating, galvanized threads where factory threaded, red lead coated threads where site threaded, factory made bends where site bending is not possible, factory made threaded fittings and connectors, and terminations made with rigid couplings, concrete tight where required.

2.03 FLEXIBLE GALVANIZED STEEL LIQUID-TIGHT CONDUIT

.1 Flexible galvanized steel liquid-tight conduit to CSA C22.2 No. 56, Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit, complete with Ideal Industries Inc. "Steel Tough" liquid-tight connectors at terminations

2.04 FLEXIBLE GALVANIZED STEEL CONDUIT

.1 Galvanized steel flexible conduit to CSA C22.2 No. 56, Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit, complete with proper and suitable squeeze type connectors at terminations.

2.05 RIGID ALUMINUM CONDUIT

.1 Factory or site threaded rigid aluminium to CSA C22.2 No. 45, Rigid Metal Conduit, with bending, threading, fitting, coupling, etc., requirements as specified for rigid galvanized steel conduit.

2.06 RIGID BRONZE CONDUIT

.1 Factory threaded rigid bronze conduit with water-tight screwed joints, fittings and terminations.

2.07 RIGID PVC CONDUIT

.1 Rigid PVC conduit to CSA C22.2 No. 211.1, Rigid Types EB1 and DB2/ES2 PVC Conduit, FT-4 rated, complete with site made heat gun bends for conduit to and including 50 mm (2") diameter, factory made fittings for conduit larger than 50 mm (2") diameter, solvent weld joints, factory made expansion joints where required, and terminations made with proper and suitable connectors and adaptors.

2.08 FLEXIBLE PVC CONDUIT

.1 Equal to Ipex Electrical Inc. "Cor-line" flexible, water-tight, corrugated PVC conduit with Ipex "Kwikon" fittings and ESU conduit supports spaced at every 600 mm to 900 mm (2' to 3"), and proper and suitable terminations and adapters.

2.09 FLEXIBLE POLYETHYLENE CONDUIT

.1 Polyethylene pipe to CSA-B137.1, Polyethylene (PE) Pipe, Tubing and Fittings For Cold Water Pressure Service, minimum Series 75, supplied in continuous coils of the proper length.

2.10 EPOXY COATED RIGID GALVANIZED STEEL CONDUIT

.1 Rigid galvanized steel to CSA C22.2 No. 45, Rigid Metal Conduit, with an additional epoxy coating both inside and outside, factory made bends where site bending is not possible, factory made threaded fittings and connectors, and terminations made with rigid couplings.

2.11 COLOUR COATED EMT

.1 Equal to Allied Tube and Conduit "True Color" EMT as specified for standard EMT but factory coated with colours selected by the Consultant from the conduit manufacturer's standard colours.

2.12 FISH CORD

.1 Polyethylene or nylon fish cord/tape with cable pull accessories to suit the application.

3 EXECUTION

3.01 GENERAL RE: INSTALLATION OF CONDUIT

.1 Refer to the article entitled General Conduit and Conductor Installation Requirements in the electrical work Section entitled Basic Electrical Materials and Requirements.

.2 Ensure that all open empty conduit ends are properly protected against dirt and debris during the construction process.

3.02 CONDUIT INSTALLATION REQUIREMENTS

.1 Unless otherwise specified, provide conduit for all conductors except armoured cable, mineral insulated fire rated cable, and except where cable tray, cable duct, or a similar raceway is used.

.2 **Conduit Types:** Conduit is to be as follows:

.1 for main distribution wiring in electrical rooms and similar areas – rigid galvanized steel

.2 for exposed conduit from floor level to 1.2 m (4”) above the floor in mechanical and other service rooms – rigid galvanized steel

.3 for concealed conduit in exterior walls – rigid galvanized steel

.4 for explosion-proof wiring – rigid galvanized steel

.5 for conduit exposed outside the building, except where rigid PVC conduit is permitted – rigid galvanized steel

.6 for conduit associated with pool area outlets but not submerged in water – rigid galvanized steel

.7 as an alternative to rigid galvanized steel, except in poured concrete construction – rigid aluminium conduit

.8 for conduit in corrosive areas – epoxy coated rigid galvanized steel

.9 for short (minimum 450 mm (18”), maximum 600 mm (24”), with a 180º loop wherever possible) runs of conduit to electric motors, distribution transformers, and vibration isolated equipment – flexible galvanized steel liquid-tight conduit

.10 at points where exposed conduit crosses building expansion joints – flexible galvanized steel conduit

.11 for branch circuit conductors underground inside the building, and underground outside the building beneath structures and concrete or asphalt paving – rigid PVC

.12 for branch circuit conductors outside the building at roof level – rigid PVC

.13 for branch circuit conductors in concrete slabs on grade, and in concrete and masonry walls except exterior walls - rigid PVC

.14 for concealed branch circuit conductors associated with isolated power systems – rigid PVC

.15 for branch circuit conductors in concrete slabs above grade – flexible PVC

.16 for underwater conduit – rigid bronze

.17 for all conduit except as specified above – EMT

.18 for fire alarm system, and communications/security systems conductors – colour coated EMT with colours as selected

.3 **Conduit Fittings:** Unless otherwise specified, conduit fittings are to be of the same material as the conduit and suitable in all respects for the application. Provide proper adaptors for joining conduit of different materials.

.4 **Conduit Bends:** Site made bends for conduit must be made using proper bending equipment, bends must maintain the full conduit diameter with no kinking, and conduit finishes and lining must not flake or crack when the conduit is bent.

.5 **Site Cutting Conduit:** Cut square and ream all site cut conduit ends.

.6 **Conduit Threads:** Site cut rigid steel conduit using proper thread cutting equipment, in an approved area. Protect the area and building surfaces from being soiled/damaged by the threading process. Clean and lubricate threads and coat threads with red lead or other zinc rich coating.

.7 **Conduit Sizes:** Generally, conduit is sized on the drawings. Conduit not sized on the drawings is to be sized in accordance with the governing Codes/Regulations. The sizes of branch circuit conductors shown/specified are minimum sizes and must be increased to suit length of run and voltage drop, and where this occurs, increase the conduit size to suit. Do not use conduit less than 20 mm (3/4") diameter.

.8 **Empty Conduit:** Ensure that all conduit left empty for future wiring is clean, capped, and properly identified. Provide end bushings and fish cord in all such conduit.

.9 **Empty Conduit At Panelboards:** Where a suspended ceiling occurs, provide 4, empty, 20 mm (¾") diameter conduits from each flush wall mounted panelboard terminated in the suspended ceiling above, capped and identified.

3.03 CONDUIT INSTALLED IN POURED CONCRETE

.1 Where conduit is to be embedded in structural poured concrete, obtain the Consultant's approval. Submit a drawing indicating the location and size of the conduit, the length of run, and any other required details. Obtain the Consultant's written approval prior to conduit installation. The Consultant's decision regarding conduit in structural poured concrete is final and is not the basis of a claim for additional costs.

.2 When and where conduit is permitted in structural poured concrete, abide by the following requirements:

.1 install the conduit in accordance with requirements of CAN/CSA-A23.1, Concrete Materials and Methods of Concrete Construction

.2 the conduit must be secured in a manner such that the c9ncrete will not be displaced when the concrete is poured, and during the concrete pour, monitor the conduit installation to prevent displacement or damage, and immediately report any misplacement or damage observed

.3 where conduit extends adjacent to a column, stay away from the column a minimum of 2 times the thickness of the slab and drop away from the column

.4 where conduits terminate adjacent to a column or wall, bring the conduit in toward the column/wall as close to 90º to the face of the column/wall as possible

.5 where more than 2 conduits are adjacent to each other they are to be spaced the greater of 3 conduit diameters or 100 mm (4") apart

.6 the total depth of conduits crossing over each other is to be less than 1 third the thickness of the slab

.7 place conduit in the middle third of the slab thickness, and do not in any case lay conduit directly on reinforcing steel

.8 do not locate conduit adjacent to parallel reinforcing bars

.9 the maximum size of any conduit is 1/5th of slab thickness

.10 do not install conduit longitudinally in a beam without specific approval of the Consultant, and extend conduit through a beam at right angles to the beam span

.11 where conduits extend through beams stay a minimum of twice the depth of the beam away from the supports

.12 do not install conduit in the slab beside a drop or beam within twice the depth of the slab from the edge of the drop or beam

.13 do not install conduits through shear walls or columns without written approval from the consultant

.14 do not install conduit in parking garage structures, garage ramps, water retaining structures, or any other concrete subject to the application of de-icing products

.15 in areas where installation of conduit embedded in concrete is not permitted, extend conduit through beams in sleeves, if the installation of the sleeves is permitted

.16 slope all underground conduit to drainage points and ensure that the conduit can be drained

3.04 CONDUIT UNDER SLAB ON GRADE

.1 Where conduit is to be installed under a slab on grade, the system is to be a pull-in system, must consider and address any effects of magnetic fields, and the following is to apply:

.1 concrete encased duct bank with non-ferrous conduits is to be used

.2 conduit is to be sloped to a proper drainage pit

.3 20% spare conduit (minimum 1) is to be provided

3.05 SEALED CONDUIT PENETRATIONS

.1 For isolation rooms, any conduit penetration any surface of the room is to be sealed with a suitable elastomeric and intumescent material to ensure complete isolation of the room/area. The sealing material must be non-hazardous and suitable in all respects for the specific application, including a fire rating if required. Submit product data for the proposed sealing material as well as WHMIS sheets and product installation instructions.

3.06 CONDUIT FOR HEALTHCARE MRI SUITES

.1 All conduit for healthcare MRI suites is to be rigid aluminium, installed and supported with non-ferrous hardware, properly coordinated with construction of the room, and connected to non-ferrous boxes.

3.07 CONDUIT SUPPORT

.1 **Underground Conduit:** Unless otherwise shown or specified, support underground conduit on a well tamped bed of earth or sand, free from rocks or protrusions of any kind.

.2 **Surface Mounted & Suspended Single/Double Conduit Runs:** Support and secure single and double runs of conduit at support spacing in accordance with Code requirements by means of galvanized steel pipe straps, conduit clips, ring bolt type hangers with galvanized steel hanger rods, or by other approved manufactured devices.

.3 **Support of Multiple Conduit Runs:** Support multiple conduit runs by means of Electrovert Ltd. “CANTRUSS” or Burndy Ltd. “FLEXIBLE” conduit racks and galvanized steel rods with support spacing to suit requirements of the smallest diameter conduit in the group.

.4 **Conduit Expansion Facilities:** Abide by the following:

.1 wherever concealed or surface mounted conduit extends across a building expansion joint, provide expansion facilities to permit free movement without imposing additional stress or loading on the support system, and to prevent excessive movement at joints and connections

.2 provide manufactured expansion joint fittings in rigid PVC conduit at spacing recommended by the expansion joint fitting manufacturer

.3 make “snaked” bends in underground flexible polyethylene conduit

END OF SECTION

1 GENERAL

1.01 SUBMITTALS

.1 **Product Data**: Submit product data sheets for wiring devices. Ensure that the sheets indicate colours and faceplate finishes.

.2 **Wiring Device Samples:** Submit identified samples in original packaging of the following wiring devices:

.1

1.02 QUALITY ASSURANCE

.1 All wiring devices are to be CSA certified as a minimum, in accordance with the following standards, as applicable:

.1 CAN/CSA C22.2 No. 42, General Use Receptacle, Attachment Plugs and Similar Wiring Devices

.2 CAN/CSA C22.2 No. 42.1, Cover plates for Flush Mounted Devices

.3 CSA C22.2 No. 111, General Use Snap Switches

.2 Wherever possible, all wiring devices are to be supplied by the same manufacturer.

.3 **Acceptable Manufacturers:** Unless otherwise specified in this Section or on the drawings, acceptable manufacturers are:

.1 Hubbell Canada LP

.2 Cooper Industries (Arrow Hart)

.3 Legrand/Pass & Seymour

.4 Leviton Canada

1.03 WIRING DEVICE AND PLATE COLOURS

.1 Unless otherwise specified, wiring device colours will be as specified in Part 3 of this Section.

2 PRODUCTS

2.01 SWITCHES

.1 Unless otherwise specified, Specification Grade, Premium Quality, back and side wired, 20 ampere, 120-277 volt A.C. quiet action toggle switches, single pole, 2-pole, 3-way, or key type as indicated on the drawings, each complete with a nickel plated steel ground terminal, brass power wiring terminals and screws, silver cadmium oxide contacts with a moveable brass contact arm, and nylon toggle with colour as specified below. Switch types are as follows:

.1 **Standard Wall Toggle Switches:** As above.

.2 **Illuminated Handle Standard Wall Toggle Switch:** As above for standard switches but with a clear red or green polycarbonate toggle which is illuminated when the switch is on or off. Confirm toggle colour and position when illuminated prior to ordering.

.3 **Decorative Wall Rocker Switch:** Generally, as specified above for standard toggle switches but rectangular decorative rocker type with rocker handles.

.4 **Illuminated Decorative Wall Rocker Switch:** Generally, as specified above for decorative toggle switches but with a rocker type illuminated handle.

.5 **Door Switch:** Box, switch and plate assemblies with a 125 volt 3 ampere illuminated switch which is on or off when the door is open (confirm prior to ordering), a 34 mm x 94 mm x 40 mm (1 11/32” x 3 11/16” x 1½”) box, cover plate, and mounting screws.

.6 **Hazardous Location Switch:** Explosion-proof, surface mounting, front operated switches suitable for use in Class 1 Division 2 locations with exact classification and configuration to suit the mounting location and the equipment the switch is provided for.

.7 **Motor Control Snap Action Switch:** Illuminated handle snap action horsepower rated switch, CSA certified for motor control and sized to suit the application.

.8 **Occupancy Sensor Switch:** Digital ultrasonic sensor type, 120–277-volt A.C. with integral photo sensor and selected to suit the area and occupancy of the room served.

2.02 SPECIFICATION GRADE STANDARD RECEPTACLES

.1 Back or side wired, U-ground, 2 pole receptacles as follows:

.1 **15 Amp. 125 Volt Duplex Receptacle:** 3-wire receptacles, NEMA configuration 5-15R

.2 **15 Amp. 250 Volt Duplex Receptacle:** 3-wire receptacles, NEMA configuration 6-15R

.3 **20 Amp. 125 Volt Duplex Receptacle:** 3-wire receptacles, NEMA configuration 5-02R

.4 **20 Amp. 250 Volt Duplex Receptacle:** 3-wire receptacles, NEMA configuration 6-20R

.5 **30 Amp. 250 Volt Simplex Receptacle:** 3-wire receptacles, NEMA configuration 6-30R

.6 **30 Amp. 125/250 Volt Simplex Receptacle:** 3-wire receptacles, NEMA configuration 14-30R

.7 **50 Amp. 250 Volt Simplex Receptacle:** 3-wire receptacles, NEMA configuration 6-50R

.8 **50 Amp. 125/250 Volt Simplex Receptacle:** 4-wire receptacles, NEMA configuration 14-50R

2.03 HOSPITAL GRADE STANDARD RECEPTACLES

.1 Hospital grade, back or side wired, U-ground 2-pole, 3-wire receptacles, each identified on the face with a green dot and as follows:

.1 **15 Amp. 125 Volt Duplex Receptacle:** NEMA configuration 5-15R

.2 **15 Amp. 250 Volt Duplex Receptacle:** NEMA configuration 6-15R

.3 **20 Amp. 125 Volt Duplex Receptacle:** NEMA configuration 5 -20R

.4 **20 Amp. 250 Volt Duplex Receptacle:** NEMA configuration 6-20R

.5 **30 Amp. 250 Volt Simplex Receptacle:** NEMA configuration 6-30R

2.04 SPECIFICATION GRADE LOCKING RECEPTACLES

.1 Specification Grade, back or side wired, U-ground 2-pole, 3-wire locking type receptacles as follows:

.1 **15 Amp. 125 Volt Duplex Receptacle:** NEMA configuration L6-15R

.2 **15 Amp. 250 Volt Duplex Receptacle:** NEMA configuration L6-15R

.3 **20 Amp. 125 Volt Duplex Receptacle:** NEMA configuration L5-20R

.4 **20 Amp. 250 Volt Duplex Receptacle:** NEMA configuration L6-20R

2.05 SPECIFICATION GREADE ISOLATED GROUND RECEPTACLES

.1 **120 Amp. 125 Volt Duplex Receptacle:** Back and side wired, duplex, U-ground, 2-pole, 20 ampere, 125 volt, 3-wire, orange colour, surge suppression isolated ground nylon construction receptacles, NEMA configuration 5-20R.

2.06 HOSPITAL GRADE ISOLATED GROUND RECEPTACLES

.1 **20 Amp. 125 Volt Duplex Receptacle:** Hospital Grade, back and side wired, duplex, U-ground, 2-pole, 20 ampere, 125 volt, 3-wire, orange colour, surge suppression isolated ground nylon construction receptacles, NEMA configuration 5-20R and complete with a green identification dot.

2.07 SPECIFICATION GRADE GROUND FAULT RECEPTACLES

.1 Heavy-duty, 15/20 ampere, 125 volt, ULC Class A, Group 1. automatic ground fault circuit interrupting duplex receptacles with a 10-kA short circuit current rating automatic self-test diagnostics, green power on LED, and red ground fault LED. Ground fault receptacles for indoor climate controlled and outdoor or non-climate-controlled areas are to be as follows:

.1 indoor climate-controlled areas: equal to Hubbell Canada No. GFST15/GFSTt20 “AUTOGUARD”

.2 outdoor areas and indoor non-climate areas: equal to Hubbell Canada No. GFR5262TR/GFR 4362TR “AUTOGUARD”

2.08 EXPLOSION-PROOF RECEPTACLES

.1 Equal to Cooper Crouse-Hinds ENR Series “Ark-Gard” dead front, simplex, interlocking circuit breaking receptacles suitable for installation Class 1 Division 1 and 2 explosion-proof receptacles, 15 ampere or 20 ampere, 125 volt or 250 volt as indicated on the drawings, each complete with a die-cast copper-free aluminium housing and spring door with stainless steel hinge and neoprene gasket, and fiberglass reinforced polyester receptacle.

