



**THE CORPORATION OF
THE CITY OF KAWARTHA LAKES**

**REQUEST FOR TENDER
2025-111-CP**

**Omemee Arena and Community Centre
Additions and Renovations
Phase 2**

212 Sturgeon Road, Omemee, Ontario

Prepared for:

THE CORPORATION OF THE CITY OF KAWARTHA LAKES
50 Wolfe St, Lindsay, Ontario K9V 2J2

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October 2025

END OF SECTION 00 15 00

1 General

1.1 GENERAL REMARKS

- .1 This Section is to be considered as additional to and complimentary with the General Conditions of the Contract which shall govern the Work of the Contractor and all Sub-contractors where applicable and shall be carefully read and adhered to.
- .2 In the event of conflict Section GC 1.1.7 of the General Conditions shall govern.

1.2 EXAMINATION OF THE SITE

- .1 Each Contractor shall examine the site prior to submission of a tender. No extras will be allowed for additional work due to lack of labour or equipment or difficulties encountered which could have been foreseen by close inspection of the site.
- .2 Each contractor shall examine all areas, surfaces and materials on which or to which he is required to work, prior to commencement of each phase of his contract. Any conditions found unsatisfactory shall be reported to the general contractor who shall make all the necessary alterations to such unsatisfactory conditions. Failure to report unsatisfactory conditions prior to commencement of the sub-trades work will be construed as evidence that all conditions are satisfactory and the responsibility for perfect shall rest solely with the sub-contractor, without recourse to others.
- .3 Unscheduled site visits are not permitted. The Bidder must arrange for any subsequent inspections with the Owner.

1.3 EXAMINATION OF DOCUMENTS

- .1 Failure to report omissions, ambiguities and contradictions contained in the documents prior to tender closing shall render the trade involved responsible to comply with the Consultant's interpretation at the time of construction.

1.4 ERROR AND OMISSIONS

- .1 This Contractor shall make good all materials omitted by sub-contractor at their expense and shall ensure that the completed work includes material and workmanship as drawn and specified or intended, implied or otherwise necessary for satisfactory completion. Any errors in the drawings and specifications not reported in writing at the time of tendering will be assumed to be allowed for by this contractor and no extras will be

accepted for extra work incurred due to errors or omissions.

1.5 PERMITS

- .1 Permits pertaining to particular trades shall be paid for by the particular sub-trade concerned. Comply with all regulations of all public authorities having jurisdiction.
- .2 The Building Permit has been applied for and paid outside of this contract. The contractor is responsible for all other permits.

1.6 CONTRACTOR OMISSIONS

- .1 Any additional work required by consultants to clarify work already indicated in documents or to correct an error by contractors may result in consultant's time to be charged back to the contractor at the consultant's hourly rate.

2 DEFINITIONS

- .1 Contract Time

Add "All time limits stated in the *Contract Documents* are of the essence of the Contract"

- .2 Add new definitions

" 21 Syntax

Wherever the words or phrases in the left-hand column are used throughout the *Contract Documents*, they shall be understood, unless context provides otherwise, to mean the words or phrases in the right-hand column:

approved – approved by the Consultant

satisfactory – satisfactory to the Consultant

directed – directed by the Consultant

submit – submit to the Consultant

make good – make good to the Consultant's satisfaction

permitted – permitted by the Consultant

inspected – inspected by the Consultant

designated – designated by the Consultant

as indicated – as indicated on the drawings, material and finishing schedules"

GENERAL CONDITIONS OF THE STIPULATED PRICE CONTRACT

PART 1 GENERAL PROVISIONS

GC 1.1 CONTRACT DOCUMENTS

1. Paragraph 1.1.6: Add “The *Contractor* is responsible for all work required in the *Contract* regardless of Division in the specifications. Such Division shall not obligate the *Consultant* or *Owner* to arbitrate to establish limits of responsibility between *Contractor* and *Subcontractor*.”
2. Add new sub-paragraphs 1.1.7.5 and 1.1.7.6
 - “1.1.7.5 In case of discrepancies, noted materials and annotations shall take precedence over graphic indications in the *Contract Documents*.”
 - “1.1.7.6 Should reference standards and specifications conflict with the Project Specifications, the Project Specification shall govern. Should reference standards and specifications conflict with each other and if reference specifications conflict with Project Specifications, the more stringent requirement shall govern.”
3. Paragraph 1.1.8: Delete in its entirety and substitute:
 - “1.1.8 The consultant shall furnish to the *Contractor* without charge, 10 copies of the *Contract Documents*, exclusive of those required by jurisdictional authorities and the executed *Contract Documents*. Additional copies will be furnished to the *Contractor* at the *Consultant’s* cost of reproduction, handling and sales taxes.”
4. Add new paragraph:
 - “1.1.13 The *Contract Documents* shall be signed in quadruplicate by the *Owner* and *Contractor*.”

PART 2 ADMINISTRATION OF THE CONTRACT

GC 2.2 ROLE OF THE CONSULTANT

5. Paragraph 2.2.6: Add the word “schedules” after the word “techniques”.
6. Paragraph 2.2.6: At the end of the second sentence add “or to adhere to the construction schedule.”
7. Add new paragraph:
 - “2.2.19 Verbal instructions, regardless of their source, will not be

binding to the Contract.”

PART 3 EXECUTION OF THE WORK

GC 3.1 CONTROL OF THE WORK

8. Paragraph 3.1.2: Add the word “schedules after the word “techniques”.

GC 3.5 CONSTRUCTION SCHEDULE

9. Paragraph 3.5.1.1: Delete “prior to the first application for payment” and substitute “before the Work commences and updated with each meetings minutes.”

10. Add new paragraph:

“3.5.1.4 Once approved this schedule shall not be altered without approval from the Owner and Consultant.”

GC 3.7 SUBCONTRACTORS AND SUPPLIERS

11. Paragraph 3.7.2: Add “*Contractor* shall not change those *Subcontractors* and *Suppliers* so identified without written permission of the *Owner*.”

GC 4.1 CASH ALLOWANCES

12. Delete paragraph 4.1.4 in its entirety and substitute new paragraph 4.1.4:

“4.1.4 Where the actual cost of the Work under any cash allowance exceeds the amount of the allowance, any unexpected amounts from other cash allowances shall be reallocated, at the *Consultant’s* direction, to cover the shortfall, and, in that case, there shall be no additional amount added to the *Contract Price* for overhead and profit. Only where the actual cost of the Work under all cash allowances exceeds the total amount of all cash allowances shall the *Contractor* be compensated for the excess incurred and substantiated, plus an amount for overhead and profit on the excess incurred and substantiated, plus an amount for overhead and profit on the excess only, as set out in the *Contract Documents*.”

13. Delete paragraph 4.1.5 in its entirety and substitute new paragraph 4.1.5:

“4.1.5 The net amount of any unexpended cash allowances, after providing for any reallocations as contemplated in paragraph 4.1.4, shall be deducted from the *Contract Price* by *Change Order* without any adjustment for the *Contractor’s* overhead and

profit on such amount.”

14. Add new paragraph 4.1.8:

- “4.1.8 The *Owner* reserves the right to call, or to have the *Contractor* call, for the competitive bids for portions of the Work, to be paid for from cash allowances.”