2.09 TIME SWITCH

.1 Flush wall mounting spring wound ivory time switch with matching faceplate, equal to Tork A500 Series with exact catalogue number to suit the connected load.

2.10 USB CHARGER COMBINATION RECEPTACLES

.1 Specialized Receptacles: Comply with NEMA WD 1 and NEMA WD 6 for standard configuration and UL498. Comply with USB battery charging spec USB BC1.2.

.2 Products: Subject to compliance with requirements, provide one of the following;

.1 Hubbel Cat.#: USB15ACPDW

.2 Pass & Seymour Cat.#:

.3 Leviton Cat.#:

.3 Description:

.1 Straight blade, 125v, 15A (or 20A); NEMA 5-15R (NEMA 5-20R)

.2 Non-feed through type

.3 Solid state charger device with duplex receptacle.

.4 Dual USB charging ports 30.A (min.), 5 VDC dual USB charging ports.

.5 Compatible with USB 2.0 devices.

.6 Tamper resistant.

2.11 AFCI RECEPTACLES

.1 General Description:

.1 Straight blade, feed through type

.2 Comply with NEMA WD 1 and NEMA WD 6 configuration 5-20R, UL498 and UL1699A

.3 Include trip/reset buttons

.4 Included correct wiring/trip indicated LED light

.2 Tamper Resisttant AFCI, Duplex Convenience Receptacles, 125V, 15A:

.1 Products: Subject to compliance with requirements, provide one of the following;

.1 Hubbell Cat.#: AFR15TRx

.2 Pass & Seymour Cat.#: AF153TRx

.3 Leviton Cat.#: AFTR15

2.12 DEVICE FACEPLATES

.1 Device faceplates are to be ULC listed and CSA certified and, unless otherwise specified, supplied by the device manufacturer. Where two or more devices are installed in a common box, a common one-piece faceplate is to be used. Faceplate colours are specified in Part 3. Faceplates, unless otherwise specified, are to be as follows:

.1 Phenolic switch and receptacle faceplates, brown or ivory, complete with matching screws

.2 “Decorator” type Phenolic switch and receptacle faceplates

.3 type 302 stainless steel switch and receptacle faceplates, brush finish or satin finish as directed, with stainless steel screws

.4 high impact smooth finish switch and receptacle faceplates

.5 hot dipped galvanized steel switch and receptacle faceplates

.6 NEMA 3 rated, single gang, horizontal/vertical mounting, weather-proof in use, gasketed cast aluminium, receptacle faceplates to suit the type of receptacle used

.7 weather-proof, gasketed, water-tight single gang type 302 stainless steel switch plate with clear silicone rubber bubble over the switch toggle

3 EXECUTION

3.01 GENERAL RE: INSTALLATION OF WIRING DEVICES

.1 Provide all required wiring devices and faceplates

.2 Confirm exact locations, including mounting heights prior to roughing-in.

.3 For barrier-free mounting heights for devices, conform to requirements of the governing code or regulation.

.4 Ensure that switches located adjacent to doors are located at the strike side of the door. Confirm door swings prior to roughing-in.

.5 Install single throw switches with the handle in the up position when the switch is closed.

.6 Confirm all switch, receptacle and faceplate types, colours and finishes prior to ordering

.7 Provide a separate insulated ground conductor for each isolated ground receptacle.

.8 Faceplates for computer equipment receptacles are to be permanently identified with “Computer Equipment Only” wording.

.9 Faceplates for housekeeping receptacles are to be permanently identified with “Housekeeping Only” wording.

.10 Do not install faceplates for flush devices until wall, etc., finishing work is complete

.11 Where devices are to be installed in casework, millwork, or similar construction, carefully coordinate device installations and device openings with the trade providing the casework, millwork, etc.

.12 Device locations indicated on the drawings are approximate, and, if requested, relocate the device up to 3 mm (10’) away from the location shown at no additional cost.

.13 All receptacles within 1.5m of a sink or shower/tub to be GFCI type.

3.02 REQUIREMENTS FOR INSTALLATION OF WIRING DEVICES IN HEALTH CARE FACILITIES

.1 In addition to requirements specified above, conform to the following requirements for health care facilities:

.1 comply with requirements of CSA Z32, Electrical Safety Essential Electrical Systems in health care facilities

.2 within imaging/scanning type room, devices, including mounting screws and hardware, are to be of non-ferrous construction

.3 safety shutter receptacles are to be provide where shown and where required by CSA Z32

.4 do not provide isolated ground receptacles in patient care areas

.5 identify devices with engraved Lamacoid plates as per CSA Z32, and confirm identification wording prior to manufacturer of the nameplates

.6 faceplates for switches and receptacles circuited to essential or isolated power are to be oversized nylon faceplates with permanent, suitable identification wording and a colour to be confirmed prior to ordering

3.03 WIRING DEVICE AND DACEPLATLE TYPES AND COLOURS

.1 Unless otherwise specified, wiring devices colours and faceplate types and colours are to be as follows:

.1 **standard switches & receptacles I finished areas-non-essential circuits:** ivory, with ivory Phenolic faceplates

.2 **“Decorator” switches & receptacles in finished areas-non-essential circuits:** white or ivory, with white or ivory “Decorator” Phenolic faceplates

.3 **switches & receptacles in finished areas-non-essential circuits:** ivory, stainless steel faceplates

.4 **switches & receptacles in unfinished areas-non-essential circuits:** ivory, stainless steel faceplates

.5 **switches & receptacles in finished areas-essential power circuits & isolated power switches:** red, with stainless steel faceplates

.6 **isolated power receptacles:** cast aluminium gasketed weather-proof faceplates to suit the type of receptacle installed

.7 **weather-proof switches:** weather-proof stainless-steel faceplates with clear silicone bubble over the switch toggle

3.04 TESTING

.1 When installation is complete, test operation of all devices.

END OF SECTION

1 GENERAL

1.01 SUBMITTALS

.1 **Product Data**: Submit product data sheets for occupancy sensors.

1.02 MOCK-UP

.1 Include for providing a sensor mock-up installation in a typical washroom to verify proper operation prior to installation of other sensors.

1.03 QUALITY ASSURANCE

.1 All occupancy sensors are to be solid-state design, UL/ULC listed and labelled and CSA certified in accordance with CAN/CSA C22.2 No. 184, Solid-State Lighting Controls, and designed specifically for energy conservation.

1.04 ACCEPTABLE MANUFACTURERS:

.1 Acceptable sensor manufacturers are:

.1 WattStopper/Legrand

.2 Pass & Seymour/Legrand

.3 Novitas Inc.

.4 Leviton Manufacturing Co. Inc.

.5 Lutron Electronics Co. Inc.

.6 Cooper Controls “Greengate”

2 PRODUCTS

2.01 PASSIVE INFRARED SENSORS

.1 “WattStopper” passive infrared sensors are to be capable of detecting presence in the floor area to be controlled by detecting changes in the infrared energy, and small movements are to be detected such as when a person is writing while seated at a desk. The sensor turns the connected load on automatically when it detects occupancy, and when the space is vacant and a time delay expires, the sensor automatically turns the connected load off. Types of passive infrared sensors are as follows:

wall switch sensor: WS-250 Series for the line voltage as indicated, each complete with green LED that blinks upon occupancy, resets and blinks again when movement is detected, a manual ON/OFF button on the switch cover, adjustable time delay with walk test feature, multiple viewing segment Fresnel lens within opaque adhesive tape supplied loose to mask the lens to site eliminate coverage in unwanted areas, and a decorator style switch cover plate

.1 **round ceiling sensor:** CI-200 Series dual-element, temperature compensated pyroelectric, 24 volt DC, 360° coverage, round, low profile sensor with LED indicator, user adjustable time delay from 15 seconds to 30 minutes in 2 minute increments, integral daylight filter to prevent short wavelength infrared waves such as sunlight from affecting the sensor, 30 segment Fresnel lens, alternate viewing patterns depending on mounting choice, adjustable 4 setting dip switch sensitivity, integral light level sensor (4 to 190 fc), isolated relay with N/C and N/O output contacts (1 A @ 24 volt AC/DC) for use with HVAC or other control equipment, application specific integrated circuit for reliability and to reduce false triggers, and mounting hardware to suit the ceiling construction

.2 **rectangular ceiling sensor:** WPIR Series dual-element, temperature compensated pyroelectric, 24 volt DC, rectangular sensor with LED indicator, user adjustable time delay from 30 seconds to 30 minutes in 2 minute increments, optional on override through a logic key/on bypass, application specific integrated circuit for reliability and to reduce false triggers, and mounting hardware to suit the ceiling construction

.3 **ceiling/wall sensor:** CX-100 Series dual-element, temperature compensated pyroelectric, 24 volt DC, pulse count processing, rectangular sensor with LED indicator, user adjustable time delay from 15 seconds to 30 minutes, integral daylight filter to prevent short wavelength infrared waves such as sunlight from affecting the sensor, multi-level Fresnel lens, integral bi-level light level sensor (3 to 200 fc), isolated relay with N/C and N/O output contacts (1 A @ 24 volt AC/DC) for use with HVAC or other control equipment application specific integrated circuit for reliability and to reduce false triggers, a swivel mounting bracket, and additional mounting hardware as required to suit the application

2.02 ULTRASONIC CEILING MOUNTING SENSORS

.1 “W” Series ultrasonic ceiling mounting volumetric sensors which use the Doppler shift principal whereby motion in the controlled area causes a slight change in the reflected frequency and amplitude of the broadcast ultrasonic waves to detect occupancy and turn lighting and/or fans on and off. Each sensor is to be complete with 15 second to 15-minute adjustable time delay, 0 to 10 setting adjustable sensitivity, a by-pass setting to override a faulty or failed sensor, a LED indicator which blinks each time the sensor is triggered, and mounting hardware to suit the application.

2.03 POWER PACKS

.1 CSA certified “B” Series, Model(s)…….. line voltage/24-volt DC prewired power pack assemblies to provide 24-volt DC power to occupancy sensors.

3 EXECUTION

3.01 INSTALLATION OF OCCUPANCY SENSORS

.1 Provide occupancy sensors, generally where shown but with exact locations in accordance with reflected ceiling plans and the sensor manufacturer’s instructions. Include for all required site assembly, and provide all required installation and support hardware.

.2 Confirm exact locations prior to roughing-in.

.3 Connect sensors to circuits indicated with wiring in conduit.

.4 Provide power packs for 24-volt DC sensors and locate where accessible for maintenance. Ensure that panelboard breakers serving power packs are equipped with lock-on devices. Unless otherwise indicated install power packs in 150 mm x 150 mm x 100 mm (6” x 6” x 4”) utility boxes painted white and identified with a Lamacoid nameplate, and connect to sensors with armoured cable with 1.5 m (5”) of slack cable for location adjustment if required.

.5 Assist the Owner’s operating personnel in the location and adjustment of sensors to suit the location and application.

.6 Include for a 4-hour on-site training session for the Owner’s personnel to demonstrate operation and adjustments of sensors, and trouble-shooting procedures.

END OF SECTION

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1 GENERAL

1.01 SUBMITTALS

.1 **Product Data**: **Samples:** Submit product data sheets for products specified in this Section.

.2 **Factory Test Reports:** Submit certified copies of the transformer manufacturer's standard factory testing.

.3 **Installation Test Report:** As specified in Part 3 of this Section, submit signed copies of the site installation test report.

.4 **Transformer Extended Warranty:** Submit a signed copy of the manufacturer's extended warranty as specified below.

1.02 QUALITY ASSURANCE

.1 Dry type distribution transformers are to be in accordance with requirements of the following:

.1 CAN/CSA-C22.2 No. 47, Air-Cooled Transformers (Dry Type)

.2 CSA-C9 Dry-Type transformers

.3 CAN/CSA-C802.2, Minimum Efficiency Values for Dry-Type Transformers

.4 NEMA TP1, Guide for Determining Energy Efficiency for Distribution Transformers

1.03 EXTENDED WARRANTY

.1 Distribution transformers are to be covered by a five-year non-prorated extended warranty (as per the Contract warranty) direct from the manufacturer to the Owner against defects in material, workmanship and performance.

2 PRODUCTS

2.01 DISTRIBUTION TRANSFORMERS

.1 Dry type distribution transformers, factory assembled and tested, supplied with a 5-year extended warranty as per Part 1 of the Section, as per the drawing schedule and with the following features:

.1 a minimum NEMA/EEMAC 3R enclosure with rigid end frame, removable gasketed front and rear plates, a bottom terminal compartment, ventilation louvers designed to protect internal live parts from fire protection sprinkler system spray, a drip shield, a factory ASA No. 61 light grey enamel finish, an aluminium nameplate secured to rivets to the front of the enclosure and listing impedance rating, weight connection diagram, style and serial number, and, where required by governing Codes and Regulations, seismic restraint facilities for site connection

.2 copper windings, a core constructed of stacked laminations of high permeability silicone streel, epoxy resin impregnation, and Class H silicone type coil insulation such that the winding temperature rise will not exceed 150° C (300° F) and the enclosure temperature rise will not exceed 65° C (150° F) under full load in a 40° C (104° F) ambient temperature

.3 an electrostatic shield for the attenuation of voltage spikes, line noise, and transients

.4 lugs or pressure type terminals to suit primary and secondary conductors

.5 four 2½ % full capacity taps, 2 above normal and 2 below normal

.6 basic impulse level (BIL), standard

.7 mounting hardware for the location(s) shown

.8 average sound levels as follows:

.1 40 dB for transformers up to 9 kVA

.2 45 dB for transformers from 10 to 50 kVA

.3 50 dB for transformers 51 to 150 kVA

.4 55 dB for transformers 151 to 300 kVA

.5 60 dB for transformers 301 kVA and larger

.6 integral vibration dampening with anti-vibration pads between the core and enclosure

.2 **Acceptable Manufacturers:** Acceptable manufacturers are:

.1 Eaton Canada

.2 Schneider Electric Canada

.3 Siemens Canada Inc.

.4 Hammond Power Solutions Inc.

.5 Rex Power Magnetics

2.02 K-RATED POWER CONDITIONING DISTRIBUTION TRANSFORMERS

.1 K-rated, shielded, 600-volt primary, high efficiency, continuous duty, power conditioning isolation transformers to support harmonic non-linear loads, factory assembled and tested, supplied with a five-year extended warranty as per Part 1 of this Section, as per the drawing schedule and with performance and features as indicated below.

.1 **Input and Output Specifications:** Input and output specifications include:

.1 the normal AC input voltage rating is to have sufficient margin to sustain a constant input of ± 10% without saturation

.2 the transformer primary is to be configured in a 3-phase delta or 1 phase 2 wire plus ground configuration as applicable and include, unless otherwise indicated, full capacity taps at 2 ½ % increments, two above and four below the nominal voltage tap

.3 when energized, the current inrush is not to exceed a maximum of ten times for full load input current for ½ cycle

.4 the output scheduled is to be continuous duty, full load output, and the impedance is to be 3% to 4% typical

.5 the output K rating is to be in accordance with $K = \Sigma Ih(pu)^2 h^2$

.2 **Performance Specifications:** Performance specifications are to include:

.1 the output voltage is to be maintained within ±2.5% or less of nominal from no load to full load, and is to remain sinusoidal with no flat topping when high crest factor (3.0 : 1) non-linear loads are present at the output

.2 the overload rating is to be 500% for 10 seconds, and 1000% for 1 cycle

.3 the transformer is to add no more than 1% total harmonic distortion to the output waveform under a linear load

.4 the audible noise is to be maximum 55 dB at 1m (3')

.5 transformer efficiency is to be a minimum of NEMA TP 1 97% efficiency standards under the specified K-rated non-linear load at or between 35% to 50% load and at an operating temperature of 75° C (167° F)

.6 the BIL is to be minimum 10,000 volts

.3 **Construction:** Construction features include the following:

.1 a minimum NEMA/EEMAC 3R enclosure with rigid end frame, removable gasketed front a d rear plates, a terminal compartment with input and output terminal connections hardwired to copper stand-off bus or terminals, a neutral conductor sized for 2 times the ampacity of the phase conductors, natural ventilation louvers designed to protect internal live parts from fire protection sprinkler system spray, a drip shield, a factory ASA No.l 61 light grey enamel finish, an aluminium nameplate secured to the front of the enclosure and listing impedance rating, weight, connection diagram, style and serial number, and where require by governing Codes and Regulations, seismic restraint facilities for site connection

.2 copper windings with separate primary and secondary isolated windings, a core constructed of stacked laminations of high permeability silicone steel with flux density not to exceed 15 gauss and core losses limited to 0.6% or less of the KVA rating, and 200° C (390° F) coil insulation such that the winding temperature rise will not exceed 115° C (240° F) above ambient under linear load and 130° C (265° F) under non-linear load

.3 a double solid copper foil electrostatic shield to minimize inner winding capacitance, transient and noise coupling between primary and secondary windings

.4 transverse mode noise attenuation of 3 dB down at 10 kHz, decaying 20 dB per decade

.5 integral vibration dampening with anti-vibration pads between the core and enclosure

.2 **Acceptable Manufacturers:** Acceptable manufacturers are:

.1 Eaton Canada

.2 Schneider Electric Canada

.3 Siemens Canada Inc.

.4 Hammond Power Solutions Inc.

.5 Rex Power Magnetics Div. of Transformer Industries Inc.

3 EXECUTION

3.01 INSTALLATION OF DISTRIBUTION TRANSFORMERS

.1 Provide distribution transformers where shown. Ensure that adequate operation and maintenance clearance is maintained on all sides of each transformer as per Code requirements.

.2 Wall mount transformers 75 kVA and less on a structural steel primed and enamelled wall mounting bracket assembly located approximately 300 mm (12') below the ceiling and adequately secured to wall construction. Submit wall bracket construction and securing details with transformer product data sheets.

.3 Secure each transformer large than 75 KVA, level and plumb, on suitable rubber-steel-rubber vibration isolation pads on a concrete housekeeping pad.

.4 Ground and bond transformers as indicated on the drawings.

.5 Isolate primary and secondary connections from transformer enclosures by means of from 300 mm to 450 mm (12' to 18') of liquid-tight flexible conduit.

.6 Identify each transformer with an engraved Lamacoid nameplate in accordance with requirements of the Section entitled Basic Electrical Materials and Methods. Confirm nameplate wording with the Consultant prior to manufacture.

.7 Provide seismic restraints in accordance with requirements of the electrical work Section entitled Seismic Control and Restraint.

3.02 VERIFICATION AND TESTING

.1 Test and verify transformer secondary voltage and make any required adjustments to produce secondary voltages specified. Re-test and verify voltages when the building is in normal operation. Submit signed testing and verification reports as per Part 1 of this Section.

3.03 TRAINING AND INSTRUCTIONS

.1 Include for a minimum of 2 separate 4-hour system operation and maintenance training sessions for up to six persons per session, to be held at the site.

.2 Prepare and submit for review, an outline of the proposed training session, including a list of all documents, visual aids, etc., to be used.

END OF SECTION

1 GENERAL

1.01 REFERENCES

.1 CSA International
- .1 CAN/CSA-C22.2 No.47-M90(current editions), Air-Cooled Transformers (Dry Type).
- .2 CSA C9-02(current editions), Dry-Type Transformers.
- .3 CAN/CSA-C802.2- (current edition), Minimum Efficiency Values for Dry Type Transformers.

.2 National Electrical Manufacturers Association (NEMA)

2 PRODUCTS

2.01 DESIGN DESCRIPTION

.1 Design 1.
- .1 Type: ANN.
- .2 As noted on drawings.
- .3 Voltage taps: standard.
- .4 Insulation: Class 220, 150 degrees C temperature rise.
- .5 Basic Impulse Level (BIL): standard.
- .6 Hipot: standard.
- .7 Average sound level: standard
- .8 Impedance at 17 degrees C: standard
- .9 Enclosure: NEMA CSA, removable metal front panel.
- .10 Finish: in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .11 Copper windings.
- .12 Winding configuration to be as noted on drawings.
- .13 Harmonic Mitigating Phase Shifting transformers as indicated on drawings.
- .14 KL-Rated Transformers as indicated on drawings.
- .15 Voltage Regulation to be 4% or better.

2.02 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results for Electrical.

.2 Label size: 7.

3 EXECUTION

3.01 INSTALLATION

.1 Mount dry type transformers up to 75 kVA on wall with proper support from structure via threaded rod and angle irons securely attached to structure, or as indicated on drawings.

.2 Mount dry type transformers above 75 kVA on floor on housekeeping concrete pad, 4” thick.

.3 Ensure adequate clearance around transformer for ventilation.

.4 Install transformers in level upright position.

.5 Remove shipping supports only after transformer is installed and just before putting into service.

.6 Loosen isolation pad bolts until no compression is visible.

.7 Make primary and secondary connections in accordance with wiring diagram.

.8 Energize transformers after installation is complete.

.9 Make conduit entry into bottom 1/3 of transformer enclosure.

3.02 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

1 GENERAL

1.01 SUBMITTALS

.1 **Product Data**: Submit product data sheets for all products specified in this Section. Indicate compatibilities and limitations, and application instructions.

.2 **Samples:** If requested, submit identified conductor samples.

.3 **MSDS Sheets:** Submit Material Safety Data Sheets for conductor pulling lubricants.

.4 **Type "MI" Cable Certifications:** Submit a minimum of four copies of a letter from the cable manufacturer certifying proper cable installation and successful testing as specified in Part 3 of this Section, and include cable test sheets.

2 PRODUCTS

2.01 DISTRIBUTION AND BRANCH CIRCUIT CONDUCTORS

.1 Conductors to and including No. 10 AWG are to be solid. Conductors larger than No. 10 AWG are to be stranded. All conductors are to be constructed from 98% conductive copper and are to be approved for 600 volts. Conductors are to be colour coded, factory identified on the insulation with the manufacturer's name, conductor size and metal, voltage rating, and CSA type and designation. Conductors are to be as follows:

.1 "T-90 Nylon" single conductor in accordance with CSA C22.2 No. 75, Thermoplastic-Insulated Wires and Cables, 90° C (195° F) rated, PVC insulated and nylon covered

.2 "RW-90" single conductor in accordance with CAN/CSA C22.2 No. 38, Thermoset-Insulated Wires and Cable, 90° C (195° F) rated, X-link polyethylene insulated

.3 "TWU" single conductor in accordance with CSA C22.2 No. 75, -40° C (-40° F) rated, PVC insulated

.4 "AC90" flexible cable to CSA C22.2 No. 51, Armoured Cable, with 90° C (195° F) rated, X-linked polyethylene insulated conductors, a concentric ground conductor, and an interlocking aluminium armour jacket

.5 " A90 ISO-BX" flexible cable to CSA C22.2 No. 51, Armoured Cable, with 90° C (195° F) rated, X-linked polyethylene insulated conductors, a concentric bare ground conductor, an insulated ground conductor, and an interlocking aluminium armour jacket

.6 Tyco/Pyrotenax "MI" ULC 2-hour fire rated conductor in accordance with CSA C22.2 No. 124, Mineral-Insulated Cable, 90° C (195° F) rated, consisting of a solid copper conductor, magnesium oxide insulation, a seamless soft drawn copper sheath, and factory supplied Pyrotenax terminations

.7 Tyco/Raychem "RHW" cable in accordance with requirements of CSA C22.2 No. 38, Thermoset-Insulated Wires and Cables, R90 90° C (195° F) rated, consisting of a stranded copper conductor and silicone rubber insulation, ULC 2-hour fire rated when installed in metal conduit

.8 Tyco/Raychem “CI” cable in accordance with requirements of CSA C22.2 No. 208, Fire /Alarm and /Signal Cable, FAS90 shielded or un-shielded as required, 90° C (195° F) rated, consisting of a copper conductor, silicone rubber insulation, and a polyolefin outer jacket

.9 equal to Nexans Canada “Corflex” II” RA90 flexible cable in accordance with requirements of CSA C22.2 No. 123, Aluminium Sheathed Cable, consisting of single or multiple copper conductors with X-link polyethylene insulation enclosed in a liquid and vapour-tight solid corrugated aluminium sheath and, as required, an overall PVC jacket

.10 equal to Nexans Canada “Firex II” TECK 90 cable in accordance with requirements of CSA C22.2 No. l3l, Type TECK 90 Cable, consisting of single or multiple copper conductors with X-link polyethylene insulation enclosed in a liquid and vapour-tight solid corrugated aluminium sheath and, where required, an overall PV C jacket

2.02 LOW VOLTAGE (24 VOLT) CONDUCTORS

.1 “T-90” or “RW90” stranded copper conductors as specified above.

.2 Equal to Nexans Canada “Securex II” FAS/LVT/FT1300 volt wire to CSA C22.2 No. 208, Fire /Alarm and Signal Wire, 105° C (220° F) rated, consisting of solid copper conductors (stranded for control wiring), flame retardant PVC insulation, an aluminium/Mylar optional shield with a #22 AWG tinned copper insulation and a drain wire, and, if required for the application, interlocking aluminium armour with or without an overall jacket.

2.03 CONNECTORS

.1 **Conductors In Conduit:** Except as noted, equal to Ideal Industries Inc. “Wing Nut” CSA certified, 60 volt rated pressure type twist connectors.

.2 **Conductors 3/0 AWG and Larger:** Long barrel, double crimp, compression type lug connectors, unless otherwise specified.

.3 **Armoured Cable:** Except as noted, proper squeeze type connectors and plastic anti-short bushings at terminations in accordance with requirements of CSA C22.2 No. 18.3, Conduit, Tubing and Cable Fittings.

.4 **Mineral Insulated Conductors:** Tyco/Pyrotenax “Pyropak” connectors, complete with brass plates with drilled and tapped mounting holes for connections to ferrous cabinets.

.5 **Corflex/Teck Cable:** Connector and termination hardware supplied by the cable manufacturer to suit the application.

2.04 CONDUCTOR PULLING LUBRICANT

.1 Equal to Ideal Industries Inc. “Yellow 77” or “ClearGlide”, as required.

.2 French Chalk or Talcum Powder conductor pulling lubricant.

3 EXECUTION

3.01 Conform to the following conductor installation requirements:

.1 **Conductor Routing:** Conductor routing indicated on the drawings is schematic and approximate. Determine exact routing and conductor lengths at the site. Route conductors to avoid interference with other work. Unless otherwise specified or shown install conductors parallel to building lines.

.2 **Conductor Pulling:** When pulling conductors into conduit use lubricant and ensure that the conductors are kept straight and are not twisted. For isolated power centre “load” side power wiring, use only French Chalk pulling lubricant.

.3 **Securing/Supporting Conductors:** Conform to the following requirements:

.1 neatly secure exposed conductors in equipment enclosures with proper supports and/or ties

.2 support flexible armoured cable in ceiling spaces and stud walls with steel two-hole cable straps to Code requirements

.4 **Conductor Splicing:** Generally, conductor splicing is not permitted unless otherwise approved by the Consultant, and if approved splicing is subject to the following conditions:

.1 splicing is permitted to extend existing conductors

.2 for thermoplastic insulated conductors, splices are to be made within an approved electrical box with mechanical compression connectors to suit the type and size of conductors, and the box(es) are to be properly identified and locations are to be indicated on “as-built” drawings

.3 do not splice mineral insulated “MI” cable

.4 do not splice “Corflex” cable unless justified by cable pulling tension calculations and when approved by the Consultant, and, if approved, locate splices where directed by the Consultant

3.02 INSTALLATION OF DISTRIBUTION AND BRANCH CIRCUIT CONDUCTORS

.1 Provide all required conductors.

.2 **Non-Fire Rated Conductors:** Unless otherwise specified herein or on the drawings, non-fired rated conductors are to be used as follows:

.1 conductors underground inside or outside the building, and in non-climate-controlled areas – **TWU**

.2 unless otherwise specified, conductors in accessible ceiling spaces, within stud wall construction, and in furniture systems to luminaries and wiring devices – **AC90 (BX) flexible armoured cable, maximum 6 m (20’) run permitted**

.3 for isolated power system wiring – **RW90**

.4 for patient care area conductors in accessible ceiling spaces (not walls) to luminaries- **AC90 (BX) flexible armoured cable, maximum 3 m (10’) run permitted**

.5 for conductors in medical headwalls and service consoles, and as per drawing details – **T90 Nylon or RW90 in flexible conduit, or AC90 ISO-BX to Code requirements**

.6 for conductors except as specified above or elsewhere in the Specification or on the drawings – **T90 Nylon or RW90**

.3 **Fire Rated Conductors:** Unless otherwise specified herein or on the drawings, fire rated conductors are to be ULC 2 hour rated bare MI cable, or “RHW” or “CI” conductors in steel conduit, provided for service as follows:

.1 power feeders to fire protection pumps

.2 power connections to smoke ventilation/pressurization fans

.3 power feeders to emergency lighting panelboards

.4 power feeders to fire alarm panels and transponders

.5 fire alarm system risers and other feeders as shown or specified

.6 any other conductors as specified on the drawings

.4 **“MI” Mineral Insulated Conductor Installation Requirements:** Generally, install type “MI” mineral insulated conductors in accordance with the manufacturer’s instructions and recommendation, including the following:

.1 provide proper clips, wall brackets, and other support hardware either shown or required

.2 terminate the cable using connectors and installation tools supplied by the cable manufacturer

.3 terminate cable immediately after installation to avoid moisture ingress

.4 do not splice “MI” cables

.5 after installation and termination, test cable, including a meggar test, in the presence of the manufacturer’s authorized representative

.6 obtain from the manufacturer a letter stating the “MI” cable has been properly installed, tested, and is ready to be energized, and submit the letter and test result sheets to the Consultant

.5 **“Corflex” Cable Installation Requirements:** Install “Corflex” cable in accordance with the manufacturer’s instructions, including the following requirements:

.1 support and secure overhead suspended “Corflex” cable on a system of cable tray where indicated

.2 secure individual cables to cable tray, or where shown, directly to building surfaces by means of single screw non-ferrous clamps

.3 ground and bond single conductor cable at both ends where the sheath currents do not affect the cable ampacity

.4 for certain areas, where the sheath currents will reduce the cable ampacity, ground and bond the cable at the supply end and isolate the cable at the load end as recommended by the cable manufacturer, and provide a No. 3/0 AWG green TW ground conductor for each cable, all as per Section No. 10 of the Ontario Electrical Safety Code

.6 **“Teck” Cable Installation Requirements:** Install “Teck” cable in accordance with the manufacturer’s instructions, including the following requirements:

.1 support and secure overhead suspended “Teck” cable tray where indicated

.2 secure individual cables to cable tray or, where shown, directly to building surfaces by means of single screw non-ferrous clamps

.3 terminate cable with lugs and termination kits supplied with the cable

.7 **Conductor Sizing:** Generally, conductor sizes are indicated on the drawings. Unless otherwise specified, do not use conductors smaller than No. 12 AWG in systems over 30 volts. Unless otherwise specified, do not use conductors smaller than No.6 AWG for exterior luminaire wiring. Conductor sizes indicated on the drawings are minimum sizes and must be increased, where required, to suit length of run and voltage drop in accordance with the voltage drop schedule found at the end of this Section.

.8 **Conductor Colour Coding:** Unless otherwise specified, colour code conductors to identify phases, neutral, and ground by means of self-laminating coloured vinyl tape, coloured conductor insulation, or properly coloured plastic discs. Colours are to be as follows:

.1 phase A – black

.2 phase B – red

.3 phase C – blue

.4 neutral – white

.5 control – orange

.

.9 **Isolated Power System Colour Coding:** Colour code isolated power system “load” side power wiring insulation as follows:

.1 live No. 1 – brown

.2 live No. 2 – orange

.3 ground – green

.10 **Communication System Colour Coding:** Unless otherwise specified, colour code conductors for communication systems in accordance with the system manufacturer’s recommendations.

MAX. BRANCH WIRING DISTANCE FOR 120 VOLT SYSTEM AT 2% VOLTAGE DROP

Wire Size	Breaker Size (AMPERES)	15	20	30	40	50	60	70	80	100
	MAX LOAD AT 80% (AMPERES)	12	16	24	32	40	48	56	68	80
No 12.	----------	16.8	12.2	---------	---------	---------	----------	-------	----------	----------
No 10	----------	25.9	19.0	---------	---------	---------	---------	-------	---------	---------
No. 8	----------	39.6	30.4	12.9	---------	---------	---------	-------	---------	---------
No. 6	----------	62.4	47.2	32.0	23.6	19.0	16.0	-------	---------	---------
No.4	----------	99.0	73.1	50.2	38.1	30.4	24.3	21.3	19.0	---------
No. 2	----------	-------	114.3	77.2	57.9	47.2	38.8	33.5	28.9	22.8
No. 1	----------	-------	-------	96.0	73.1	57.9	47.2	42.6	36.5	27.4
No.1/0	----------	-------	-------	-------	85.3	68.5	56.3	48.7	41.9	33.5
No. 2//0	----------	-------	-------	--------	102.8	80.7	67.0	57.9	50.2	40.3
No. 3/0	----------	-------	-------	---------	---------	95.2	79.2	68.5	59.4	47.2
No. 4/0	----------	-------	-------	----------	---------	---------	92.9	79.2	70.1	56.3
250 MCM	----------	-------	-------	----------	--------	---------	102.8	86.8	76,.2	60.9
300 MCM	----------	-------	-------	----------	---------	---------	----------	100.5	88.3	70.1

NOTE: DISTANCES INDICATED IN METRES FROM PANEL TO LOAD FOR SINGLE PHASE

MAX. BRANCH WIRING DISTANCE FOR 120 VOLT SYSTEM AT 3% VOLTAGE DROP

Wire Size	Breaker Size (AMPERES)	15	20	30	40	50	60	70	80	100
	MAX LOAD AT 80% (AMPERES)	12	16	24	32	40	48	56	68	80
No 12.	----------	24.4	18.3	---------	---------	---------	----------	-------	----------	----------
No 10	----------	38.1	29.0	19.1	---------	---------	---------	-------	---------	---------
No. 8	----------	59.4	44.2	30.5	22.9	---------	---------	-------	---------	---------
No. 6	----------	91.4	70.1	47.2	35.1	28.2	23.6	-------	---------	---------
No.4	----------	-------	109.7	73.2	54.9	42.7	38.1	32.0	27.4	---------
No. 2	----------	-------	---------	114.3	85.3	68.6	57.9	50.3	41.1	35.0
No. 1	----------	-------	-------	--------	103.6	85.3	73.2	61.0	54.9	43.4
No.1/0	----------	-------	-------	-------	128.0	102.9	85.3	73.2	64.0	48.8
No. 2//0	----------	-------	-------	--------	--------	122.9	100.6	86.9	74.7	60.9
No. 3/0	----------	-------	-------	---------	---------	---------	118.1	102.1	88.4	70.1
No. 4/0	----------	-------	-------	----------	---------	---------	---------	120.4	102.9	83.8
250 MCM	----------	-------	-------	----------	--------	---------	---------	-------	114.3	91.4
300 MCM	----------	-------	-------	----------	---------	---------	----------	-------	----------	103.6

NOTE: DISTANCES INDICATED IN METRES FROM PANEL TO LOAD FOR SINGLE PHASE

END OF SECTION

1 GENERAL

1.01 SUBMITTALS

.1 **Product Data**: Submit product data sheets for products specified in this Section.

.2 **Panelboard Door Keys:** Submit identified keys (minimum 6) for panelboard doors.