PART 5 PAYMENT

GC 5.1 FINANCING INFORMATION REQUIRED OF THE OWNER

15. General Condition 5.1: Delete in its entirety.

GC 5.2 APPLICATIONS FOR PROGRESS PAYMENT

16. Add new paragraph:

- “5.2.8 After the first application, the *Contractor* shall attach to all applications for payment, a statutory declarations, using CCDC form 9A-2001, that all accounts for labour, subcontracts, products, construction machinery and equipment, and other indebtedness which may have been incurred by the *Contractor* and for which the *Owner* might in any way be held responsible have been paid in full, except for amounts properly retained as a holdback or as an identified amount in dispute, are paid up to the last invoice.”

GC 5.5 PAYMENT OF HOLDBACK UPON SUBSTANTIAL PERFORMANCE OF THE WORK

17. Paragraph 5.5.3: Delete in its entirety.

GC 5.7 FINAL PAYMENT

18. Paragraph 5.7.4, second line: Delete “5 days” and substitute “10 days”.

19. SC 30 Add new paragraph

- “5.7.5 The application for final payment will not be approved or processed by the *Owner* until a copy of all disposal site receipts have been submitted to the *Owner's Representative*, as outlined in the Designated

Substances and Hazardous Materials Remedial Action Plan."

PART 6 CHANGES IN THE WORK

GC 6.2 CHANGE ORDER

20. Add new paragraph:

- "6.2.3 The value of a change shall be determined in one or more of the following methods as directed by the *Consultant*:
- .1 by estimate and acceptance of a lump sum.
 - .2 by unit prices as set out in the *Contract* or subsequently agreed upon, which shall include overhead, profit, and other reasonable charges of the *Contractor* which shall be the total cost to the *Owner*. Adjustment to the *Contract Price* shall be based on net quantity difference from original quantity.
 - .3 by actual credits and cost to the *Owner*. Where additional work is required, the cost to the *Owner* shall be the actual cost plus a percentage covering overhead and profit, after all credits included in the change have been deducted.

The following percentage fee for overhead and profit shall be applied to additional work:

- .1 On work performed by the *Contractor's* own forces, the *Contractor* may charge a maximum of 10% combined percentage for overhead and profit;
- .2 On work performed by *Subcontractors*, the *Subcontractors* may charge a maximum of 10% combined percentage for overhead and profit. The *Contractor* may charge a maximum of 5% combined percentage for overhead and profit on work performed by the *Subcontractors*.

GC 6.3 CHANGE DIRECTIVE

21. Add new paragraph

- "6.2.6.4 The *Contractor's* fee shall be a maximum of 10 percent combined percentage for overhead and profit on work

performed by the *Contractor's* own forces. On Work performed by *Subcontractors*, the *Subcontractor's* fee shall be a maximum of 10 percent combined percentage for overhead and profit. The *Contractor's* fee on work performed by *Subcontractors* shall be a maximum of 5 percent, combined percentage on overhead and profit"

22. Paragraphs 6.3.7.5 and 6.3.7.6, "tools", "*Construction Equipment*" and "hand tools" shall only include those that have a new purchase value that is greater than \$500.00.

PART 7 DEFAULT NOTICE

GC 7.1 OWNER'S RIGHT TO PERFORM THE WORK, STOP THE WORK OR TERMINATE THE CONTRACT

23. Paragraph 7.1.2: Add "Without limiting what is stated above, the *Contractor* will be considered to have failed to comply with the requirements of the Contract to a substantial degree if the *Contractor* fails to maintain in force the insurance required to be maintained by the *Contractor* under this Contract or is not in compliance with GC 10.4 WORKERS' COMPENSATION."

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

24. Paragraph 7.2.3.1: Delete in its entirety.

25. Paragraph 7.2.3.4: Delete "except for GC 5.1 – FINANCING INFORMATION REQUIRED OF THE OWNER".

PART 9 PROTECTION OF PERSONS AND PROPERTY

GC 9.3 TOXIC AND HAZARDOUS SUBSTANCES AND MATERIALS

26. SC 43 Add new paragraph:

"9.3.2.3 provide the Contractor with a copy of the Designated Substance and Hazardous Materials Assessment and a copy of the Designated Substance and Hazardous Materials Remedial Action Plan."

SC 49 Paragraph 9.3.8: Delete in its entirety and substitute:

"9.3.8 The Contractor shall indemnify and hold harmless the Owner, the Consultants, their agents and employees, from and against

claims, demands, losses, costs, damages, actions, suits, or proceedings arising out of or resulting from exposure to, or presence of, toxic and hazardous substances or materials which were at the Place of Work prior to the Contractor commencing the Work.”

GC 9.4 CONSTRUCTION SAFETY

27. Add new paragraph:

- “9.4.2 The *Contractor* shall indemnify and hold harmless the *Owner* and the *Consultant*, their agents and employees from and against claims, demands losses, costs, damages, actions suits or proceedings by third parties that arise out of, or are attributed to, the *Contractor’s* safety performance.”

PART 10 GOVERNING REGULATIONS

GC 10.2 LAWS, NOTICES, PERMITS, AND FEES

28. SC 50 Add new paragraph:

- “10.2.6 The Contractor shall be responsible for any and all fees associated with the disposal of all materials resulting from the Work.”

GC 10.4 WORKERS COMPENSATION

29. SC 51 Add new paragraph:

- “10.4.3 The Workers Compensation certificate must clearly indicate an endorsement for the Wrecking and Structural Demolition of Buildings.”

PART 11 INSURANCE AND CONTRACT SECURITY

GC 11.1 INSURANCE

30. SC 55 Add new paragraph:

- “11.1.1.5 Building Demolition Insurance:

The insurance policy must endorse the Demolition of Building and must be clearly indicated on the certificate of insurance. All

premiums in respect to such policy shall be paid by the Contractor.”

PART 12 INDEMNIFICATION – WAIVER – WARRANTY

GC 12.3 WARRANTY

31. Add new paragraphs:

- “12.3.7 The *Contractor* shall commence to correct any deficiency within two working days after receiving a notice in writing from the *Owner* or the *Consultant*, and complete the Work as expeditiously as possible, except that in case the deficiency would prevent maintaining security or keep basic Upgrades essential to the ongoing business of the *Owner* and/or his tenants, operational as designed, all necessary corrections and/or installation of temporary replacements shall be carried out immediately as an emergency service. Should the *Contractor* fail to provide this emergency service within 24 hours of a request made in writing during the normal business hours of the *Contractor*, the *Owner* is authorized to carry out all necessary repairs or replacements at the *Contractor*’s expense.”
- “12.3.8 The carrying out of replacement work and making good of defects shall be executed at times convenient to the *Owner* and this may require work outside of normal working hours at the *Contractor*’s expense.”

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 00820 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 until April 15, 2026 at which time the facility will be completely closed and turned over to the Contractor. Staff will continue to attend the site part time in the temporary office located on the northeast corner f the rink. 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 relinquish control of this area until the facility is back to normal operation.
- .3 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, while the facility is open, which are listed in the Instructions to Bidders, unless instructed otherwise.
- .4 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 The intention is to start exterior work on the Dressing Room addition as soon as weather permits (early March 2026)
- .2 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.
- .3 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.
- .4 Prohibit use of existing washrooms and services in building by construction

personnel unless approved by the Consultant.

- .5 The Contractor shall co-ordinate 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.
- .6 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.
- .7 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.
- .8 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 the ice pad (both levels) 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.

1.1 GENERALLY

- .1 Cash allowances specified shall be carried, administered and co-ordinated 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 CASH ALLOWANCES

- .1 For Inspection and Testing Services Specified for:

Section 31 01 00 : Earthworks

A Cash Allowance of Eight Thousand Dollars (\$8,000.00).