2 PRODUCTS

2.01 BRANCH CIRCUIT PANELBOARDS

.1 **General Re: Panelboards:** Breaker type branch circuit panelboards are to be dead front, factory assembled panelboards designed for sequence phase connection of branch circuit breakers, as per the drawing schedule and plans, and in accordance with requirements CAN/CSA-C22.2 No. 29, Panelboards and Enclosed Panelboards Industrial Products. Comply with OESC Rule 14-014 with regards to series rated combinations of over-current protective devices and ensure that equipment in which the lower rated devices are installed are marked with a series combination interrupting rating at least equal to the available fault current., Each panelboard is to be complete with:

.1 electrical grade, 95% conductivity copper sequence phase bus mains for the full length of each enclosure

.2 a fully capacity neutral unless otherwise specified

.3 main and branch circuit conductor solderless set-screw type lugs approved for copper conductors

.4 neutral bus and main lugs at the same end, and a removable cover for main lugs

.5 a manufacturer’s nameplate which indicates panelboard characteristics including the fault current that the panelboard, including breakers, has been constructed to withstand

.2 **Panelboard Enclosures:** Panelboard enclosures, unless otherwise specified, are to be EEMAC 2 sprinkler-proof, flush or surface mounted as indicated, constructed of Code gauge galvanized sheet steel, equipped with drip shields, and factory cleaned, primed, and finished with ASA-61 light gray equipment enamel. Each enclosure is also to be equipped with:

.1 wiring gutter space on all sides in accordance with CAN/CSA-C22.2 No. 29 requirements

.2 space for future breakers an applicable and as per the drawing schedule

.3 a concealed hinged door and flush latch with keyed alike lock, and a frame with acetate cover and a circuit directory card on the inside face of the panel door

.4 mylar circuit breaker identification strips secured in place

.3 **Circuit Breakers:** Breakers are to be moulded case, bolt-on breakers in accordance with CSA/C22.2 No. 5, Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit Breaker Enclosures, calibrated for operation in a 40° C (105° F) ambient temperature, sized in accordance with the drawing schedules, and as follows:

.1 branch circuit breaker interrupting capacity is to suit the panelboard voltage and be as scheduled, or in accordance with Code requirements to suit the application

.2 odd numbered breakers on left and even on right, with each breaker identified by permanent number identification as to circuit number

.3 for ground fault breakers, CSA Class A, Group 1 combination thermal magnetic trip breakers with solid-state ground default interrupters

.4 for breakers 225 amperes and larger, a solid-state adjustable trip unit with long time, short-time, and instantaneous time functions and time delays, set a ratings in accordance with the distribution coordination study

.5 for dedicated breakers, handle lock devices

.6 as scheduled or shown, spare breakers or space for future breakers

.4 **Modification & Accessories:** Where indicated on the drawings or scheduled, panelboards are to be factory equipped with modifications and accessories as follows:

.1 a factory installed, maintenance free surge protective device (SPD) in accordance with ANSI/UL 1449, connected to the bussng through a disconnect device and equipped with a diagnostic package with status indicators on each phase, LCD six-digit surge counter display, EMI/RFI filtering, audible alarm with silence button, and Form C alarm contacts

.2 200% neutrals for panelboards equipped with SPD units and other panels as scheduled

.3 isolated ground bus for panelboards feeding electrically sensitive equipment and as scheduled

.4 insulated ground bus assembly

.5 sub-feed lugs

.6 through-feed lugs

.7 a non-automatic or automatic (as schedule) main breaker

.8 a shunt trip for the main breaker

.9 Isolated ground bus

.5 **Acceptable Manufacturers:** Acceptable Manufacturers are:

.1 Eaton Canada

.2 Schneider Electric Canada

.3 Siemens Electric Canada

3 EXECUTION

3.01 INSTALLATION OF BRANCH CIRCUIT PANELBOARDS

.1 Provide breaker type branch circuit panelboards where shown. Ensure adequate operation and maintenance clearance on all sides of each panelboard as per Code requirements.

.2 Unless otherwise specified, supply panelboards from a single manufacturer only.

.3 Wall mount panelboards independent of connected conduit. Accurately install with reference to wall finish and confirm exact locations prior to roughing-in.

.4 Where two or more panelboards are installed in one enclosure equip the panelboards with double lugs and increase gutter capacity to accommodate additional cabling.

.5 In addition to load circuit breakers scheduled and indicated for each normal power panelboard, provide five 15A-1P additional breakers for small power and miscellaneous mechanical loads, each connected with 30 m (100') of 12 mm (½") diameter EMT and two # 12 AWG plus ground, with terminations as directed during construction.

.6 In each panelboard adjacent to mechanical equipment spaces, provide a dedicated 15A-1P breaker with lock-on device, and 12 mm (½") diameter EMT and two #12 AWG plus ground terminated in an identified junction box (BAS) in the equipment space.

.7 Provide additional devices and accessories for panelboards as indicated and/or scheduled.

.8 Test each surge protection device in accordance with the manufacturer's instructions.

.9 For each GFI breaker demonstrate in the presence of the Consultant that the protected circuit will trip when a simulated ground fault is applied to the "load" side of the breaker, and meggar the "load" side neutral to ensure that the neutral is not grounded on the "load" side of the GFI.

3.02 INSTALLATION OF LOAD CENTRE PANELBOARDS

.1 Provide load centre type panelboards where shown. Ensure adequate operation and maintenance clearance on all sides of each panelboard as per Code requirements.

.2 Wall mount panelboards independent of connected conduit. Accurately install with reference to wall finish and confirm exact locations prior to roughing-in.

.3 For each GFI breaker demonstrate in the presence of the Consultant that the protected circuit will trip when a simulated ground fault is applied to the "load" side of the breaker, and meggar the "load" side neutral to ensure that the neutral is not grounded on the "load" side of the GFI.

END OF SECTION

1 GENERAL

1.01 SUBMITTALS

.1 **Shop Drawings/Product Data:** Submit shop drawings/product data sheets for all equipment specified in this Section. Shop drawings/product data is to include:

.1 any details required for site assembly and erection of the switchboard

.2 a dimensioned front view elevation and a plan view of the assembly, and a dimensioned rear-view elevation if the rear is active

.3 a single line diagram and a schematic diagram

.4 component nameplate and warning sign data

.5 short circuit ratings, voltage ratings, continuous current ratings, and interrupt ratings

.6 a mimic bus layout

.7 any additional information requested by the Consultant

.2 **Test Reports:** Submit signed copies of all test reports, and include a copy of each report with O & M Manual project close-out data.

.3 **Tools, Spare Fuses, and Maintenance Equipment**: Submit as specified in Part 3 of this Section.

.4 **Manufacturer's Installation Certification Letter**: Submit a switchboard manufacturer's installation certification letter as specified in Part 3 of this Section.

.5 **Surge Protection Device Extended Warranty**: Submit a signed copy of the surge protection device manufacturer's 4-year extended warranty, in the name of the Owner, to commence following the date of expiration of the one-year Contract warranty. The extended warranty is to be a written, full on-site parts and labour warranty with the same terms and conditions as the Contract warranty.

1.02 QUALITY ASSURANCE

.1 **Equipment Withstand Ratings**: Switchboard equipment, as applicable, is to be rated to interrupt and withstand short circuit faults greater than the available short circuit faults.

.2 **Codes and Regulations:** The switchboard and installation are to be in accordance with requirements of the following:

.1 CAN/CSA-C22.2 No. 31, Switchgear Assemblies

.2 EEMAC G8-3.2, Standard for Metal-Clad and Station Type Cubicle Switchgear

.3 ANSI/IEEE C37.20.1, Standard for Metal-Enclosed Low-Voltage Power Circuit Breaker Switchgear

.4 UL 1006, Low-Voltage AC and DC Power Circuit Breakers Used In Enclosures

.5 NEMA SG3, Low-Voltage Power Circuit Breakers

.3 Comply with OESC Rule 14-014 re: series rated combinations of over-current protective devices and ensure that equipment in which the lower rated devices is installed is marked with a series combination interrupting rating at least equal to the available fault current.

2 PRODUCTS

2.01 SECONDARY SWITCHBOARD

.1 Indoor, metal enclosed, free-standing, dead front secondary switchboard assembly in accordance with the drawing plan, elevations, schedule, and any details, and in accordance with all applicable Codes and Standards.

.2 **Enclosure:** Tamper-resistant enclosure consisting of individual sections (cells) constructed of cold rolled steel and bolted together and reinforced as necessary to form a self-supporting, self-contained structure with the necessary louvres for proper ventilation. The enclosure is to be NEMA/EEMAC Type 1 if the Electrical Room is not sprinkler protected, NEMA/EEMAC Type 2 if the Electrical Room is sprinkler protected, and finished with ANSI #61 grey enamel. The enclosure is to be complete with:

.1 **base** of 100 mm (4") structural steel channel which extends continuously around the perimeter of each section and is welded or bolted at each corner, and is equipped with removable lifting and blind tapped sockets, all finished to match the enclosure

.2 **front doors** of formed sheet steel and equipped with gasketing, concealed steel hinges with stainless steel hinge pins, and a pad-lockable handle operator and locking tabs

.3 **rear access panels** as indicated for compartment access, constructed of formed steel gasketed panels with hinges and thumb screw securement hardware

.4 **top and side panels** of formed steel panels secured to the framework and steel base

.5 **interior barriers**, full height and depth of fire retardant and non-hygroscopic material in sections where required to contain faults and minimise passage of ionized gases between sections

.6 **ventilation louvres**, storm-proof type, provided where required to maintain switchboard component ratings

.7 **door windows** for doors for interrupter switch sections and wherever else shown or specified are to be wide view type constructed from impact resistant material and located for a clear view of the component they are provided for

.8 **power and ground bus** and interconnections consisting of rectangular, square edge, hard temper, CA 110 E. T. P. high electrical conductivity copper designed so that the maximum temperature rise in any part of the switchboard will not exceed 65º C (120º F), with bolted silver plated copper-to-copper connections using, for each bolt, a 15 mm (½") diameter stainless steel bolt and nut with brass washer under the head and under the nut, and a stainless steel split lock washer between the flat washer and the nut, and the following features and components:

.1 main bus is to be installed not lower than 300 mm (12") above the switchboard base

.2 the bus supports, bus, and interconnections are to be capable of withstanding the stresses associated with short circuit current up to the maximum rating of the switchboard, including transient conditions

.3 bolted bus joints are to be tightened with a torque wrench to 47.5 Nm torque

.4 minimum 50 mm x 6 mm (2" x ¼") ground bus bolted to a nickel-plated steel bracket (minimum 1 per section), welded to the steel enclosure, and with a short time current carrying capacity equal to the short circuit rating of the switchboard assembly

.5 one grounding device per phase on the line side of each incoming load interrupter switch and on the load side of each outgoing feeder fuse

.6 two ground devices per phase, one on each side (line and load) of the metering current transformer bus connection, and one line side of the primary connection to each metering potential transformer

.7 one grounding device on the ground bus in front of each section and in the metering transformer compartments

.9 **current and potential transformers (CT's and PT's)** including Utility Ct's and PT's, of the draw-out type insulated for the full voltage rating of the switchboard, complete with current limiting fuses, ratios to suit the application, a mechanical rating equal to the momentary rating of the circuit breakers, and, for the enclosure, 2 viewing windows in the front panel/door 1 viewing window on each side for a maintenance check on the alignment of the primary disconnecting sleeves, and permanent grounding connection to the steel framework of the drawer

.10 **control wiring** in each section consisting of neatly harnessed and secured minimum #14 AWG thermoplastic insulated type "SIS" extra flexible wiring with pressure type terminal blocks with removable marking strips, and enclosed barrier type shorting blocks in the control cubicle

.11 **mimic bus, nameplates, and warning signs** with red single line vinyl mimic bus approximately 9 mm x 3 mm (⅜" x 1/8") to represent the switchboard bus and components and riveted to the front of the switchboard, engrave laminated plastic nameplates as specified, and engraved red-white laminated plastic warning signs secured in place with stainless steel screws

.12 **facilities for future cells** for installation where shown, consisting of silver-plated bus terminations drilled for future connections, gasketed and removable side panels, and, for future breakers, all necessary hardware and wiring so that only the draw-out breaker element is required

.13 **seismic restraint anchoring**, consisting of anchoring connection hardware factory installed on the switchboard to suit requirements of the electrical work Section entitled Seismic Control and Restraint

.3 **Main and Tie Circuit Breakers:** Equal to Eaton Canada Corp. "Magnum DS" electrically operated, stored energy air circuit breaker assembly mounted behind a full-sized flanged type heavy gauge steel panel with a nameplate indicating the breaker rating. No external electrical power is to be required to trip the breaker in the event of a fault or overload occurring, and the required tripping energy is to be derived from monitoring current transformers provided with the breakers. Each breaker is to consist of an operating mechanism, three pole units, and a solid-state adjustable tripping unit. Breaker hardware and features are to include:

.1 **fuses:** where current limiting is required for greater interrupter rating to suit a specific application, current limiting fuses supplied by the breaker manufacturer, including3 spare fuses for each type used

.2 **operating mechanism:** 2-step stored energy closing requiring 1 stroke of the operating handle to charge the spring, after which the breaker may be tripped by pushing a manual or electrical pushbutton or by the tripping mechanism, and complete with colour coded breaker contact position indicators, and a safety cover for the open operator to prevent inadvertent operation

.3 **emergency charging handle:** an emergency charging handle for manual charging if control power is lost, and a manual closing lever to permit closing the breaker with the compartment door closed

.4 **breaker position indicator:** a breaker position indicator, and hardware to permit pad-locking the breaker in the open position

.5 **control circuit transformer:** a 120-volt single phased fused secondary control circuit transformer for breaker closing and tripping current

.6 **breaker tripping unit:** equal to Eaton Canada Corp. Model 1150 “Digitrip” microprocessor based, continuously self-checking and monitoring tripping unit with adjustable tripping functions including but not limited to long time pick-up, long time delay, short time pick-up, short time delay, instantaneous pick-up, ground fault pick-up, ground fault delay, and the following:

.1 trip settings determined by results of the distribution system testing and coordination study specified in the electrical work Section entitled Electrical Work Testing, for coordinated protective devices throughout the distribution system

.2 three sensors, one in each phase conductor, arranged such that a trip signal from any sensor opens all 3 poles of the breaker

.3 LED indication of mode and trip and a display panel indicating the protection function settings and system data, including peak demand, present demand, and energy consumption with complete system coordination equipped with individually adjustable time/current shaping solid-state elements

.4 an integral test panel with selector switches and pushbutton

.5 an actuator that mechanically trips the breaker when a tripping pulse is emitted by the tripping unit, and test plug terminals to permit field checking of calibration

.7 **breaker fixed mounting:** for breakers as indicated or specified, fixed breaker mounting in the section or cubicle

.8 **breaker draw-out mounting”** for breakers as indicated or specified, a draw-out cradle and primary and control wiring disconnects, and the following:

.1 draw-out contacts consisting of a set of contact fingers suitably spaced on the breaker studs such that the connected position of the contact fingers engage stationary contacts to form a current carrying bridge for high pressure point silver-to-silver contacts maintained by individual short coil springs

.2 secondary disconnecting devices consisting of silver-plated floating fingers mounted on removable units engaging flat contact segments located at the rear of the compartment, with contact engagement maintained in the connected and test positions

.3 four positions consisting of connected, test, disconnected, and removal

.4 a draw-out element with worm gear levering “in” and “out” mechanism with removable lever crank, and mechanical interlocking so that the breaker has to be in the tripped position before being levered in or out of the section or cubicle

.5 hardware for pad-locking the breaker open to prevent manual or electric closing, and to secure the breaker in each of the 4 positions described above

.4 **General Re: Distribution Panelboards:** Distribution panelboards are to be dead front, factory assembled panelboards designed for sequence phase connection of branch circuit devices, as per the drawing schedule/plan, and in accordance with requirements of the electrical work Section(s) entitled Distribution Panelboards.

.5 **Surge Protection Device:** In accordance with ANSI/UL 1449 and IEEE C62.41 and .45. maintenance-free, covered by an extended 4-year parts and labour warranty as per Part 1 of this Section, and factory flush mounted in the switchboard enclosure and factory connected to bussing through an external disconnect. The maximum voltage protection rating is not to exceed 700 volts (120/208-volt system) or 1500 volts (347/600-volt system) L-N, L-G, and N-G, and peak surge current of 250 KA per phase. The device is to be complete with:

.1 a diagnostics package with status indicators on each phase

.2 an LCD surge counter display

.3 audible alarm with silence button and Form C alarm contacts

.6 **Ground Fault Protection:** As per the electrical work Section entitled Ground Fault Protection Equipment and factory installed and connected.

.7 **Meters:** Factory installed meters with the required instrument transformers, as follows:

.1 watt-hour meter

.2 demand meter with kW/hr register

.3 ammeter with phase selector switch

.4 voltmeter with phase selector switch

.8 **Safety Interlock System:** Kirk Key Interlock Co. 3 lock and 2 trapped key interlock system for protective devices as indicated

.9 **Rubber Mats:** Rubber mats with a non-slip surface, minimum 900 mm (3’) wide by 9 mm (⅜”) thick with length(s) to suit and supplied loose.

.10 **Accessories:** Supplied with the switchboard by the switchboard manufacturer, and as follows:

.1 a manual circuit breaker closing handle

.2 a circuit breaker levering crank to move a circuit breaker between test and connected positions

.3 a circuit breaker transfer truck assembly to enable a single person to remove/replace circuit breakers, with the loading platform height to suit the switchboard mounting height on a housekeeping pad, and equipped with lockable wheels, front wheels that rotate 360º, and rear wheels that do not rotate

.4 a set of tools and accessories as normally required for installation, operation and maintenance of the switchboard

.11 **Building Automation System Connection Hardware:** Switchboard manufacturer factory installed hardware or facilities for all building automation system (BAS) connections specified/indicted, and all compatible with the BAS.

.12 **Acceptable Manufacturers:** Acceptable manufacturers are:

.1 Schneider Electric Canada

.2 Eaton Electric Canada

.3 Siemens Canada

3 EXECUTION

3.01 INSTALLATION OF SWITCHBOARD

.1 Provide an electric service switchboard where shown.

.2 If shipped in sections, assemble in accordance with the manufacturer's written instructions.

.3 Secure the switchboard in place, level, and plumb, on a concrete housekeeping pad.

.4 Anchor the switchboard and support base in accordance with requirements specified in the electrical work Section entitled Seismic Control Restraint.

.5 Check all bus joint connections with a torque wrench to ensure proper tightness.

.6 Make all required conductor connections with proper terminations in accordance with the conductor manufacturer's written instructions and the requirements specified with the conductors.

.7 Ground and bond the switchboard as indicated and as per the electrical work Section entitled Grounding and Bonding.

.8 Supply a complete set of identified fuses for each fuse protected device and store in an identified wall mounted steel cabinet within the Electrical Room.

.9 If switchboard main and section/cubicle/device identification is not factory installed, install at the site using stainless steel screws.

.10 Provide continuous rubber mat on the floor for the full length of the front of the switchboard and, if the rear is accessible, for the full length of the rear of the switchboard.

.11 Supply all accessories shipped loose with the switchboard and submit as specified in Part 1 of this Section.

.12 Coordinate building automation system connections to switchboard hardware with the mechanical trade doing the BAS work. Assist as required during testing and commissioning of the BAS.

.13 **Equipment and System Manufacturer's Certification:** Refer to the article entitled Equipment and System Manufacturer's Certification in the Electrical Work General Instructions Section.

.14 **Start-Up:** Refer to the article entitled Equipment and System Start-up in the Electrical Work General Instructions Section.

.15 **Commissioning:** Commission equipment after successful start-up and submittal of reports. Refer to commissioning requirements specified in the article entitled Equipment and System Commissioning in the Electrical Work General Instructions Section.

.16 **Demonstration and Training:** Refer to the article entitled Equipment and System O&M Demonstration & Training in the Electrical Work General Instructions Section. Include for one 8-hour day of on-site operation demonstration and training for two groups of six people.

END OF SECTION

1 GENERAL

1.01 SUBMITTALS

.1 **Product Data**: Submit product data sheets for all products specified in this Section.

.2 **Panelboard Door Keys:** Submit an identified key (minimum 3) for panelboards equipped with doors.

1.02 QUALITY ASSURANCE

.1 Distribution panelboards are to be rated to interrupt and withstand short circuit faults greater than the available fault current. Indicate conformance with this requirement on product data sheets submitted for review.

2 PRODUCTS

2.01 DISTRIBUTION PANELBOARDS

.1 **General Re: Panelboards:** Distribution panelboards are to be dead front, factory assembled panelboards designed for sequence phase connection of branch circuit devices, as per the drawing schedule and plans, and in accordance with requirements of CAN/CSA- C22.2 No. 29, Panelboards and Enclosed Panelboards Industrial Products. Comply with OESC Rule 14-014 with regards to series rated combinations of over-current protective devices and ensure that equipment in which the lower rated devices are installed are marked with a series combination interrupting rating at least equal to the available fault current. Each panelboard is to be complete with:

.1 silver plated, electrical grade, 95% conductivity copper bus mains for the full length of each enclosure

.2 main and branch circuit conductor solderless lugs approved for copper conductors

.3 neutral bus and main lugs at the same end, and a removable cover for main lugs

.4 for panelboards in Elevator and/or Escalator Machine Rooms, hardware to permit padlocking the switch or breaker in the open position

.2 **Panelboard Enclosures:** Panelboard enclosures, unless otherwise specified, are to be EEMAC 2 sprinkler-proof, constructed of Code gauge galvanized sheet steel, equipped with drip shields, and factory cleaned, primed, and finished with ASA-61 light gray equipment enamel. Each enclosure is also to be equipped with:

.1 wiring gutter space on all sides in accordance with CAN/CSA-C22.2 No.29 requirements

.2 space for future breakers/switches as applicable and as per the drawing schedule, and where spare beaker space is scheduled, breaker connector kits

.3 for panelboards in areas other than secure Electrical, etc., Rooms, a concealed hinged door and flush latch with keyed alike lock

.4 for free-standing floor mounted panelboards, reinforcement as required for a rigid enclosure

.3 **Circuit Breaker Panelboards:** Breakers are to be moulded case, bolt-on breakers in accordance with CSA-C22.2 No. 5, Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit Breaker Enclosures, calibrated for operation in a 40° C (150° F) ambient temperature, sized in accordance with the drawing schedules, and complete with:

.1 a top main breaker

.2 for breakers 225 amperes and larger, a solid-state adjustable trip unit with long time, short time, and instantaneous time functions and time delays, set at ratings in accordance with the distribution coordination study

.4 **Switch and Fuse Panelboards:** Fusible switches are to be quick-make, quick-break, visible contact bolt-on switches in accordance with CSA-C22.2 No. 5, Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit Breaker Enclosures, sized in accordance with the drawing schedules, and complete with:

.1 a top main switch

.2 operating handles which protrude through the dead front enclosure, interlocked with the switch mechanism, and equipped with facilities for padlocking in either the “ON” or “OFF” position

.3 fuse clips, and HRC fuses as per the drawing schedule

.5 **Modifications & Accessories:** Panelboards are to be factory equipped with modifications and accessories as follows:

.1 200% rated neutral

.2 insulated ground bus assembly

.3 isolated ground bus assembly

.4 sub-feed lugs

.5 through-feed lugs

.6 entry plates for Corflex cable

.7 a barriered main breaker or switch

.8 a main breaker/switch through the cover key interlock

.9 an electrically held contactor in the mains, installed in a separate compartment with removable cover

.10 a shunt trip for the main breaker

.11 undervoltage release for the main breaker

.12 an alarm switch for the main breaker

.13 a surge protection package with audible alarm and silence button, From “C” relay contact, and EMI/RFI filtering providing 50 dB noise attenuation at 100 kHz

.6 **Acceptable Manufacturers:** Acceptable manufacturers are:

.1 Eaton Canada

.2 Schneider Electric Canada

.3 Siemens Electric Canada

3 EXECUTION

3.01 INSTALLATION OF DISTRIBUTION PANELBOARDS

.1 Provide distribution panelboards where shown. Ensure adequate operation and maintenance clearance on all sides of each panelboard as per Code requirements.

.2 Wall mount panelboards independent of connected conduit.

.3 Secure each free-standing panelboard, level and plumb, to a concrete housekeeping pad.

.4 Connect neutral conductors to common neutral bus with respective neutral identified.

.5 Identify each panelboard and each panelboard component with an engraved Lamacoid nameplate in accordance with requirements of the Section entitled Basic Electrical Materials and Methods. Confirm nameplate wording with the Consultant prior to manufacture. Include a printed circuit directory card in a frame with acetate cover.

END OF SECTION

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1 GENERAL

1.01 SUBMITTALS

.1 **Shop Drawings/Product Data**: Submit shop drawings and product data sheets for all equipment specified in this Section.

.2 **Test Reports**: Submit signed test reports for all testing work specified in Part 3 of this Section.

.3 **Manufacturer's Installation Certification Letter**: Submit an installation certification letter from the equipment manufacturer as specified in Part 3 of this Section.

1.02 QUALITY ASSURANCE

.1 **Codes and Standards:** Each ground fault unit is to be in accordance with requirements of the following Codes and Standards:

.1 CAN/CSA C22.2 No.144, Ground Fault Circuit Interrupters

.2 NEMA PG 2.2, Application Guide to Ground Fault Protection Devices for Equipment

.2 **Training and Instructions:** As specified in Part 3 of this Section.

2 PRODUCTS

2.01 GROUND FAULT PROTECTION EQUIPMENT

.1 Panel mounting (unless otherwise indicated) ground fault protection units(s) supplied by one manufacturer, designed to operate instantaneously at the ground current setting, and with characteristics as indicated on the drawings. Each unit it to be complete with:

.1 a ground fault sensing relay for operation at the setting indicated on the drawings, and with 120-volt control voltage

.2 an ammeter with a 0 to 5 ampere scale to indicate the ground fault current

.3 a 3-position sensitivity control switch to select the value of leakage current at which the relay will operate

.4 an identified indicating LED which is illuminated when no ground fault exists and is extinguished when a ground fault occurs or the unit is tested

.5 a manual reset switch with manual target indication and SPDT contacts for alarm and trip, and a rest button for the contacts and target

.6 a zero-sequence transformer of a type to suit the conductors involved, with 300 to 3000 mA range

.7 an artificial neutral and grounding resistor or a neutral ground resistor unit to suit the system

2.02 ACCEPTABLE MANUFACTURERS: Acceptable manufacturers are:

.1 Schneider Electric Canada

.2 Eaton Canada

.3 Siemens Canada

3 EXECUTION

3.01 INSTALLATION OF GROUND FAULT PROTECTION EQUIPMENT

.1 Provide ground fault protection equipment for electric service entrance and distribution equipment where shown.

.2 Where ground fault equipment is to be part of an assembly such as switchgear, arrange for the ground fault equipment to be shipped to the distribution equipment manufacturer's plant for factory installation.

.3 Ensure that the neutral on the load side of the sensor is not grounded, and that phase conductors including the neutral are installed through the zero-sequence transformer.

.4 Make all required conductor connections with proper terminations in accordance with the ground fault unit manufacturer's instructions and requirements.

.5 When installation is complete but before the system is energized, arrange for the manufacturer's authorized service representative to visit the site to inspect the installation, check trip settings, test operation of the units including simulated ground faults, and, when the inspections and reports have been satisfactorily completed, checked, and the equipment operates as intended, submit a copy of an inspection certification letter to the Consultant.

3.02 TRAINING AND INSTRUCTION

.1 Ground fault protection equipment operation and maintenance training is to be done by qualified manufacturer's personnel in accordance with requirements specified in the electrical work section entitled Electrical Work General Requirements, and is to consist of a minimum of 2 on-site 4-hour sessions for 6 people per session.

END OF SECTION

1 GENERAL

1.01 SUBMITTALS

.1 **Product Data**: Submit product data sheets for lighting fixtures. Include certified fixture photometric data which includes total input watts, candlepower summary, candela distribution zonal lumen summary, CIE type coefficient of utilization, and lamp type and lumen rating in accordance with CSA IESNA testing procedures.

.2 **Lighting Fixture Colour(s)**: For all lighting fixtures where the colour is to be selected after award of the Contract, submit colour charts and obtain fixture colour information in writing prior to ordering.

.3 **Spare Lamps**: Submit spare lamps as specified in Part 3 of this Section.

1.02 QUALITY ASSURANCE

.1 All lighting fixtures are to be ULC listed and/or CSA certified and labelled.

1.03 JOB SITE MOCK-UP

.1 Construct a mock-up installation, including temporary wiring connection, of a minimum of five type……. lighting fixtures where directed by the Consultant.

2 PRODUCTS

2.01 GENERAL RE: LIGHTING FIXTURES AND LAMPS

.1 Lighting fixtures and lamps are scheduled on the drawings.

.2 **Lighting Fixture Construction:** Unless otherwise specified the following requirements apply to lighting fixture construction:

.1 bodies are to be constructed of minimum #20 gauge cold rolled prime coat steel, of rigid construction and complete with knockouts as required

.2 fixtures are to be suitable in all respects for the mounting locations indicated on the drawings, and are to be complete with all required mounting hardware

.3 any fixture located in a high humidity area, i.e. swimming pool areas, must be gasketed and corrosion-resistant, regardless of what is selected on the fixture schedule

.4 unless otherwise specified, any fixture operated by means of a ballast must be equipped with its own ballast

.3 **Lighting Fixture Finish:** Unless otherwise specified, lighting fixtures are to be finished in two coats of spray applied baked white enamel applied to chemically degreased and neutralized surfaces. Reflecting surfaces are to be white with a reflectance of minimum 85%. Confirm exact colour and finish of fixtures at the submittals stage and prior to ordering.

.4 **Ballasts:** Unless otherwise specified or scheduled, ballasts are to be integral with the fixture. Ballasts are specified in the Section entitled Ballasts, Lamps, lenses and Louvres.

.5 **Lamps:** Unless otherwise specified, lamps are specified/scheduled with the fixtures they are associated with. Lamps are specified in the Section entitled Ballasts, Lamps, Lenses and Louvres.

.6 **Lenses/Louvres:** Unless otherwise specified, lenses/louvres are scheduled with the fixtures they are associated with. Lenses/louvres are specified in the Section entitled Ballasts, Lamps, Lenses and Louvres.

2.02 DISCONNECTING MEANS – FLUORESCENT FIXTURES

.1 Each fluorescent lighting fixture connected to a branch circuit with a voltage exceeding 150 volts-to-ground is to be equipped with a disconnecting means integral with the fixture that simultaneously opens all circuit conductors between the branch circuit conductors and the conductors connecting the ballast(s). The disconnect device is to be identified in a conspicuous, legible and permanent manner.

3 EXECUTION

3.01 INSTALLATION OF LIGHTING FIXTURES

.1 **General Installation Requirements:** Provide lighting fixtures and lamps where shown. Include for all required site assembly, and provide all required installation and support hardware. Additional requirements are as follows:

.1 confirm exact lighting fixture locations prior to roughing-in

.2 in finished areas, refer to architectural reflected ceiling plans and/or wall elevations

.3 in equipment rooms, shafts, and similar unfinished areas, install fixtures after the equipment is roughed-in, and shelving and similar items are installed, and do not suspend fixtures from piping, ductwork, conduit equipment, or similar items

.4 prior to roughing-in for lighting fixture installations, examine drawings and site conditions to determine that suitable space is available for the fixture installation as shown. If sufficient space is not available, notify the Consultant immediately and, if required, relocate the fixtures within reasonable distances without additional cost

.5 locate recessed downlights, troffers, and surface mounted fixtures in or on suspended tile ceilings in or on full tiles, and where ceiling tile openings are cut for fixtures, cut to exact sizes so that there are no gaps, and fixture trim completely covers the perimeter of the opening

.6 provide plaster frames for fixtures in suspended plaster or drywall ceilings

.7 use clean gloves when handling reflector cones, louvres, halogen lamps, glass sconces, and all exposed surfaces of fixtures

3.02 SUSPENDED LIGHTING FIXTURES

.1 Support all lighting fixtures in suspended ceilings from the slab or building construction above, independent of the suspended ceiling construction. Support 1.2 m (4') fluorescent fixtures with a minimum of 2 aircraft type cable supports or 2 #3 Tenso Chains. Support HID or incandescent fixtures with 1 #3 Tenso Chain or 1 aircraft type cable. All supports are to be in accordance with requirements of governing Codes and Regulations.

.2 Support continuous rows of fixtures at minimum 1.2 m (48") centres.

3.03 LIGHTING FIXTURES IN FIRE RATED CEILING CONSTRUCTION

.1 Where lighting fixtures penetrate a fire rated ceiling they are to be enclosed in an enclosure with a rating to match that of the ceiling. The enclosure is to be constructed by the trade constructing the ceiling. Ensure that conductors connecting the fixtures are fire rated type and that ceiling penetrations for conductors are properly sealed with fire stopping and smoke seal material. Fixtures installed in the fire rated enclosures are to be equipped with thermal overload protection.

3.04 LIGHTING FIXTURES ALIGNMENT

.1 Align lighting fixtures mounted in continuous rows to form straight uninterrupted lines. Alignment variation is not to exceed 6 mm (¼") in any 5 m (15') run.

.2 Align lighting fixtures mounted individually parallel and/or perpendicular to building lines.

.3 Aim accent and spot lighting as indicated and/or as directed by the Consultant, and secure the fixture positions after the Consultant's approval.

3.05 LAMPS

.1 Provide new lamps for each lighting fixture.

.2 Include a full listing of lamps in O & M Manuals.

.3 At Substantial Performance, replace all lamps used for construction lighting.

.4 Supply 15% of spare lamps for each fixture type (rounded out to a full carton if more than ⅔ of a carton), and hand to the Owner at Substantial Performance as specified in Part 1 of the Section. Identify all lamp packaging with the associated fixture type.

.5 Operate all high-pressure sodium and metal halide lamps for a "settling down" period of a continuous 100 hour burn or by 10-hour continuous burns, unless otherwise recommended by the lamp manufacturer, in which case follow the lamp manufacturer's recommendations. After the "settling down" period, take luminance measurements to confirm design specifications.

3.06 LIGHTING FIXTURES CIRCUIT WIRING

.1 Connect lighting fixtures to circuits indicated with wiring as shown/specified.

.2 Minimize the number of splices required.

3.07 EXISTING LIGHTING FIXTURES

.1 Where existing lighting fixtures are to be reused, examine the fixtures during the bidding period and include for replacing faulty ballasts, broken lenses, and any other obvious damage, include for replacing all lamps at Substantial Performance, and conform to the following requirements:

.1 disconnect existing fixtures to be reused, safely store where directed, relocate and reinstall

.2 unless otherwise directed, disconnect and remove obsolete fixtures, identify and make wiring safe, and dispose of the fixtures off-site in an approved manner

.3 if existing fixtures to be removed are equipped with ballasts that contain PCB's, engage the services of a disposal company licensed by the MOE to remove and destroy PCB ballasts, to remove the ballasts and destroy them off-site at an approved facility, and the disposal company is to be fully insured, registered, and in good standing with the WSIB, and is to issue a Certificate of Destruction upon completion of the work

3.08 CLEANING

.1 When all lighting fixture installation work is complete, clean all fixtures and lamps, and any ceiling, wall, etc., surfaces soiled as a result of the fixture installation work.

.2 If wall and ceiling surfaces are damaged as a result of the fixture installation, replace the wall or ceiling surface to the Consultant's approval.

END OF SECTION

1 GENERAL

1.01 SUBMITTALS

.1 **Product Data**: Product data submittal requirements are as follows:

.1 submit product data sheets for lighting fixtures, and include certified horizontal and vertical beam spread, beam lumens, beam efficiency, complete photometric data which includes total input watts, candlepower summary, candela distribution zonal lumen summary, CIE type, coefficient of utilization, and lamp type and lumen rating in accordance with CSA IESNA testing procedures

.2 for floodlighting fixtures, computer printout for aiming angles

.3 for pole mounted fixtures, submit documentation to confirm that the poles proposed are suitable for the steady wind velocity and wind gust velocity data for the area of installation, and for the total weight and project area of the fixtures

.4 submit complete design and construction shop drawings for pole mounted fixture concrete bases, prepared, stamped ad signed by a Professional Structural Engineer registered in the place of the work

.2 **Lighting Fixture and Accessory Colour(s)**: For all lighting fixtures and accessories where the colour is to be selected after award of the Contract, submit colour charts and obtain fixture and accessory colour information in writing prior to ordering.