- .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 abatement of hazardous material:

Section 02 41 00 : Demolition

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

.4 For supply of hardware:

Section 08 71 00 : Door Hardware

A Cash Allowance of Sixty-Five Thousand Dollars (\$65,000.00).

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

Solar Panels on Dressing Room Addition

.2 Provisional Price No. 2

Supply and install heat recovery system on refrigeration system.

.3 Provisional Price No. 3

Supple and install 50,000 litre cistern for grey water and associated piping.

.4 Provisional Price No. 4

Second floor kitchen upgrades including painting millwork and walls, replacing millwork hardware, new ceiling tiles, remove propane tank, power for new stoves.

.5 Provisional Price No. 5

Granular base upgrade and paving of existing gravel parking lot.

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 01 02 00.

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. This is applicable to the Omemee Arena and Community Centre:

Base Bid

The base bid will include shown on the drawings.

Work includes (but not limited to):

- removals as shown, including lobby and second floor items, resurfacer room walls and room
- Lobby and second floor renovations
- New elevator
- Replace counter and sinks in second floor kitchen
- Dressing room addition
- Resurfacer room and garage addition

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

Solar panels on dressing room addition

Work includes:

- Supply and install solar panels on dressing room addition
- Install inverters in Mechanical Room 104
- Associated mechanical and electrical
- Solar panels to be supplied and installed by Solar Direct
 - Contact Paul West
 - paul@solardirectcanada.com
 - Mobile – 647-323-9867
 - Office – 519-853-2308

Provisional Price No. 2

Heat recovery from ice plant

Work includes:

- Install heat recovery system on refrigeration (by Cimco)
- Connect recovery to resurfacer water storage tanks
- Associated mechanical and electrical

Provisional Price No. 3

40,000 precast cistern for grey water

Work includes:

- Supply and install precast cistern (Model H40S by Wilkinson Heavy Precast or equal)
- Install filtration system
- Connect all plumbing for toilet and urinals
- Associated mechanical and electrical

Provisional Price No. 4

Second floor kitchen improvements

Work includes:

- painting millwork and walls
- replacing millwork hardware
- new ceiling tiles (grid to remain but paint)
- remove propane tank
- power for new stoves

Provisional Price No. 5
Pave gravel parking lot

Work includes:

- Removal of existing granular
- Supply, placement, grading and compaction of granular base
- Curbs as shown
- New asphalt
- Line painting
- Associated mechanical and electrical

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 DESIGNATED SUBSTANCE

- .1 A designated substance report has been completed (and included in these tender documents).
- .2 Hazardous material shall be removed in accordance with the regulations. Should hazardous materials be uncovered, notify the Consultant immediately, cease Work in the area and carry out containment and removal at the direction of the Consultant.
- .3 The Bidder shall make allowances in his schedule for this material. The Bidder will not be compensated for lost time of waiting time while testing and/or decisions are being made.

6.1 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.

7.1 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.

8.1 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.

9.1 SITE MEETINGS/PROGRESS RECORDS

- .1 As specified in Section 01 20 00.
- .2 Interim monthly reviews of Work Progress, based on the current Work Schedule, will be conducted by the Consultant, 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.

10.1 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.

11.1 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.

12.1 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.

13.1 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.

14.1 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.

15.1 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.

16.1 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 City staff will require access to the refrigeration room 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.

17.1 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.

18.1 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.

19.1 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.

20.1 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 or any of his Trades or Suppliers.

21.1 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 01500. 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°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.

22.1 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.

23.1 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.

24.1 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.

25.1 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.

26.1 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.

27.1 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.

28.1 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 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.

29.1 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.

30.1 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.

31.1 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 if the element is a fire separation he shall be responsible for maintaining the separation in an approved manner.

32.1 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.

33.1 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 Refrigerant Sub-contractors to document the responsibilities and necessary activities of the Contractor, Subcontractor and Suppliers during construction, establish procedures for co-operation and co-ordination 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 Consultant shall record all minutes of meetings and forward to the Contractor for 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.

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 co-ordinate 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 5.

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.

9.1 PRE-POUR MEETING

- .1 The contractor to schedule a meeting with all relevant trades, consultants and owner's representatives prior to placing the concrete for the ice pad. This meeting shall review all procedures, material, backup plans, testing, quality control, line testing and schedule.

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 01300.
- .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 City staff (to refrigeration room etc) 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 1985, 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.

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 Paper towel and toilet paper dispensers
- .4 Building Permit
- .5 Sound System – contractor to re-install existing
- .6 Canteen equipment – existing to be reinstalled
- .7 Kitchen equipment – new stoves, other fixtures to be reinstalled
- .8 Exterior and interior signage. Contractor to remove and reinstall rules and general boards

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 Subcontractors 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.

.3 Section 15 - Refrigeration

- .1 Construction Record Drawings.
- .2 Maintenance Manuals and Operating Instructions.
- .3 Certificate of Verification of system.
- .4 Plumbing, Hydro, Gas and all other inspection permits and documentation.

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 17	:	Refrigeration
Division 22	:	Plumbing
Division 23	:	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 ice pad. 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.

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 Provide 102 x 102 MW 18.7 x MW 18.7 (4" x 4" x 6/6) welded wire fabric for the top layer of reinforcing in the ice pad. Provide a minimum 1 cell (150mm) lap on all edges. Stagger sheets to avoid long lines of overlap. Cut out corners at overlaps so that there is a maximum two layers at any point.

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.

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 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/m³
 - .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.
- .2 The Contractor shall submit references for the Concrete Floor finisher. This subcontractor must have completed at least 5 arena concrete pads in the last 5 year. The submission is to include a list of past experience with ice pads and a minimum 3 references:

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, dashboard 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 Curing for the arena slab shall include a flood cure, maintained in place for 7 days from time of pour. Dam all edges to retain the water. Replenish the water regularly to maintain a constant level of water at least 12mm.
- .5 Circulate cold water through the refrigerant piping for the first 48 hours after placement.
- .6 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 Cast a minimum of 4 sets of 5 cylinders. Cylinder breaks to be as follows:
 - 1 of each at 3 days
 - 1 of each at 7 days
 - 1 of each at 21 days
 - Final 2 of each at 28 days.
- .4 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 ice slab:

: In any 3m (10')	-	3 mm (1/8")
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- | | | | |
|-----|--|---|--------------|
| | : 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. | | |
| .10 | Rink slab surface to conform to the following tolerances per CSA-A23.1, Table 16, for a moderately flat floor: | | |
| | .1 Straight-edge Tolerance: ±5mm | | |
| | .2 Floor Flatness, F_F : 30 | | |
| | .3 Floor Levelness, F_L : 20 | | |
| | .4 Waviness Index, SWI: 3mm | | |
| .11 | No rink slab surface elevation shall vary from the specified datum elevation by more than ±5 mm. | | |
| .12 | Upon completion, the Contractor shall complete a topographic survey of the ice pad in a maximum 3m x 3m grid | | |
| .13 | The Contractor shall grind down all high spots in the rick slab surface as required to meet the specified height tolerances. | | |
| 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.

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 23	:	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.
- .2 The Contractor shall submit references for the Concrete Floor finisher. This subcontractor must have completed at least 5 arena concrete pads in the last 5 years. The submission is to include a list of past experience with ice pads and a minimum 3 references:

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.