.3 **Spare Lamps**: Submit spare lamps as specified in Part 3 of this Section.

1.02 QUALITY ASSURANCE

.1 All lighting fixtures and lamps are to be ULC listed and/or CSA certified and labelled.

2 PRODUCTS

2.01 GENERAL RE: LIGHTING FIXTURES AND LAMPS

.1 Lighting fixtures and lamps are scheduled on the drawings.

.2 All lighting fixtures are to be completely weatherproof, non-corrosive, suitable in all respects for the mounting locations indicated on the drawings, and are to be complete with all required mounting hardware.

.3 Unless otherwise specified, any fixture operated by means of a ballast must be equipped with its own ballast.

.4 Confirm exact colour and finish of lighting fixtures at the submittals stage and prior to ordering.

2.02 LAMPS

.1 Lamps are scheduled with the lighting fixtures and are specified in the Section entitled Ballasts, Lamps, Lenses and Louvres.

2.03 BALLASTS

.1 Ballasts are to be supplied with the lighting fixtures and are specified in the Section entitled Ballasts, Lamps, Lenses and Louvres.

2.04 POLES

.1 **Concrete Poles:** Reinforced, pre-stressed, round, tapered, spun concrete pole, plain grey finish, designed for underground wiring and for direct bury, sized as indicated on the drawings, and complete with an access hand hole with frame and cover for wiring connections 450 mm (18”) above grade, and a suitably sized grounding lug.

.2 **Steel Poles:** Hot dipped galvanized, minimum 4.5 mm (⅛”) thick steel, round or octagonal monotube style poles sized as indicated on the drawings, designed for underground wiring and mounting on a concrete base. Unless otherwise specified poles are to be tapered and complete with an access hand hole with frame and cover for wiring connections 450 mm (18”) above grade, a minimum of four non-corrosive anchor bolts and nuts with shims and tamper-proof covers, and a suitably sized grounding lug.

.3 **Aluminium Poles:** G063-T6 aluminium, minimum 3 mm (3/16”) thick, round or octagonal monotube style poles sized as indicated on the drawings, designed for underground wiring and mounting on a concrete base. Unless otherwise specified poles are to be tapered and complete with an access hand hole with frame and cover for wiring connections 450 mm (18”) above grade, a minimum of four non-corrosive anchor bolts and nuts with shims and tamper-proof covers, and a suitably sized grounding lug.

2.05 LIGHTING FIXTURE MOUNTING BRACKETS

.1 Corrosion-resistant metal brackets, cantilevered without under-braces, of sizes and styles specified with the fixtures they are required for, and complete with all required non-corrosive mounting and connection hardware.

3 EXECUTION

3.01 INSTALLATION OF EXTERIOR LIGHTING FIXTURES

.1 Provide exterior lighting fixtures where shown and in accordance with the drawing schedule. Include for all required site assembly, and provide all required installation and support hardware.

.2 Confirm exact lighting fixtures locations prior to roughing-in.

.3 Secure grade mounted building floodlighting fixtures to concrete pads set flush with finished grade.

3.02 INSTALLATION OF LIGHTING FIXTURES POLES

.1 Provide poles with mounting brackets for pole mounted lighting fixtures. For direct bury concrete poles, backfill the excavation around the pole with concrete.

.2 Secure metal poles to reinforced concrete bases. Install pole anchor bolt support hardware in the base concrete during the pour, and ensure that the hardware is properly positioned and remains properly positioned until concrete has set. Provide vandal-proof anchor bolt covers.

.3 Refer to pole concrete base detail indicated on the drawings.

.4 Ensure that all poles are true and plumb.

3.03 CONCRETE, EXCAVATION AND BACKFILL WORK

.1 Carefully coordinate concrete and excavation and backfill work with the trades performing the work.

.2 Perform all required concrete and excavation and backfill work in accordance with requirements of Division 03 and Division 31.

3.04 LIGHTING FIXTURES ALIGNMENT

.1 Aim and align building floodlighting and/or spotlighting during evening hours under the direction and to the approval of the Consultant, and secure the fixture positions after the Consultant's approval.

3.05 LAMPS

.1 Provide new lamps for each lighting fixture.

.2 Include a full listing of lamps in O & M Manuals.

.3 At Substantial Performance, replace all lamps used for construction lighting.

.4 Supply 15% spare lamps for each fixture type (rounded out to a full carton if more than two-thirds of a carton), and hand to the Owner at Substantial Performance as specified in Part 1 of the Section. Identify all lamp packaging with the associated fixture type.

.5 Operate all high pressure sodium and metal halide lamps for a "settling down" period of a continuous one hundred hour burn or by ten hour continuous burns, unless otherwise recommended by the lamp manufacturer, in which case follow the lamp manufacturer's recommendations. After the "settling down" period, take luminance measurements to confirm design specifications.

3.06 LIGHTING FIXTURES CIRCUIT WIRING

.1 Connect lighting fixtures to circuits indicated with wiring as specified. Install wiring in conduit.

.2 Minimize the number of splices required.

.3 Connect metal parts of poles with ground conductors connected to the building grounding system.

3.07 CLEANING

.1 When all lighting fixtures installation work is complete, clean all fixtures and lamps, and surfaces soiled as a result of the fixture installation work.

.2 If building surfaces are damaged as a result of the fixture installation, repair the surface to the Consultant's approval.

END OF SECTION

1 GENERAL

1.01 SUBMITTALS

.1 **Product Data:** Submit product data sheets for emergency lighting. Include complete battery charger data, battery charger and discharge voltage/time characteristics, and, where required, certified wiring diagrams.

.2 **Battery Warranty:** Submit a copy of the battery warranty specified below, and include a copy in the O & M Manual.

.3 **Letter of Certification:** As per Part 3 of this Section, submit a letter from the representative of the emergency lighting manufacturer to certify that the installation has been tested and adjusted and operates as intended.

1.02 QUALITY ASSURANCE

.1 All emergency lighting is to be CSA certified in accordance with:

.1 CSA C22.2 No. 141, Unit Equipment for Emergency Lighting

.2 UL 924, Standard for Emergency Lighting and Power Equipment

.3 CSA C22.2 No. 107.2, Battery Chargers

1.03 WARRANTY

.1 For batteries, the Contract warranty is to be extended to ten years with no-charge replacement during the first five years, and a pro-rate charge during the last five years. Submit a signed copy of the warranty in the name of the Owner.

2 PRODUCTS

2.01 SELF-CONTAINED EMERGENCY LIGHTING UNITS

.1 Lumacell Inc. Model RG123S200 solid-state, factory assembled and tested, 120-volt AC input, 12-volt DC output, battery operated emergency lighting units, each capable of supplying the specified load for the length of time indicated, and to automatically shut-off. Each unit is to be complete with:

.1 a white enamelled steel cabinet suitable for shelf or direct wall mounting, with conduit knock-outs and a removable or hinged front panel for battery access

.2 white enamelled steel mounting and support hardware to suit installation locations indicated

.3 a sealed, maintenance-free battery in a high-impact, heat resistant translucent plastic casing

.4 a multi-rate, voltage/current regulated, inverse temperature compensated, short circuit protected pulse type battery charger with a regulated output of ± 0.01 volts for ± 10% input variations, transfer circuit, solid-state modular low voltage disconnect to operate at 80% battery output voltage, and a suitable length of 3-wire power cord with “twist-lock” plug

.5 signal lights for “AC POWER ON” and red “HIGH CHARGE”, an ammeter and a voltmeter, a test switch, time delay relay, battery disconnect device, RFI suppressors, and AC input and DC output terminal blocks inside the cabinet

.6 cabinet mounted, dual, adjustable (345° horizontal and 180° vertical) lamp heads, integral with the cabinet and/or remote mounting as indicated, each complete with a 13-watt tungsten-halogen glare-free lamp

.7 Lumacell Inc. Model MT1 remote surface mounted lamp head with a 12-volt DC 9-watt tungsten-halogen lamp

.8 Lumacell Inc. Model MT1 remote recess mounted lamp head with a 12-volt DC 25-watt tungsten-halogen lamp

.9 where indicated, a wire guard

.2 Acceptable manufacturers are:

.1 Lumacell Inc.

.2 Emergi-Lite Ltd.

.3 Hubbell Inc. “Dual-Lite”

.4 Philips “LightGuard”

2.02 CENTRAL EMERGENCY LIGHTING SYSTEM

.1 Lumacell Inc. CSA certified, central DC battery operated emergency lighting system with remote fixtures, and characteristics as follows:

.

.1 **battery fully charged voltage and capacity:** 24 volts DC with a total capacity of ……watts for …… hours minimum and to produce not less than 91% of nominal DC system voltage with the AC supply off

.2 **battery charger input** ……volts AC, ……phase, ……wire grounded, 60 Hz

.3 **battery charger output:** ……amperes DC with ripple voltage less than 2%

.2 **Batteries:** Sealed lead-acid batteries capable of being recharged in twenty-four hours to not less than 95% of full charge after discharge with no harmful effects including leaking or foaming of electrolyte, and capable of delivering the specified output in ambient temperatures between 20° C (68° F) to 40° C (104° F). Batteries are to be complete with:

.1 battery-to-battery and rack tier-to-tier braided copper connectors

.2 a torque wrench for connector bolts and nuts, self-adhesive numbers for battery identification, battery lifting straps, no-oxide grease, and a wall mounting cabinet with hinged door and latch sized to accommodate the non-installed accessories

.3 **Battery Rack:** Free standing welded steel angle framework with all welds ground smooth, steel channel tier rails bolted to the frames with corrosion-resistant bolts and nuts, sized to suit the number of batteries required, configured to permit removal of a battery without removing any other battery, and complete with:

.1 the bottom tier a minimum of 120 mm (4¾) above the floor and the top of the rack not more than 2 m (7') above the floor

.2 rubber strips to insulate batteries from tier rails

.3 rubber sheet to insulate the rack assembly from the floor

.4 a corrosion resistant epoxy paint finish on cleaned and primed metal surfaces

.4 **Battery Charger:** Automatic battery charger to maintain the batteries in a fully charged state with AC power available, capable of maintaining DC float voltage with ± 1% of setting, no load to full load, during mains voltage variations of +10% to -15% and frequency variations of ± 5%, and with performance characteristics and features as follows:

.1 an AC input circuit breaker

.2 equalize the charging rate such that after the batteries have provided full power output for the specified duration, the charger will return the batteries to 95% fully charged state in eight hours

.3 automatically equalize the charging circuit to initiate equalized charging of the batteries for twenty-four hours after discharge of 5% of the ampere-hour battery rating

.4 facilitate manual equalized charging features with an automatic timer adjustable from 0 to 24 hours, to return the unit to float charge

.5 facilitate manual adjustment of the equalizing charge voltage

.6 automatic current limiting adjustable between 80% and 120% of the normal voltage rating

.7 an audible noise level of maximum 65 dBA at 1.5 m (5')

.8 a switchboard type DC voltmeter and DC ammeter, both with an accuracy of ± 2% of full scale, to measure rectifier output voltage and current

.9 all required hardware and circuity for the following alarms:

.1 AC power failure with time delay to prevent alarm during short power outages

.2 low DC voltage alarm

.3 high DC voltage alarm and high DC voltage automatic shut-down

.4 no-charge alarm to indicate that the charger has no DC output

.5 ground detector relay and alarm

.10 an audible alarm and visual alarm LED's for all alarms listed above except ground detector alarm, a common alarm LED test switch, and a common Form C alarm contact

.11 a twenty-eight-day automatic reset type equalizing timer for unattended stations

.12 a filter to reduce ripple voltage in the rectifier output from 2% to 30 mV

.13 a circuit breaker distribution panel sized to suit the connected loads and equipped with three spare breakers, breaker identification, and a circuit directory card filled in by a printer

.14 battery cables and clips

.5 **Battery Charger Enclosure:** Free-standing, minimum #14-gauge sheet steel EEMAC 2 enclosure with facilities for handling with a forklift or a sling, and the following:

.1 convection ventilation

.2 a dead front latched front door with full length piano hinge

.3 a corrosion resistant epoxy paint finish on cleaned and primed metal surfaces

.4 battery charger LED's, meters, and LED test switch mounted on the front panel door, complete with identification

.6 **Emergency Lighting Fixtures:** Unless otherwise shown or specified emergency lighting fixtures are to be as follows:

.1 Lumacell Inc. Model MT1 remote surface mounted lamp head with a 12-volt DC 9-watt tungsten-halogen lamp

.2 Lumacell Inc. Model RS22 remote recess mounted lamp head with a 12-volt DC 25-watt tungsten-halogen lamp

.7 **Acceptable Manufacturers**: Acceptable manufacturers are:

.1 Lumacell Inc.

.2 Emergi-Lite Ltd.

.3 Hubbell Inc. "Dual-Lite"

.4 Phillips "LightGuard"

3 EXECUTION

3.01 INSTALLATION OF SELF-CONTAINED EMERGENCY LIGHTING UNITS

.1 Provide self-contained emergency lighting units where shown. Include for all required site assembly, provide all required installation and support hardware, and plug the assemblies into adjacent receptacles. Confirm exact locations prior to installation.

.2 Where remote lamp heads are indicated, install and connect to the battery unit with conductors (sized as indicated) in conduit. Ensure that panelboard breakers serving battery units are equipped with lock-on devices.

.3 Connect exit light 12-volt DC lamp holders to battery units with wiring in conduit as indicated.

.4 Provide all required lamps.

.5 Aim all adjustable lamp heads to the Consultant's approval.

.6 When all installation work is complete, clean all battery units, lamp heads, and lamps, and any ceiling, wall, etc., surfaces soiled as a result of the installation work.

.7 If wall and ceiling surfaces are damaged as a result of the installation, replace the wall or ceiling surface to the Consultant's approval.

.8 Test operation of each battery unit, including charge rate after discharge, in the presence of the manufacturer's representative, and submit a letter from the manufacturer's representative to certify that all battery units and lamp heads have been tested and operate as intended.

3.02 INSTALLATION OF CENTRAL BATTERY EMERGENCY LIGHTING SYSTEM

.1 Provide a central battery-operated emergency lighting system as shown on the drawings.

.2 Secure the battery rack in place where shown and install batteries on the rack.

.3 Clean battery posts and connectors, apply no-oxide grease, and install battery-to-battery and tier-to-tier cable connectors. Tighten with a torque wrench to the battery manufacturer's instructions.

.4 Install the battery charger on a concrete housekeeping pad, and connect the input terminals to the AC source and the DC output terminals to the batteries.

.5 Install emergency lighting fixtures and lamps where shown. Confirm exact locations prior to roughing-in. Connect to the battery charger assembly distribution panelboard with conduit and conductors as indicated.

.6 When installation is complete, arrange and pay for the system manufacturer's representative to attend at the site, as required, to supervise/perform the following:

.1 check battery voltage and electrolyte specific gravity to confirm that the batteries are in accordance with the manufacturer's requirements

.2 energize the battery charger and float charge the batteries for 8 hours to confirm that the batteries are fully charged and in stable condition

.3 discharge the batteries to full discharge condition, then re-charge while recording DC voltage and current once per hour for eight hours

.4 charge the batteries to full charge, then continue charging to ensure that the charger switches from equalize rate to float charge rate, and demonstrate that the automatic timer controls charging and correctly transfers from equalize to float rate charge after the selected time period

.5 simulate faults to demonstrate all visual and audible alarms are operating properly

.6 at the end of the tests and with the batteries in a fully charged condition, operate the charge on "float" for a minimum period of twenty-four hours to confirm stable condition is reached and held

.7 confirm proper operation of all emergency fixtures, and perform any aiming required by the Consultant

.8 submit a letter from the system manufacturer's representative to certify correct installation and operation of the system

END OF SECTION

1 GENERAL

1.01 SUBMITTALS

.1 **Shop Drawings/Product Data**: Submit product data sheets for exit lighting fixtures.

1.02 QUALITY ASSURANCE

.1 All exit lighting fixtures are to be CSA certified in accordance with:

.1 CAN/CSA- C22.2 No. 141, Unit Equipment for Emergency Lighting

.2 CAN/CSA- C860, Performance of Internally-Lighted Exit Signs

2 PRODUCTS

2.01 EXIT LIGHTS

.1 Recessed, wall end to wall, or ceiling mounted, single or double face exit lights as indicated, complete with directional arrows as shown, 120 volt maximum five watt LED'S designed for a minimum of 50,000 hours of continuous operation without re-lamping and located so as to be visible, all required mounting accessories, and the following:

.1 an average exit legend illumination level of 15 cd/m²

.2 an emergency power source

.3 unless otherwise specified, a 1.0 mm (1/25") thick satin aluminium, enamel finish cold rolled steel, or brush finish extruded or die-cast aluminium housing, all as per the drawing schedule

.4 unless otherwise specified, white enamelled die-formed cold rolled steel or cast aluminium alloy back and/or face plates, as per the drawing schedule

.5 minimum 150 mm (6") high, 20 mm (¾") wide red "EXIT" lettering, or "EXIT" and "SORTIE" lettering as specified

.6 a white glass or translucent acrylic downlight in the bottom of the fixture

.7 a third lamp socket for an emergency lamp lighting circuit

.8 a wire guard where indicated

.9 for self-powered exit lights, a dust-tight relay transfer and maintenance free nickel-cadmium battery with low voltage disconnect, charger, high charge rate and brownout features

.10 for water-proof exit lights, a gasketed water-tight housing

.2 **Acceptable Manufacturers:** Acceptable manufacturers are:

.1 Lumacell Inc.

.2 Emergi-Lite Ltd.

.3 Philips “LightGuard”

.4 Canlyte Inc. “Uniglo”

.5 Hubbell Inc. “Dual-Lite”

.6 Luxnet Corp.

3 EXECUTION

3.01 INSTALLATION OF EXIT LIGHTS

.1 Provide exit lights where shown. Include for all required site assembly, and provide all required installation and support hardware.

.2 Confirm exact exit light locations prior to roughing-in, and in any case, ensure that exit lights are not less than 2 m (6½’) from the underside of the fixture to the finished floor.