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 : Earthwork
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

.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 Acoustical Concrete Masonry Units to CSA-A165-14, purpose made with slots to provide the acoustical characteristics specified:
- .1 Size and extent as shown on the drawings.
 - .2 Reinforcing patterns as shown on the structural drawings.
 - .3 Type H/15.0 A/M normal weight block.
 - .4 Incombustible fibrous cavity filler.
 - .5 Type "R" sound block as manufactured by TCG Materials, or Acousta-Wall as manufactured by Day & Campbell Ltd.
 - .6 Colour – BK-5599 black ("F" Series – 6% loading) by Harcross

Pigments or equal.

- .5 Single Score Masonry Units to CSA-A165.1-14 Series:
- .1 Type H/15.0 A/M.
 - .2 Size Metric Modular.
 - .3 Special Shapes – Supply corner block, "L" shape block, bullnose block, header block, lintel block and the like as specified, and as required.
 - .4 Colour – dark grey (from manufacturer standard colour range).
 - .5 2 rib split face on new works
- .6 Polished Face Concrete Masonry Units Type DA1 to CSA-A165-14:
- .1 Type H/15.0 A/M.
 - .2 Size Metric Modular.
 - .3 Special Shapes – Supply corner block, "L" shape block, bullnose block, header block, lintel block and the like as specified, and as required.
 - .4 Colour – Natural Grey, Standard Colour Series, as selected by the Consultant.
- .7 Glass Fibre Board: Glass fibre insulation, semi-rigid board, density of 20.8 kg/m³ (1.3 lbs./cu.ft.).
- .8 Bellows for Control and Expansion Joint: Bituminous membrane type compatible with wall membrane.
- .9 Dampproof/Thru-Wall Flashing: Fibre reinforced membrane, coated one side with 0.61 kg/m² (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.
- .10 Asphalt Emulsions: As specified in CGSB 37-GP-2M.
- .11 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.
- .12 Wall Reinforcing: As shown on Structural drawings.

- .13 Cavity Wallbonding Box Tie: 4.76mm (3/16") galvanized high tensile steel wire, truss type reinforcing with box ties @ 400 o/c in two sections to form a hook and eye, Blok-Lok Limited or equivalent by Dur-O-Wal Limited.
- .14 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.
- .15 Wall Ties: 22 gauge galvanized corrugated steel.
- .16 Stud Anchors: 14 gauge, hot-dipped galvanized steel plate anchors with 4.76mm (3/16") diameter galvanized steel wire ties for cavity wall.
- .17 Bond Anchor: 4.76 mm (3/16") diameter steel galvanized with 50 mm (2") end bent 90°.
- .18 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.
- .19 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 nailing 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 DAMPROOF 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 damp-proofing 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 DAMPROOF 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 damp proof 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.

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 03 30 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/CSA G164-18: 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 of 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 01 33 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/m².
- .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 be 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.

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 50 00	:	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)

CSA W47.1:09 (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 01300 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. Heavy AZ180 for deck surfaces within the arena portions and standard AZ150 for the remainder of the 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/m².

- .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 shop coat, 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.

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/m² 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.
- .6 Bench Brackets:
 - : Bench support brackets 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.

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 manufacturer. 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 repellent 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 20	:	Mechanical
Division 66	:	Electrical

.2 Products Supplied Under Work of Other Sections 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 70 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 09 90 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 aluminum sliding doors as supplied under Section 08 42 29.
- : 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 16.

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 50 x 100 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 m²) 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 m²) 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.

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- .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.

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 hexhead screws with $\frac{1}{2}$ " 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 $\frac{1}{2}$ " (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.

1 General

1.1 SUMMARY

- .1 Section includes:
- a. Factory formed standing seam metal roofing panels.
 - b. Accessories including regular and thermal seam clips, flashings, closures, and sealants.

1.2 WORK IN OTHER SECTIONS

.1 Related Work Specified in Other Sections

Section 05 50 00 : Metal Fabrications
Section 07 90 00 : Joint Protection

1.3 REFERENCES

- .1 CAN/C.S.A. Standard S136 latest edition for the Design of Cold Formed Steel Structural Members.
- .2 Canadian Sheet Building Institute Standards 10M and 20M.
- .3 National Building Code of Canada (latest edition).

1.4 SYSTEM DESCRIPTION

- .1 Roofing Panels manufactured, fabricated and installed to withstand structural and thermal movement, wind loading, and weather exposure to maintain manufacturer's performance criteria without defects, damage, failure or infiltration of water.
- .2 Design system to -40 C to 80 C.

1.5 SUBMITTALS

- .1 Submit duplicate 200 x 200mm samples of roof system, colours, and finishes in accordance with Section 01 30 00.
- .2 Submit shop drawings indicating type of preformed metal panels, thickness of metal components, size, spacing, and location of supports, connections, type and locations of fastenings, sealing, finish and colour in accordance with Section 01 30 00.

1.6 PROTECTION

- .1 Protect prefinished steel during fabrication, transportation, site storage and erection in accordance with CSSBI Standards.

1.7 QUALITY ASSURANCE

- .1 Installer's Qualifications: Firm with 5 years' experience in installation of systems similar in size and complexity to those required for this project.

1.8 WARRANTY

- .1 Submit a two year warranty for the work of this Section against defects in materials and workmanship.

2 Products

2.1 MATERIALS

- .1 Sealant: in accordance with Section 07 90 00 and manufacturer's recommendations.

- .2 Flashing and Trims: same prefinished metal material and finish as roof panels.

- .3 Closures: As recommended by manufacturer.

- .4 Prefinished Metal Roof Panels:

- Minimum [0.61 mm] thick, galvalume, commercial grade A to ASTM A446.

- Finish: Perspectra series.

- Colour – from manufacturer's standard colour range

- Profile: interlocking standing seam at 400 mm o/c.

- Roof panel support system: concealed fastener, purpose-made thermally responsive clip system, and allow full thermal expansion and contraction of roof sheet. Provide clips with minimum Z275 zinc coating.

- 18 GA Z275 galvanized "Z" bars to suit insulation depth.

- Acceptable Product: "CRS" by Classic Roofing Systems.

- Colour to match existing canopy

- .5 Seam Clips and other Fasteners: as specified by panel manufacturer, to resist wind uplift and sliding snow.

- .6 Ridge Caps, Closures, and Valleys:

- Made from same material as roof panels with matching colour.

- Vented closers has to be used, if ventilation is needed through ridge cap,
- CR-Vent closer system gives Air-flow values 170cm² / 1 meter (8 sq. inch / 1 ft).
- Solid closer can be used, if ventilation is not needed through Ridge Cap.

.7 Snow Fence [One] [Two] pipe system:

- Galvalume pipe minimum 32 mm diameter and 1.3 mm wall thickness.
- Galvanized base combination fastened to roof seam.
- All bolts, nuts, and washers stainless steel.
- Acceptable Product: "CR-SF" by Classic Roofing Systems.

.8 Touch-up Paint: as recommended by panel manufacturer.

3 Execution

3.1 VERIFICATION OF CONDITIONS

- .1 Examine areas and conditions under which work is to be performed and identify conditions detrimental to proper or timely completion. Do not proceed until unsatisfactory conditions have been corrected.
- .2 Comply with manufacturer's product data, recommendations and installation instructions for substrate verification, preparation requirements and installation.

3.2 INSTALLATION

- .1 Install membrane air/vapour barrier primed to subtrade. Ensure all joints are properly lapped, sealed and tied in with roof and wall air/vapour barriers to ensure airtight construction.
- .2 Closely follow details shown on drawings to provide a continuous air/vapour seal.
- .3 Attached thermal clip panel support using fasteners of type and size recommended by the manufacturer to resist uplift forces.
- .4 Lay insulation in accordance with manufacturers specifications.
- .5 Install starters and other parts needed for proper roof installation.
- .6 Install exterior roof panels using hidden seam fasteners, with folded bottom edge hooked to the starter trim, with accordance to the manufacturer's installation procedure. Fold seam (180 degree double seam).
- .7 Install outer roof panels with folded sides and hook them to starter trim or

- use gable-end flashing, according to manufacturer's installation procedure.
- .8 Install snow fence base combination to every second seam in proper distance from roof edge with accordance to the manufacturer recommendations. No holes allowed through the roof panel or seam.
 - .9 Remove manufacturer's protective film from surfaces of roofing panels.
 - .10 Install ridge cap and metal closures in accordance with manufacturer's specifications.
 - .11 Touch-up minor paint abrasions with touch-up paint and clean the roof by dry wiping.
 - .12 No exposed fasteners allowed, unless approved by the Consultant.

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 23 : 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	:	16 gauge
Channels	:	
Vertical Stiffeners	:	18 gauge
Insulation (ext. doors and to rink)	:	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	<u>Hollow Metal Frames and Screens</u> :	<u>Welded Type</u>
	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 08710.
- .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 08700.
- .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.

PART 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.

PART 2 PRODUCTS

2.1 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.

2.2 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.

2.3 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.

2.4 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 ____ HP minimum, suitable for ____ volts, ____ 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.

2.5 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.

PART 3 EXECUTION

3.1 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.

3.2 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.

3.3 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.

3.4 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.

3.5 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.

1 General

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following types of automatic entrances:
1. Exterior and interior, single slide and bi-parting, sliding automatic entrances.
- B. Related Sections:
1. Division 7 Sections for caulking to the extent not specified in this section.
 2. Division 8 Section "Aluminum-Framed Entrances and Storefronts" for entrances furnished and installed separately in Division 8 Section.
 3. Division 8 Section "Door Hardware" for hardware to the extent not specified in this Section.
 4. Division 8 Section Glazing for materials and installation requirements of glazing for automatic entrances.
 5. Division 26 Sections for electrical connections provided separately, including conduit and wiring, for power to sliding automatic entrances.

1.3 REFERENCE STANDARDS

- A. General: Standards listed by reference, including revisions by issuing authority, form a part of this specification section to extent indicated. Standards listed are identified by issuing authority, authority abbreviation, designation number, title or other designation established by issuing authority. Standards subsequently referenced herein are referred to by issuing authority abbreviation and standard designation.
- B. Underwriters Laboratories (UL):
1. UL 325 – Standard for Door, Drapery, Gate, Louver, and Window Operators and Systems.
- C. American National Standards Institute (ANSI) / Builders' Hardware Manufacturers Association (BHMA):
1. ANSI/BHMA A156.10: Standard for Power Operated Pedestrian Doors.
 2. ANSI/BHMA A156.5: Standard for Auxiliary Locks and Associated Products

- D. American Society for Testing and Materials (ASTM):
 - 1. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
 - 2. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
- E. American Association of Automatic Door Manufacturers (AAADM):
- F. National Fire Protection Association (NFPA):
 - 1. NFPA 101 – Life Safety Code.
 - 2. NFPA 70 – National Electric Code.
- G. International Code Council (ICC):
 - 1. IBC: International Building Code
- H. Building Officials and Code Administrators International (BOCA), 1999:
- I. International Organization for Standardization (ISO):
 - 1. ISO 9001 - Quality Management Systems
 - 2. ISO 14025 – Environmental Labels and Declarations -- Type III Environmental Declarations -- Principles and Procedures
 - 3. ISO14040 – Environmental Management -- Life Cycle Assessment -- Principles and Framework
 - 4. ISO 14044 – Environmental Management -- Life Cycle Assessment -- Requirements and Guidelines
 - 5. ISO 21930 – Sustainability in Buildings and Civil Engineering Works -- Core Rules For Environmental Product Declarations Of Construction Products And Services
- J. National Association of Architectural Metal Manufacturers (NAAMM):
 - 1. Metal Finishes Manual for Architectural and Metal Products.

1.4 DEFINITIONS

- A. Activation Device: Device that, when actuated, sends an electrical signal to the door operator to open the door.
- B. Safety Device: Device that prevents a door from opening or closing, as appropriate.

1.5 PERFORMANCE REQUIREMENTS

- A. General: Provide automatic entrance door assemblies capable of withstanding loads and thermal movements based on testing manufacturer's standard units

- in assemblies similar to those indicated for this Project.
- B. Operating Range: Minus 30 deg F (Minus 34 deg C) to 130 deg F (54 deg C).
 - C. Opening-Force Requirements for Egress Doors: Force shall be adjustable; but, not more than 50 lbf (222 N) required to manually set swinging egress door panel(s) in motion.
 - D. Closing-Force Requirements: Not more than 30 lbf (133 N) required to prevent door from closing.

1.6 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of the Contract and Division 1 Specification Sections.
- B. Shop Drawings: Include plans, elevations, sections, details, hardware mounting heights, and attachments to other work.
- C. Color Samples for selection of factory-applied color finishes.
- D. Closeout Submittals:
 1. Owner's Manual.
 2. Warranties.
- E. Reports: Based on evaluation performed by a qualified agency, for automatic entrance door assemblies.
 1. Environmental Product Declaration.
 2. Evaluation Report for compliance with IBC.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative, with certificate issued by AAADM, who is trained for installation and maintenance of units required for this Project.
- B. Manufacturer Qualifications: A qualified manufacturer with a manufacturing facility compliant with ISO 9001.
- C. Manufacturer shall have in place a national service dispatch center providing 24 hours a day, 7 days a week, emergency call back service.
- D. Certifications: Automatic sliding door systems shall be certified by the manufacturer to meet performance design criteria in accordance with the following standards:

1. ANSI/BHMA A156.10.
 2. NFPA 101.
 3. UL 325 listed.
 4. IBC.
 5. BOCA.
- E. Environmental Product Declaration (EPD): EPD for automatic sliding entrances shall be certified by the manufacturer to comply with the following:
1. Prepared under Product Category Rule (PCR) UNCPC 4212.
 2. Conform to ISO standards 14025, 14040, 14044, 21930
 3. Life Cycle Assessment Basis: Cradle to Gate, minimum.
- F. Source Limitations: Obtain automatic entrance door assemblies through one source from a single manufacturer.
- G. Product Options: Drawings indicate sizes, profiles, and dimensional requirements of automatic entrance door assemblies and are based on the specific system indicated. Refer to Division 1 Section "Product Requirements."
- H. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- I. Emergency-Exit Door Requirements: Comply with requirements of authorities having jurisdiction for automatic entrances serving as a required means of egress.

1.8 PROJECT CONDITIONS

- A. Field Measurements: General Contractor shall verify openings to receive automatic entrance door assemblies by field measurements before fabrication and indicate measurements on Shop Drawings.
- B. Mounting Surfaces: General Contractor shall verify all surfaces to be plumb, straight and secure; substrates to be of proper dimension and material.
- C. Other trades: General Contractor shall advise of any inadequate conditions or equipment.

1.9 COORDINATION

- A. Templates: Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing automatic entrances to comply with indicated requirements.

- B. Electrical System Roughing-in: Coordinate layout and installation of automatic entrance door assemblies with connections to power supplies.