.3 For ceiling mounted exit lights in areas with unfinished ceilings, mount the fixture alongside a junction box, with or without canopy, and connect the fixture laterally with conduit (or with embedded conduit where permitted or specified) or by using the exit light canopy as a junction box where permitted.

.4 Connect exit lights to circuits indicated with wiring as specified. Install wiring in conduit. Ensure that panelboard breakers serving exit lights are equipped with lock-on devices.

.5 Connect emergency power sockets to the emergency power source as indicated and/or specified.

.6 Provide all required lamps. Lamps are specified in the Section entitled Ballasts, Lamps, Lenses and Louvres.

.7 When all exit light installation work is complete, clean all fixtures and lamps, and any ceiling, wall, etc., surfaces soiled as a result of the installation work.

.8 If wall and ceiling surfaces are damaged as a result of the installation, replace the wall or ceiling surface to the Consultant’s approval.

END OF SECTION

1 GENERAL

1.01 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 two-stage 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.

1.02 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.

1.03 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.

.1 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 s Territory ies _____ of _____, 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 15working days to prior to final inspection.

.4 Submit following:

.1 Manufacturer's Data for:

.1 Control panel and modules.

.2 Storage batteries.

.3 Battery charger.

.4 Manual pull stations.

.5 Heat detectors.

.6 Open-area smoke detectors.

.7 Duct smoke detectors.

.8 Alarm bells.

.9 Alarm horns.

.10 Visible appliances.

.11 Main annunciator.

.12 Remote annunciator panel.

.13 Graphic annunciator panel.

.14 Combination auxiliary transmitter and interface panel.

.15 Freeze protection thermostatic switch.

.16 Valve tamper switches.

.17 Wiring.

.18 Ground rods.

.19 Conduit.

.20 Outlet boxes.

.21 Fittings for conduit and outlet boxes.

.22 Trouble bell buzzer.

.23 Surge suppression devices.

.24 Mark data which describe more than one type of item to indicate which type will be provided.

.25 Submit 1original 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 Instructions for operation:

.1 Projected beam smoke detector.

.5 Schedules:

.1 Conductor wire marker schedule.

.6 Test Reports:

.1 Open-area 2-wire smoke detectors.

.2 Preliminary testing:

.1 Final acceptance testing.

.2 Submit for inspections and tests specified under Field Quality Control.

1.04 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 To Canadian Forces Fire Marshal approval.

.4 Extra Materials:

.1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.

.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 Departmental Representative DCC Representative Consultant.

1.05 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.

.2 Waste Management and Disposal:

.1 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.

2 PRODUCTS

2.01 MATERIALS

.1 Equipment and devices: ULC listed and labelled and supplied by single manufacturer.

.1 Power supply: to CAN/ULC-S524.

.2 Audible signal devices: to CAN/ULC-S525.

.3 Visual signal devices: to CAN/ULC-S526.

.4 Control unit: to CAN/ULC-S527.

.5 Manual pull stations: to CAN/ULC-S528.

.6 Thermal detectors: to CAN/ULC-S530.

.7 Smoke detectors: to CAN/ULC-S529.

.8 Smoke alarms: to CAN/ULC-S531.

2.02 SYSTEM OPERATION

.1 Provide complete, electrically supervised, code 3 temporal common coded, manual and automatic, zoned, annunciated, fire alarm system.

.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.

.6 Fire standpipe 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 fire alarm transmitter monitoring station.

.3 Zone of alarm device to be indicated on control panel and remote annunciators.

.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 Electro-magnetic 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.

.5 Two stage operation: operation to actuation following:

.1 Manual station.

.2 Heat detector.

.3 Smoke detector.

.4 Automatic fire sprinkler system.

.5 Fire extinguishing system.

.6 Fire standpipe system.

.6 Actuation of two stage operation device to initiate following:

.1 Audible signal devices throughout building to sound at 20 strokes per minute.

.2 Audible signal devices in zone of alarm and adjacent zones on same floor level zones on floor level immediately above and floor level immediately below to sound continuously while other audible signal devices throughout building sound at 20 strokes per minute.

.3 Zone of alarm to be indicated on control panel and remote annunciator.

.4 Transmit signal to fire department via fire alarm transmitter monitoring station.

.5 Air conditioning and ventilating fans to shut down or to function so as to provide required control of smoke movement.

.6 Fire doors and smoke control doors if normally held open, to close automatically.

.7 Electro-magnetic door holders to de-energize.

.8 Operations to remain in alarm mode (except alarm notification appliances if manually silenced) until system is manually restored to normal.

.7 Operation of alarm initiating device on second stage to:

.1 Cause audible signal devices throughout building to sound continuously.

.8 Capability to program smoke detector status change confirmation on any or zones in accordance with CAN/ULC-S527, Appendix C.

2.03 CONTROL PANEL

.1 Class A B.

.2 Single Two stage operation.

.3 Zoned Non-zoned.

.4 Coded Non-coded.

.5 Enclosure:

.1 CSA Enclosure 1, c/w lockable concealed hinged door, full viewing window, flush lock and 2 keys.

.2 Provide modular type panel installed in flush surface mounted steel cabinet with hinged door and cylinder lock.

.3 Mount with panel centreline 1.5 m above finished floor elevation.

.4 Switches and other controls: not accessible without use of key.

.5 Design of control panel: neat, compact assembly containing parts and equipment required to provide specified operating and supervisory functions of system.

.6 Control panel components: CSA approved and approved by control panel manufacturer for use in control panel.

.7 Panel cabinet: finished on inside and outside with factory-applied enamel finish.

.8 Provide main annunciator located on exterior of cabinet door or visible through cabinet door.

.9 Provide audible trouble signal.

.10 Provide permanent engraved rigid plastic metal identification plates, silk-screened labels attached to rear face of panel viewing window, for lamps and switches.

.11 Provide 1 set of Form C dry alarm contacts per zone, common system Form C dry alarm contact, and common system Form C dry trouble contact. Indicate set/unset condition of master box auxiliary transmitter by control panel.

.12 Permanently label switches.

.13 Provide panel with following switches:

.1 Trouble silencing switch which silences audible trouble signals including remote trouble devices without extinguishing trouble indicating lamp(s).

.1 For non-self-resetting type switch: Upon correction of trouble condition, audible signals will again sound until switch is returned to its normal position.

.2 For silencing switch of momentary action self-resetting type: trouble signal circuit automatically restored to normal upon correction of trouble condition.

.2 Evacuation alarm silencing switch which when activated will silence alarm notification appliances without resetting panel, and cause operation of system trouble signals. Subsequent alarm(s) from additional zone(s) not originally in alarm to cause activation of notification appliances even with alarm silencing switch in "silenced" position.

.3 Individual zone disconnect switches which when operated will disable only their respective initiating circuit and cause operation of system and zone trouble signals.

.4 Reset switch which when activated will restore the system to normal standby status after cause of alarm has been corrected, and activated initiating devices reset.

.5 Operation of reset switch to restore activated smoke detectors to normal standby status.

.6 Lamp test switch.

.7 Drill switch which will enable test of notification appliances and restoration to normal without tripping master box.

.8 Master box disconnect switch which when activated will disconnect coded device and cause operation of system trouble signal.

.9 HVAC shutdown bypass switch. Operation of the switch to allow HVAC system to operate with detectors in alarm and cause operation of system trouble signals.

.6 Supervised, modular design with plug-in modules:

.1 Alarm receiver with trouble and alarm indications provision for remote supervised annunciation, for class A B initiating circuit.

.2 Spare zones: compatible with smoke detectors and open circuit devices.

.3 Space for future modules.

.4 Latching type supervisory receiver circuits. Discrete indication for both off-normal and trouble.

.7 Components:

.1 Coded alarm receiver panel with trouble and alarm indications for class A B initiating circuit.

.2 Single stage alarm pulse rate panels:

.1 Single stroke control type for output to signal control panel continuously.

.3 Two stage alarm pulse rate panel for single stroke output to signal control panel. First stage-20 strokes per minute, second stage continuous.

.4 Common control and power units:

.1 Control panel containing following indications and controls:

.1 "Power on" LED (green) to monitor primary source of power to system.

.2 "Power trouble" indication.

.3 "Ground trouble" indication.

.4 "Remote annunciator trouble" indication.

.5 "System trouble" indication.

.6 "System trouble" buzzer and silence switch c/w trouble resound feature.

.7 System reset switch.

.8 "LED test" switch if applicable.

.9 "Alarm silence" switch to silence signals manually. If new alarm occurs after signals have been silenced, signals to resound.

.10 ."Signals silenced" indication.

.2 Master power supply panel to provide 24 V dc to system from 120 V ac, 60 Hz input.

.3 Fire department connections:

.1 Plug-in module for tripper shunt type municipal box.

.2 Fire department bypass switch c/w indicator for trouble at panel.

.4 Auxiliary relays: plug-in type, dust cover, supervised against unauthorized removal by common trouble circuit and c/w individual bypass switch.

.1 Contacts: 2.0 A, 120 V ac, for functions such as release of door holders or initiation of fan shut down.

.2 Contact terminal size: capable of accepting 22-12 AWG wire.

2.04 POWER SUPPLY

.1 120 V, ac, 60 Hz input, 24 V dc output from rectifier to operate alarm and signal circuits, with standby power of gell cell batteries minimum expected life of 4 years, sized in accordance with NBC.

2.05 MANUAL ALARM STATIONS

.1 Provide non-coded single double 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 semi-flush mounted and interior weatherproof 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 engraved raised-letter plastic metal bilingual English French signage indicating "FIRE ALARM" with white letters of 19 mm high.

2.06 AUTOMATIC ALARM INITIATING DEVICES

.1 Heat detectors: provide heat detectors designed for detection of fire by combination fixed temperature rate-of-rise rate compensating line-type fixed temperature principle.

.2 Combination Fixed Temperature Rate-Of-Rise Detectors (Spot Type): designed for surface semi-flush 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 Rate Compensating Detector (Spot Type): designed for surface flush vertical unit outlet box mounting and supported independently of conduit, tubing or wiring connections.

.1 Detectors: hermetically sealed and automatically resetting type which will operate when ambient air temperature reaches detector setting regardless of rate of temperature rise.

.2 Detector operation: not be subject to thermal time lag.

.4 Line-Type Fixed Temperature Detectors: provide thermostatic or thermistor line-type heat detection cable with weather-resistant outer covering where indicated.

.1 Cable: nominally rated for temperature of 6888 138 degrees C and operate on fixed temperature principle.

.5 Open-Area Smoke Detectors: provide detectors designed for detection of abnormal smoke densities by ionization photoelectric principle.

.1 Detectors: 4-wire 2-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 located above suspended ceilings, beneath raised floors, 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).

.6 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.

.7 2-Wire Smoke Detectors: detector circuits of 2-wire type capable of transmitting detector operating power over initiating circuit are permitted, provided detectors used are approved by control panel manufacturer for use with control panel provided and are ULC listed as being compatible with control panel.

.1 Total number of detectors on any detection circuit: not exceed 80% of maximum number of detectors allowed by control panel manufacturer for that circuit. Provide additional zones if required to meet this requirement.

.8 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.

.9 Photoelectric Detectors: operate on light scattering principle using LED light source.

.1 Detector: respond to both flaming and smouldering fires.

.10 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 meters or larger in area.

.11 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.

.12 Temperature rating of detectors: in accordance with NFPA 72.

.13 Locate detectors minimum 300 mm to lighting fixtures and not closer than 600 mm to air supply or return diffuser.

.14 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.

.15 Provide detectors with terminal screw type connections.

.16 Removal of detector head from its base to cause activation of system trouble signals if detectors are provided with separable heads and bases.

2.07 ALARM INITIATING DEVICE SPACING AND LOCATION

.1 Detector spacing and location: in accordance with manufacturer's recommendations and requirements of NFPA 72.

.2 Provide at least 2 detectors in rooms of 54 square meters or larger.

.3 Spacing: not to exceed 9 m by 9 m per detector, and 9linear m per detector along corridors.

.4 Locate detectors minimum 0.9 1.5 m from air discharge or return grille, and not closer than 300 mm to lighting fixtures.

.5 In areas without finished ceilings, mount detectors at underside of deck above unless otherwise indicated.

.6 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.

2.08 AUDIBLE SIGNAL DEVICES

.1 Provide remote system trouble 100mm bell buzzer arranged to operate in conjunction with panel's integral trouble signal.

.2 Locate remote trouble bell buzzer as indicated.

.1 Provide 100 mm trouble bell external trouble buzzer at control panel arranged to operate in conjunction with panel's integral trouble signal.

.2 Provide trouble bell buzzer 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: flush surface recessed mounted, single stroke, polarized, 24 V dc, 100 150 250 mm, _____ db.

.2 Signal chimes: heavy duty, single stroke, 24 V dc, with solid striking plunger and resonating chamber, _____ db.

.3 Bells: vibrating motorized type, gongs of special alloy steel, 24 V dc, 100 150 250 mm, _____ db.

.4 Horns: _____ db, weatherproof mounting, 24 V dc.

.5 Mini-horns: _____ db, surface flush mounting, red beige colour, 24 V dc.

.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.

2.09 END-OF-LINE DEVICES

.1 End-of-line devices to control supervisory current in alarm circuits and signalling circuits, sized to ensure correct supervisory current for each circuit. Open , short or ground fault in any circuit will alter supervisory current in that circuit, producing audible and visible alarm at main control panel and remotely as indicated.

2.10 REMOTE ANNUNCIATOR PANELS

.1 Provide panels where indicated mounted 1.5 m above finished floor elevation.

.2 Panels: duplicate requirements for control panel annunciator, with exception of individual trouble lamps are not required.

.3 LED type with designation cards to indicate zone.

.4 LEDs to annunciate alarm and trouble.

.5 Wired in multiple with main control panel and with other remote annunciator panels.

.6 Supervised, including trouble signal for open circuit.

.7 LED test button.

2.11 GRAPHIC ANNUNCIATOR PANEL

.1 Provide panel located as shown.

.2 Mount with panel centreline 1.5 m above finished floor elevation.

.3 Panel: interior weatherproof type, flush surface pedestal-mounted.

.4 Panel: provided with building room floor plan, drawn to scale, with alarm lamps mounted to represent location of each concealed detector each initiating device.

.5 .Panel graphic: 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.

.6 .Label principal rooms and areas shown with room numbers titles.

.7 .Provide detectors mounted above ceilings on ceilings, beneath raised floors and different types of initiating devices with different symbols lamps of different colours 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 Flush-mounted assembly of stroboscopic type suitable for use in electrically supervised circuit and powered from notification appliance circuits.

.2 Appliances: minimum of 15 30 75 110 candela measured as approved by ULC, but not less than effective intensity required by National Building Code of Canada for appliance spacing and location shown.

.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 as indicated.

.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 close 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 centreline 1.5 m above finished floor.

.4 Provide with insulating subbase when mounting on exterior wall.

2.14 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.

2.15 ELEVATOR INTERFACE

.1 Provide addressable relays adjacent to the elevator controller to provide inputs to the controller program to operate based on smoke detector activation.

.2 Provide relay based smoke detector around elevator (as indicated) to provide inputs to the elevator controller.

.3 Coordinate fire alarm interface with elevator.

2.16 GROUNDING

.1 Ground each master box transmitter by connection from grounding terminal connection of box to either driven ground rod or buried, metallic water pipe.

.1 Resistance to ground: not exceed 10 ohms.

.2 Ground rods: sectional type, copper-encased steel, with minimum diameter of 19 mm and total length of 3 m.

.3 Rods: hard, clean, smooth, continuous copper surface throughout rods length.

.4 Copper: minimum wall thickness of 0.325mm at any point on rod.

.5 Ground rods: not to protrude more than 75 mm above grade.

2.17 LOCATION LIGHT

.1 Provide vapor tight type fixture constructed of cast aluminum housing and unbreakable, heat resistant, threaded ruby globe.

.2 Support light with 12 mm minimum galvanized steel conduit screwed into hub on top of master box.

.3 Locate light approximately 300 mm above master box.

.4 Mount light in pendant position.

.1 Provide light with screw-in, 9-watt minimum compact fluorescent lamp with integral ballast.

2.18 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.

2.19 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 12 AWG minimum solid copper conductor.

.5 Insulation 75 degrees C minimum with nylon jacket.

.6 For underground or wet allocations cable from control panel to master box auxiliary transmitter and to telegraphic loop: type UF.

.7 Colour code wiring.

2.20 SURGE SUPPRESSION

.1 Provide line voltage and low voltage surge suppression devices to suppress voltage transients which might damage control panel and transmitter components.

.2 Mount suppressors in separate enclosure(s) adjacent to control panel and transmitter unless suppressors are specifically UL approved for mounting inside control panel and transmitter provided and approved for such use by control panel and transmitter manufacturers.

2.21 LINE VOLTAGE SURGE SUPPRESSOR

.1 Suppressor : ULC approved with maximum 330 volt clamping level and maximum response time of 5 nanoseconds.

.2 Suppressor: multi-stage construction which includes inductors and silicon avalanche zener diodes.

.3 Equip suppressor with long-life indicating lamp light emitting diode neon lamp which extinguishes upon failure of protection components.

.4 Fuses: externally accessible.

.5 Wire in series with incoming power source to protected equipment using screw terminations

2.22 LOW VOLTAGE SURGE SUPPRESSOR

.1 Provide surge suppression for circuits which 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 volt clamping level and maximum response time of 5 nanoseconds.

.4 Suppressor: multi-stage construction and both differential and common mode protection.

2.23 AS-BUILT RISER DIAGRAM

.1 Fire alarm system riser diagram: in glazed frame on black lamicoid sheet with bevelled edges, white lettering and designations, minimum size 600 x 600 mm. .

2.24 ANCILLARY DEVICES

.1 Remote relay unit to initiate fan shutdown.

3 EXECUTION

3.01 MANUFACTURER'S INSTRUCTIONS

.1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.02 INSTALLATION

.1 Install systems in accordance with CAN/ULC-S524 and TB OSH Chapter 3-04.

.2 Install main control panel and connect to ac power supply, ac dc standby power.

.3 Locate and install manual alarm stations and connect to alarm circuit wiring.

.4 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.