1.10 WARRANTY

- A. Automatic Entrances shall be free of defects in material and workmanship for a period of one (1) year from the date of substantial completion.
- B. During the warranty period the Owner shall engage a factory-trained technician to perform service and affect repairs. A safety inspection shall be performed after each adjustment or repair and a completed inspection form shall be submitted to the Owner.
- C. During the warranty period all warranty work, including but not limited to emergency service, shall be performed during normal working hours.

2 Products

1.11 AUTOMATIC ENTRANCES

- A. Manufacturer: Stanley Access Technologies; Dura-Glide™3000 Series sliding automatic entrances.

1.12 MATERIALS

- A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
1. Headers, stiles, rails, and frames: 6063-T6.
 2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221.
 3. Sheet and Plate: ASTM B 209.

- B. Sealants and Joint Fillers: Performed under Division 7 Section "Joint Sealants".

1.13 AUTOMATIC ENTRANCE DOOR ASSEMBLIES

- A. General: Provide manufacturer's standard automatic entrance door assemblies including doors, sidelights, framing, headers, carrier assemblies, roller tracks, door operators, activation and safety devices, and accessories required for a complete installation.
- B. Sliding Automatic Entrances:
1. Single Slide Entrances:
 - a. Configuration: One sliding leaf and one full sidelight.
 - b. Traffic Pattern: Two-way.

- c. Emergency Breakaway Capability: Sliding leaf only.
 - d. Mounting: Between jambs.
2. Bi-Parting Entrances:
- a. Configuration: Two sliding leaves and two full sidelights.
 - b. Traffic Pattern: Two-way.
 - c. Emergency Breakaway Capability: Sliding leaves only.
 - d. Mounting: Between jambs.

1.14 COMPONENTS

- A. Framing Members: Manufacturer's standard extruded aluminum reinforced as required to support imposed loads.
 - 1. Nominal Size: 1 $\frac{1}{4}$ inch by 4 $\frac{1}{2}$ inch (45 by 115 mm)
 - 2. Concealed Fastening: Framing shall incorporate a concealed fastening pocket, and continuous flush insert cover, extending full length of each framing member.
- B. Stile and Rail Doors and Sidelights: Manufacturer's standard 1 $\frac{3}{4}$ inch (45 mm) thick glazed doors with extruded-aluminum tubular stile and rail members. Incorporate concealed tie-rods that span full length of top and bottom rails.
 - 1. Glazing Stops and Gaskets: Snap-on, extruded-security aluminum stops and preformed gaskets.
 - 2. Stile Design: Narrow stile; 2 inch (51 mm) nominal width.
 - 3. Bottom Rail Design: Minimum 4 inch (102 mm) nominal height.
 - 4. Muntin Bars: Horizontal tubular rail member for each door; 2 inch (51 mm) nominal width.
- C. Glazing: Furnished under Division 8 Section Glazing. All Glazing furnished under separate section shall be 1/4 inch (6 mm) tempered insulated, hermetically sealed.
- D. Headers: Fabricated from extruded aluminum and extending full width of automatic entrance door units to conceal door operators, carrier assemblies, and roller tracks. Provide hinged or removable access panels for service and adjustment of door operators and controls. Secure panels to prevent unauthorized access.
 - 1. Mounting: Concealed, with one side of header flush with framing.
 - 2. Capacity: Capable of supporting up to 220 lb (100 kg) per panel, up to four panels, over spans up to 14 feet (4.3 m) without intermediate supports.
- E. Carrier Assemblies and Overhead Roller Tracks: Manufacturer's standard carrier assembly that allows vertical adjustment of at least 1/8 inch (3 mm);

consisting of urethane with precision steel lubricated ball-bearing wheels, operating on a continuous roller track. Support panels from carrier assembly by load wheels and anti-riser wheels with factory adjusted cantilever and pivot assembly. Minimum two ball-bearing load wheels and two anti-rise rollers for each active leaf. Minimum load wheel diameter shall be 2 1/2 inch (64 mm); minimum anti-rise roller diameter shall be 2 inch (51 mm).

Specifier Note: Modify paragraph below to suit project requirements.

- Select appropriate thresholds for applications.
- Make multiple selections as required; schedule accordingly.
- “No threshold” option for 2000 Series only.

- F. Thresholds: Manufacturer's standard thresholds as indicated below:
1. Continuous standard tapered extrusion double bevel.
 2. Standard square extrusion track under sidelights, for recessed installation; no threshold under sliding opening.
 3. All thresholds to conform to details and requirements for code compliance.
- G. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, non-staining, non-bleeding fasteners and accessories compatible with adjacent materials.
- H. Signage: Provide signage in accordance with ANSI/BHMA A156.10.

1.15 DOOR OPERATORS

- A. General: Provide door operators of size recommended by manufacturer for door size, weight, and movement; for condition of exposure; and for long-term, operation under normal traffic load for type of occupancy indicated.
- B. Electromechanical Operators: Self-contained overhead unit powered by a minimum of 1/4 horsepower, permanent-magnet DC motor with gear reduction drive, microprocessor controller; and encoder.
1. Operation: Power opening and power closing.
 2. Features:
 - a. Adjustable opening and closing speeds.
 - b. Adjustable open check and close check speeds.
 - c. Adjustable hold-open time between 0 and 30 seconds.
 - d. Obstruction recycle.
 - e. On/Off switch to control electric power to operator.
 - f. Energy conservation switch that reduces door-opening width.
 - g. Closed loop speed control with active braking and acceleration.
 - h. Adjustable obstruction recycle time delay.
 - i. Self-adjusting stop position.

- j. Self-adjusting closing compression force.
 - k. Onboard sensor power supply.
 - l. Onboard sensor monitoring.
 - m. Optional Switch to open/Switch to close operation.
 - n. Fire alarm interface, configurable to safely open or close the entrance on signal from fire alarm system.
 - 3. Mounting: Concealed.
 - 4. Drive System: Synchronous belt type.
- C. Electrical service to door operators shall be provided under Division 26 Electrical. Minimum service to be 120 VAC, 5 amps.
- 1.16 ELECTRICAL CONTROLS**
- A. Electrical Control System: Electrical control system shall include a microprocessor controller and a high-resolution position encoder. The encoder shall monitor revolutions of the operator shaft and send signals to microprocessor controller to define door position and speed.
 - 1. The high-resolution encoder shall have a resolution of not less than 1024 counts per revolution. Systems utilizing external magnets and magnetic switches are not acceptable.
 - 2. Electrical control system shall include a 24 VDC auxiliary output rated at 1 amp.
 - B. Performance Data: The microprocessor shall collect, and store performance data as follows:
 - 1. Counter: A non-resettable counter to track operating cycles.
 - 2. Event Reporting: Unit shall include non-volatile event and error recording including number of occurrences of events and errors, and cycle count of most recent events and errors.
 - 3. LED Display: Display presenting the current operating state of the controller.
 - C. Controller Protection: The microprocessor controller shall incorporate the following features to ensure trouble free operation:
 - 1. Automatic Reset Upon Power Up.
 - 2. Main Fuse Protection.
 - 3. Electronic Surge Protection.
 - 4. Internal Power Supply Protection.
 - 5. Resetable sensor supply fuse protection.
 - 6. Motor Protection, over-current protection.
 - D. Soft Start/Stop: A “soft-start” “soft-stop” motor driving circuit shall be provided for smooth normal opening and recycling.

- E. Obstruction Recycle: Provide system to recycle the sliding panels when an obstruction is encountered during the closing cycle. If an obstruction is detected, the system shall search for that object on the next closing cycle by reducing door closing speed prior to the previously encountered obstruction location, and will continue to close in check speed until doors are fully closed, at which time the doors will reset to normal speed. If obstruction is encountered again, the door will come to a full stop. The doors shall remain stopped until obstruction is removed and operate signal is given, resetting the door to normal operation.
- F. Programmable Controller: Microprocessor controller shall be field programmable.
 - 1. The following parameters may be adjusted:
 - a. Operating speeds and forces as required to meet specified ANSI/BHMA standard.
 - b. Adjustable and variable features specified.
 - c. Reduced opening position.
 - 2. Manual programming shall be available through local interface which has a two-digit display with a selection control including three push buttons.

1.17 ACTIVATION AND SAFETY DEVICES

- A. Combined Activation and Safety Sensors: Combined activation and safety sensors shall, in a single housing, detect motion and presence in accordance with ANSI/BHMA A156.10. Motion shall be detected using K-band microwave technology, presence by active infrared reflection technology.
 - 1. Mounting Height: Up to 11.5 feet (3.5 m) above finish floor
 - 2. Temperature Range: Between -31°F and 131°F (-35°C to 55°C) in all environmental conditions
 - 3. Relays: Form C, 50V at 0.3A for both activation and safety. Hold time of less than 0.5 seconds.
 - 4. Detection Pattern: When detection is made in the activation zone, and the entrance opens, the safety zone shall extend through the threshold on each side; creating an X-pattern. When activation and safety zones are cleared and the entrance closes the sensor will ignore the X-pattern safety zones.
 - 5. Combined motion and presence sensors shall be equal to or better than X-Zone Sensor by Optex.
- B. Photoelectric Beams: In addition to the threshold sensor include a minimum of two (2) doorway holding beams. Photoelectric beams shall be pulsed infrared type, including sender receiver assemblies for recessed mounting.
- C. Presence Sensor Monitoring: Sliding automatic entrances control system shall include a means to verify the functionality of all active presence sensors in

accordance with ANSI/BHMA A156.10. A detected fault shall cause automatic operation to cease until the fault is corrected.

1.18 HARDWARE

- A. General: Provide units in sizes and types recommended by automatic entrance door and hardware manufacturers for entrances and uses indicated.
- B. Emergency Breakaway Feature: Provide release hardware that allows panel(s) to swing out in direction of egress to full 90 degrees from any position in sliding mode. Maximum force to open panel shall be 50 lbf (222 N) according to ANSI/BHMA A156.10. Interrupt powered operation of panel operator while in breakaway mode.
 - 1. Emergency breakaway feature shall include at least one adjustable detent device mounted in the top of each breakaway panel to control panel breakaway force.
 - 2. Limit Arms: Limit arms shall be provided to control swing of sliding or non-sliding panels on break-out; swing shall not exceed 90 degrees. Limit arms shall be spring loaded to prevent shock, and include adjustable friction damping.
- C. Deadlocks: Manufacturer's standard deadbolt operated by exterior cylinder and interior thumb turn; with minimum 1 inch (25 mm) long throw bolt; ANSI/BHMA A156.5, Grade 1.
 - 1. Cylinders: As specified in Division 8 Section "Door Hardware."
 - 2. Hook Latch: Laminated-steel hook, mortise type, BHMA A156.5, Grade 1.
 - 3. Two-Point Locking: On bi-parting entrances, provide locking system that incorporates a device in the stile of active door leaves that automatically extends a flush bolt into overhead carrier assembly.
- D. Control Switch: Provide manufacturer's standard header mounted rocker switches and door position switch to allow for full control of the automatic entrance door. Controls to include, but are not limited to:
 - 1. One-way traffic
 - 2. Reduced Opening
 - 3. Open/Closed/Automatic
- E. Power Switch: Sliding automatic entrances shall be equipped with a two position On/Off rocker switch to control power to the door.
- F. Sliding Weather Stripping: Manufacturer's standard replaceable components complying with AAMA 701; made of wool, polypropylene, or nylon woven pile with nylon-fabric or aluminum-strip backing.

- G. Weather Sweeps: Manufacturer's standard adjustable nylon brush sweep mounted to underside of door bottom.

1.19 FABRICATION

- A. General: Factory fabricates automatic entrance door assembly components to designs, sizes, and thickness indicated and to comply with indicated standards.
1. Form aluminum shapes before finishing.
 2. Use concealed fasteners to greatest extent possible.
 - a. Where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration, use self-locking devices.
 - b. Reinforce members as required to receive fastener threads.
- B. Framing: Provide automatic entrances as prefabricated assemblies.
1. Fabricate tubular and channel frame assemblies with manufacturer's standard mechanical or welded joints. Provide sub-frames and reinforcement as required for a complete system to support required loads.
 2. Perform fabrication operations in manner that prevents damage to exposed finish surfaces.
 3. Form profiles that are sharp, straight, and free of defects or deformations.
 4. Prepare components to receive concealed fasteners and anchor and connection devices.
 5. Fabricate components with accurately fitted joints with ends coped or mitered to produce hairline joints free of burrs and distortion.
- C. Doors: Factory fabricated and assembled in profiles indicated. Reinforce as required to support imposed loads and for installing hardware.
- D. Door Operators: Factory fabricated and installed in headers, including adjusting and testing.
- E. Glazing: Fabricate framing with minimum glazing edge clearances for thickness and type of glazing indicated.
- F. Hardware: Factory install hardware to the greatest extent possible; remove only as required for final finishing operation and for delivery to and installation at Project site.

1.20 ALUMINUM FINISHES

- A. General: Comply with NAAMM Metal Finishes Manual for Architectural and Metal Products for recommendations for applying and designing finishes. Finish

designations prefixed by AA comply with system established by Aluminum Association for designing finishes.

Specifier Note: Modify paragraph below to suit project requirements.

- Select appropriate standard finish from options below.
- Make multiple selections as required; schedule accordingly.
- See last page of this document for a summary of unspecified finish options.

- B. Class II, Clear Anodic Finish: AA-M12C22A31 and the following:
1. AAMA 607.1
 2. Applicator must be fully compliant with all applicable environmental regulations and permits, including wastewater and heavy metal discharge.

2 Execution

1.21 INSPECTION

- A. Examine conditions for compliance with requirements for installation tolerances, header support, and other conditions affecting performance of automatic entrances. Proceed with installation only after unsatisfactory conditions have been corrected.

1.22 INSTALLATION

- A. General: Do not install damaged components. Fit frame joints to produce joints free of burrs and distortion. Rigidly secure non-movement joints.
- B. Entrances: Install automatic entrances plumb and true in alignment with established lines and grades without warp or rack of framing members and doors. Anchor securely in place.
1. Install surface-mounted hardware using concealed fasteners to greatest extent possible.
 2. Set headers, carrier assemblies, tracks, operating brackets, and guides level and true to location with anchorage for permanent support.
- C. Door Operators: Connect door operators to electrical power distribution system as specified in Division 26 Sections.
- D. Glazing: Performed under Division 8 Section "Glazing" in accordance with sliding automatic entrance manufacturer's instructions.
- E. Sealants: Comply with requirements specified in Division 7 Section "Joint Sealants".

1.23 FIELD QUALITY CONTROL

- A. Testing Services: Factory Trained Installer shall test and inspect each automatic entrance door to determine compliance of installed systems with applicable ANSI standards.

1.24 ADJUSTING

- A. Adjust door operators, controls, and hardware for smooth and safe operation, for tight closure, and complying with requirements in ANSI/BHMA A156.10.