.5 Connect alarm circuits to main control panel.

.6 Locate and install signal bells chimes horns and visual signal devices and connect to signalling circuits.

.7 Connect signalling circuits to main control panel.

.8 Install end-of-line devices at end of alarm and signalling circuits.

.9 Install remote annunciator panels and connect to annunciator circuit wiring.

.10 Locate and install door releasing devices.

.11 Locate and install remote relay units to control fan shut down.

.12 Sprinkler system: wire alarm and supervisory switches and connect to control panel.

.13 Room detection system including Halon 1301.

.1 Locate and install detectors. Make necessary connections between room detection panel and main fire alarm panel.

.2 Locate and install audible signals visual alarms.

.3 Locate and install detectors under raised floor. Fasten to steel brackets approximately 300 mm above sub-floor level to clear cables and conduits.

.4 Locate and install gas discharge stations. Connect valves on Halon system to room detection panel.

.14 Connect fire suppression systems to control panel.

.15 Confirm connections to elevator controller with elevator installer. Test all smoke detectors for proper inputs to elevator.

3.03 FIELD QUALITY CONTROL

.1 Site Tests:

.1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electricaland CAN/ULC-S537.

.2 Fire alarm system:

.1 Test each device and alarm circuit to ensure manual stations, thermal and smoke detectors sprinkler system Halon system transmit alarm to control panel and actuate first stage alarm general alarm ancillary devices.

.2 Check annunciator panels to ensure zones are shown correctly.

.3 Simulate grounds and breaks on alarm and signalling circuits to ensure proper operation of system.

.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 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 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 Verification requirements in accordance with Section 01 47 17 - Sustainable Requirements: Contractor's Verification, 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.

3.04 TRAINING

.1 Arrange and pay for on-site lectures and demonstrations by fire alarm equipment manufacturer to train operational personnel in use and maintenance of fire alarm system.

3.05 CLEANING

.1 Proceed in accordance with Section 01 74 11 - Cleaning.

.2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

1 General

1.1 GENERAL REQUIREMENTS

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

1.2 WORK IN OTHER SECTIONS

.1 Related Work Specified in Other Sections

Section 02 41 10	:	Demolition
Section 03 30 00	:	Cast-in-Place-Concrete
Section 31 01 00	:	Earthwork

.2 Products Specified Under Work of This Section and Installed Under Work of Other Sections

Division 15	:	Plumbing
Division 26	:	Electrical

1.3 SCOPE OF WORK

.1 Work of this Section shall include but not be limited to the following:

.1 Excavation for building footprint and backfill with specified materials.
.2 Excavation for building additions
.3 Excavation and grading for sidewalk and parking areas
.4 Employment of adequate equipment for excavation, backfill, compaction, haulage and disposal.

1.4 REQUIREMENTS OF REGULATORY AGENCIES

.1 Work of this Section shall include protection measures, consisting of materials, constructions and methods, required by the Occupational Health and Safety Act 2006, and Regulations for Construction Projects O. Reg. 213/91, amended Ontario Reg. 443/09, of the Province of Ontario, and as otherwise imposed by jurisdictional authorities to save persons and property from harm.

1.5 SPECIAL PROTECTION

.1 Ensure that the locations of existing buried utilities and other services have been established by an investigation conducted together with the utilities of services concerned.

.2 When unknown services are encountered during execution of work of this Section: identify, notify appropriate authority and the Consultant and brace and support them.

1.6 EXAMINATION

.1 Ensure in examination of the site that all possible factors concerning earthwork are investigated, and that the following are known in particular:
- methods and means available for material handling, disposal, storage and transportation
- physical conditions of site, including ground water table and drainage courses
- conformation and conditions of ground surfaces
- character, quality and quantity of surface and sub-surface materials.

1.7 SOIL INVESTIGATION

.1 The Owner has engaged a consultant to carry out a soil investigation within the building.

1.8 FIELD QUALITY CONTROL

.1 Excavation and placement of fill shall be carried out under the control of the Soils Engineers. The Owner will appoint an inspection and testing company to inspect and report on compliance with the Specification of the Work of this Section.

.2 Inspection and testing shall include approval of materials, adequacy of bearing surfaces, backfilling, fill, and necessary analysis and inspection of materials and operations to ensure specified compaction density is obtained. The testing and inspection shall include but not be limited to gradation, Standard Proctor Density, optimum moisture content determination, thickness and degree of compaction of each lift, and plate test for determination of Young's Modulus. Inspection and testing shall also include approval of materials and adequacy of bearing surfaces.

.3 The costs of inspection and testing will be paid by the City covering this work as set forth in Section 01 21 00.

.4 Copies of all inspection reports to be forwarded to the Consultant.

1.9 DISPOSAL OF MATERIALS

.1 All surplus excavated material, which will not be reused within the site, shall be removed from the site by the Contractor. Soil to be tested and Letter of Acceptance from the Owner of the proposed dump site is to be submitted to the Consultant.

.2 The Contractor shall coordinate with the Owner for testing of the subsoil below the building footprint. A provisional quantity has been estimated for disposal of this contaminated soil, if encounters. The unit price will include loading, trucking and dumping to a certified dump pit.

2 Products

2.1 MATERIALS

.1 Fill "A": Granular material meeting Standard Specifications #314 of Ministry of Transportation and Communications, Ontario, for Class "A" Selected Granular Base Course. Minimum compaction density = 98% Standard Proctor.

.2 Fill "B": Granular material meeting Standard Specifications #314, of Ministry of Transportation and Communications, Ontario, for Class "B" Selected Granular Base Course. Minimum compaction density = 98% Standard Proctor.

.3 Fill "C": Site or imported material, containing no organic or foreign matter, and which the Sub-Contractor can demonstrate is compactable to a density of 98% Standard Proctor and is acceptable to the Soils Engineer.

.4 Fill "D": Clear crushed stone graded 19.0 mm (3/4") to minimum depth of 200 mm (8"). Install as noted on the drawings.

.5 Sand: A washed, sharp, hard, durable, granular, natural sand consisting of fine and course particles, free of all deleterious material conforming to CAN3-A23.1-M94 for fine aggregate. Minimum compaction density = 95% Standard Proctor.

.6 Filter Cloth: Conforming to OPSD Form 1860 shall be Terrafix 270-R beneath and behind precast retaining walls and Terrafix 400-R beneath the rip rap.

.7 Notify the Engineer three (3) days before commencement of work as to source supply for all imported fill.

3 Execution

3.1 EXCAVATION

.1 Excavate to extent and depth required for construction of the new slab and insulation.

.2 Subexcavate the existing fill material within the limits of the slab structure to elevations shown. Proofroll the exposed surfaces with a drum roller as required to ensure a uniform high density. Cut and/or fill the site area to obtain finished subgrades shown on drawings. Compact to 95% modified Proctor maximum dry density.

.3 If any soft or spongy areas are located, the Soils Engineer shall be notified at once. Further, if the Soils Engineer so directs, the excavation shall be carried down to a greater depth until a firm bearing is obtained.

Subexcavate soft spots disclosed during proof rolling and replace with approved fill compacted to at least 95% Standard Proctor maximum dry density.

.4 Observe the rules and regulations governing the respective utilities during excavation. Report to the Consultant existing unlocated services encountered, and do not continue with excavation without the Consultant's instructions. Repair damages to services should they occur.

.5 Carry out excavation to the extent, elevations and depths required to permit proper construction, shoring and inspection of the work.

.6 Keep excavations clear of water at all times and check for adequacy of all pumping requirements and water control until foundation work and backfilling are completed.

3.2 BACKFILLING

.1 Do not commence backfill until the subgrade is properly consolidated and approval is obtained from the Soils Engineer.

.2 Care shall be taken to avoid damage to or displacement of walls, waterlines, drains, cables, conduits, insulation, etc. Where temporary unbalanced earth pressures are liable to develop in walls before the floor slabs are placed, the Contractor shall provide and place the necessary shoring and bracing to counteract the unbalance and shall leave the members in place until removal is approved by the Consultant.

.3 Backfill to underside of slabs with Granular 'A' compacted to 98% Standard Proctor Density.

END OF SECTION 31 01 00

1 General

1.1 GENERAL REQUIREMENTS

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

1.2 WORK IN OTHER SECTIONS

.1 Related Work Specified in Other Sections

Section 31 01 00	:	Earthwork
Section 32 12 00	:	Bases, Ballast and Paving

1.3 SCOPE OF WORK

.1 Provision of all labour, equipment, machinery, materials, tools, services and incidentals to establish and construct finished grades for the entire project.

1.4 UNDERGROUND SERVICES AND STRUCTURES

.1 Information concerning location and nature of existing underground services and structures, must be obtained from the various agencies concerned, the Contractor and the Owner.

1.5 REQUIREMENTS OF REGULATORY AGENCIES

.1 Work of this Section shall include protection measures, consisting of materials, constructions and methods required by the Occupational Health and Safety Act, O.R. 213/91, of the Province of Ontario, and as otherwise imposed by Jurisdictional Authorities to save persons and property from harm.

1.6 SPECIAL PROTECTION

.1 Ensure that adjacent property is not damaged in any way by site grading work; by the removal, stockpiling and transporting of materials; by blown sand or dust, or by spillage during the removal, stockpiling and transporting of materials; by the collapse or movement of excavated banks and stockpiles; or by storm water from altered drainage courses.

.2 Do not excavate or grade until locations of services has been verified and protective measures taken are satisfactory to all that are concerned.

.3 Ensure that no damage is caused by earthwork to existing structures, trees, buried and above-ground services, bench marks and survey monuments on the site, or adjacent property. Arrange or ensure that all damage which occurs is repaired completely and immediately.

1.7 SOILS INVESTIGATION

.1 Visit site and examine site and soil conditions and be satisfied that work can be carried out in accordance with requirements or contract documents.

1.8 TESTING

.1 Take samples of existing topsoil (one litre sample per 300m3 of stockpiled soil minimum), and have tested.

2 Products

2.1 MATERIALS

.1 Fill: as specified in Section 31 01 00.

3 Execution

3.1 LAYOUT

.1 Stake out high points, low points, swales, and specific site elements to establish clear interpretation of grade.

.2 Set grades by means of grade stakes clearly marked with final and subgrade elevations.

3.2 ROUGH GRADING

.1 Subgrade constitutes a compacted machine finished surface.

.2 Establish the subgrade parallel to approved finished grades and shape the subgrade so that free drainage is permitted at all times.

.3 Establish uniform slopes between points for which finish grades are approved or between such points and existing grade.

.4 Round and smooth grades at top and toe of slopes and banks.

.5 The subgrade established will clearly exhibit the land form character and balance and interrelationship delineated by contract documents.

.6 Blend smoothly and flush with existing grades.

.7 Do not grade when material is wet or frozen.

.8 Do not obstruct flow in swales and provide adequate surface runoff and drainage at all times.

.9 Ensure that all surfaces and gutters are properly graded with adequate falls so as to drain.

.10 Get all rough grading work approved prior to placing other materials on subgrade.

.11 Existing grade contours, where shown on plans, are approximate only.

.12 Provide for the following minimum depths of topsoil in areas indicated:

In Flower Beds	450mm
In Planting Bed Areas	600mm
In Sodded/Seeded Areas	100mm

3.3 FINAL GRADING

.1 Final grade constitutes a smooth surface free of all pockets and depressions. All final grading shall be in accordance with the drawings, specifications and to the satisfaction of the Landscape.

.2 Round and smooth grades at top and toe of slopes and banks. Blend smoothly and flush with existing grades.

.3 Clean surface of all stones, rocks, branches, extraneous material, etc. larger than 40mm in diameter and live weeds.

.4 Get approval by Consultants of finish grading, prior to commencement of any subsequent work.

3.4 FIELD QUALITY CONTROL

.1 Assist Inspection Company in the execution of their work.

END OF SECTION 31 22 00

1 General

1.1 GENERAL REQUIREMENTS

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

1.2 WORK IN OTHER SECTIONS

.1 Related Work Specified in Other Sections

Section 03 30 00: Cast-in-Place Concrete
Section 32 22 00: Grading
Section 32 01 00: Earthwork

.2 Products Specified Under Work of Other Sections

and Installed Under Work of this Section

Section 32 01 00: Earthwork

1.3 SUBMITTALS

.1 At least two (2) weeks prior to commencing work inform the Consultant of proposed source of aggregates and provide access for sampling.

.2 Submit asphalt concrete mix design to the Consultant in accordance with sub-section 1150.04.01.02 Contractor Mix Designation, of Ontario Provincial Standard Specification 1150.

1.4 QUALIFICATIONS

.1 Execute the work of this Section by a Subcontractor who has equipment adequate for project, and skilled tradesmen supervised by foremen experienced in type of work specified so that work is performed expeditiously.

1.5 EXAMINATION

.1 Ensure that subgrade level, drainage pattern and compaction has been completed in accordance with Section 32 01 00 of this Specification and drawings, and that subgrade conditions are satisfactory for placing of granular base and asphaltic pavements. Commencement of work is deemed to be acceptance for all work preceding it.

.2 Ensure that all services have been installed prior to commencement of work.

1.6 FIELD QUALITY CONTROL

.1 The Owner shall employ an independent inspection and testing company to carry out all testing and inspection as required. The Consultant will appoint the inspection and testing company. The cost of inspection and testing shall be paid by the Contractor, out of the cash allowance for this testing specified under 01 21 00.

2 Products

2.1 MATERIALS

.1 General: Granular Base Courses shall be in accordance with Specification of MTC Form 1010 for material designated as Class "A", Class "B" materials and as specified in Section 02200. Thickness of granular base courses shall be as follows:

TYPE 'A' PAVEMENT	-	150mm Gran. 'A'
(Heavy Duty and fire routes)		450mm Gran. 'B'
TYPE 'B' PAVEMENT	-	150mm Gran. 'A'
(Regular Duty)		300mm Gran. 'B'
TYPE 'C' PAVEMENT	-	300mm Gran. 'A'
(Concrete or paved sidewalk)		

.2 Asphaltic Cement: in accordance with Ontario Provincial Standard Specification 1150 compacted to at least 96% Marshall Density.

.3 Pavement Markings: in accordance with Ontario Provincial Standard Specifications 1710 for permanent markings (colour white).

.4 Joint Painting, Tack Seal Coating: shall be SS-1 emulsion complying with Ontario Provincial Standard Specification 1103, excluding Section 1103.09.

2.2 ASPHALT CONCRETE MIXES

.1 Thickness after compaction of Asphalt Concrete mix shall be as follows:

TYPE 'A' PAVEMENT	-	40mm HL3
	-	90mm HL6
TYPE 'B' PAVEMENT	-	40mm HL3
	-	50mm HL6
TYPE 'B' PAVEMENT	-	60mm HL3

Existing Granular at gravel parking area

.2 Remove existing 10" of granular material and stockpile for sampling by Inspector. Only reuse this material if approved by the Inspector and if free of contaminants.

3 Execution

3.1 ENVIRONMENTAL CONDITIONS

.1 Commence laying of asphalt binder courses only when base surfaces are at least 2°C (35°F) and the temperature is rising.

.2 Commence laying of asphalt surface courses only when binder course surfaces are completely dry, and at least 7°C (45°F) and the temperature is rising.

.3 Suspend paving operations if temperature drops below specified minimums.

3.2 TOLERANCES

.1 Grade base courses with surfaces within 12.5mm (½") of established elevations and within a tolerance of 12.5mm (½") under a 3000mm (10'-0") long straightedge.

.2 Apply additional layers of aggregate, as specified in, to attain design depth.

.3 Shape base course at edges of asphalt pavement where it does not abut concrete curbs, to form extended shoulder and to allow for thickened asphalt edge band.

.4 Eliminate and smooth surface irregularities to within a tolerance of 6.4mm (1/4") under a 3000mm (10-0") long straightedge.

3.3 PLACING OF FINISH PAVEMENTS

1. <u>Generally</u>

- Finish pavement surfaces to elevations indicated on Drawings.
- Maintain accuracy of elevations to within specified tolerances.
- Ensure that drainage is effected from all areas without formation of puddles.
- Inform Consultant if slopes to drains are less than 1% before commencing work in order that corrective methods may be considered.
- Maintain finished granular sub base and base courses in conditions conforming to this Section until placement of finished asphalt courses.

Remove contaminated material prior to paving.

2. PLACING OF ASPHALT

- Lay asphalt mixture only on dry bases from which foreign matter has been removed.
- Deliver mixtures to site at minimum workable temperature. After spread and before initial rolling, temperature of mixture shall be no less than 110°C (235°F).
- Control spreading alignment by positive means such as string lines set from grade stakes or alignment stakes, or both. Place these controls on each side of pavement, or utilize other approved methods so that spreading is not guided by edges of preceding courses.
- Locate containers carrying fuel oil, to clean shovels, rakes or brooms, where they will not drip or splash oil on freshly laid asphalt.
- Adjust course widths so that centre joints of successive courses do not coincide.

3. FINISHING ASPHALT SURFACES

- Smooth surfaces irregularities to within a tolerance of 6.4mm (¼") under a 3000mm (10'-0") straightedge.
- Roll asphalt to a smooth, dense, uniform surface with a sufficiently heavy roller to thoroughly compact asphalt courses. Manually tamp areas around inaccessible areas to produce surfaces matching rolled areas.
- Shape and roll alternately to obtain a smooth, even and uniformly compacted surface.
- Trim exposed edges to neat straight lines.
- Correct alignment and grade irregularities at edges of pavement by addition or removal of asphalt mixture before rolling.

3.4 SPECIAL PROTECTION

.1 Prevent vehicle or foot traffic over freshly paved areas until sufficiently cured that they will not suffer damage. Barricade as required.

3.5 PATCHING

.1 Replace defective asphalt pavements with patches cut into pavement, in rectangular areas, and with joints made as specified.

.2 Correct and repair all areas showing checking or hairline cracking as directed by the Inspector.

3.6 WARRANTY

.1 The Contractor hereby warrants that, with ordinary wear and tear, the works shall remain in such condition as will meet the approval of the Consultant for a period of two (2) years from the date of substantial performance for the project.

END OF SECTION 32 12 00