1.25 CLEANING AND PROTECTION

- A. Clean glass and aluminum surfaces promptly after installation. Remove excess glazing and sealant compounds, dirt, and other substances. Repair damaged finish to match original finish. Comply with requirements in Division 8 Section "Glazing", for cleaning and maintaining glass.

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END OF SECTION 08 42 29

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 00 : Insulated Sectional Steel Doors
Section 08 42 29 : Sliding Automatic Entrances

.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 :	Monhard Ltd.
Locksets, Latchsets :	Schlage Lock Co.
Pulls, Pushes, Floor and 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 Monhard 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 4Ø41 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. Hager equivalents will be accepted.
- .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 or 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 01 70 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 03 30 00	:	Cast-in-Place Concrete
Section 05 50 00	:	Metal Fabrications

1.3 EXAMINATION

- .1 Examine floor surfaces to ensure that they are clean, level and free from cracks, ridges, dusting, scaling and carbonation. Report to the Consultant in writing of any conditions which might preclude a satisfactory installation.

1.4 SUBMITTALS

- .1 Samples: Submit samples of each specified flooring, base and accessory material in accordance with Section 01 33 00.
- .2 Maintenance Instructions: Submit maintenance instructions in accordance with Section 01 33 00 for incorporation in Project Data Book.
- .3 Extra Stock: Deliver to Owner on completion of work, and as they direct, 1% of the quantity of flooring installed (minimum one (1) box), of each material and colour, in labelled packages.

1.5 MAINTENANCE

- .1 Submit two copies of a maintenance manual, giving specific warnings of any maintenance practice or materials which may damage or stain the resilient flooring.

2 Products

2.1 MATERIALS

- .1 Corridor Covering: Mondo Ramflex tile – 900mm x 900mm x 9.5mm, allow two colours (border and field).
- .2 Adhesive: Two part urethane.

3 Execution

3.1 PREPARATION

- .1 Clean all surfaces to receive flooring of all grease, oil, paint and other foreign material, before beginning work. Fill all cracks and hollows with materials approved by the Consultant. Remove all existing floor and existing adhesives.
- .2 Prior to the installation of the flooring, concrete slabs shall be tested for excessive moisture content by a method acceptable to the Consultant, the manufacturer and the Contractor.
- .3 Concrete slabs shall be minimum 28 days old before commencing installation.
- .4 Ensure that surfaces and material are at a minimum temperature of between 18°C and 32°C (65°F and 90°F) for 24 hours before, during and for 72 hours after installation.
- .5 Thoroughly clean sub-floors of any substance deleterious to the bond of the adhesive.

3.2 INSTALLATION

- .1 Apply primer, adhesive, flooring and base materials in accordance with manufacturer's recommendations.
- .2 Apply adhesives evenly with notched trowel. Lay flooring to good contact with close, even joints, finish surfaces in true, even plane and perfectly smooth. Roll evenly with 150 lb. roller immediately after laying, in both directions, to ensure uniform adhesion and to remove air pockets.
- .3 Accurately scribe around walls, columns, floor outlets and other floor penetrations.
- .4 Each type of material used shall be from one manufacturer throughout the work and material in each area shall be of the same production run.
- .5 Install edge strips at all unprotected edges of resilient flooring and at junction of other floor finish.
- .6 Finish flooring in door openings, if not continuous and where no threshold exists, against the strike side of the door stop unless otherwise noted or directed.
- .7 Remove any adhesive from the surface of the flooring as the work

progresses and upon completion.

- .8 Protect newly laid flooring from construction traffic for a period of four to seven days to allow the flooring to bond firmly. Upon completion, leave floors clean, smooth and free from buckles, cracks and projecting edges.
- .9 Colour pattern to match to be provided by Consultant.

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°C (40°F), except for

7°C for latex paint at interior locations
10°C for latex paint at exterior locations
21°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.
- .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.

.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 80 00	:	Washroom 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 Cordon 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

1 General

1.1 RELATED SECTIONS

.1 Related Work Specified in Other Sections

Section 03 30 00 : Cast-in-Place Concrete
Section 04 20 00 : Unit Masonry

1.2 REFERENCES

- .1 AAMA 2605-22: Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminium Extrusions and Panels (With Coil Coating Appendix).
- .2 ASTM A1008/A1008M-23e1: Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Harness, Solution Hardened, and Bake Hardenable.
- .3 ASTM B456-17 (2022): Standard Specification for Electrodeposited Coatings of Copper Plus Nickle Plus Chromium and Nickel Plus Chromium.
- .4 ASTM D3363-2020: Standard Test Method for Film Hardness by Pencil Test.

1.3 SHOP DRAWINGS

- .1 Submit Shop Drawings as specified in Section 01 33 00.
- .2 Shop Drawings: Project-specific drawings, illustrating materials, layouts, dimensions, anchorage details, and details for base, trim, and end panels.

1.4 SAMPLES

- .1 Submit samples as specified in Section 01 33 00.
- .2 Selection Samples: Duplicate copies of manufacturer's standard colour charts, indicating available colour selections

1.5 EXTRA STOCK MATERIALS

- .1 Extra stock materials: Hooks, hinges, doors, bodies, base and end panels, sufficient quantity to reconstruct 10 additional lockers, colour to match those installed; clearly marked to identify:
 - a. Manufacturer's name,
 - b. Products name,

- c. Product colour.

1.6 MOCK-UPS

- .1 Mock-ups: One full-height mock-up panel, consisting of minimum 3 locker bays, demonstrating components, anchoring and finishing details, colours, base construction, sloping top and end panels.
- .2 Accepted mock-ups will be used as the standard for acceptance of the Work.
- .3 Remove and replace installed product that does not conform to accepted mock-up.
- .4 Remove mock-ups from Place of the Work upon Substantial Performance of the Work.

2 Products

2.1 MANUFACTURERS

- .1 Manufacturers having product considered acceptable for use:
 - a. ASI Group Storage
 - b. Hadrian Manufacturing Inc.
 - c. General Storage Systems.
 - d. Buddsteel.
 - e. Lincora Group.

2.2 DESCRIPTION

- .1 Metal Lockers: Single-tier design; 305 mm wide, 1 830 mm high, 380 mm deep; ventilated; complete with metal shelves, sloping tops, end panels, base, fillers and jamb trims.

2.3 MATERIALS

- .1 Sheet Steel: To ASTM A1008/A1008M, Commercial Steel (CS) Types A,B and C; cold-rolled steel sheet; thicknesses as specified below.

2.4 COMPONENTS

- .1 Frame: Welded construction; 1.52 mm thick sheet steel, formed channel sections, completed with punched ventilation slots; powder coated finish.
- .2 Compartment Doors: Welded construction; 1.89 mm thick sheet steel outer panel and 0.91 mm thick sheet steel full door size inner panel; rigid box

construction; powder coated finish.

- .3 Compartment Sides and Backs: 0.91 mm thick sheet steel; stiffening ribs on sides and flanges on backs; powder coated finish.
- .4 Compartment Shelves: 1.52 mm thick sheet steel, flanged, complete with channel formation at front; powder coated finish.
- .5 Compartment Tops: 1.52 mm thick sheet steel, flanged, complete with channel formation at front; powder coated finish.
- .6 Compartment Bottoms: Injection moulded copolymer polypropylene; having minimum 90 kg load capacity; impact resistant; black colour.
- .7 Metal Base: 1.52 mm thick sheet steel, recessed construction; 100 mm high; powder coated finish.
- .8 Sloping Tops: 1.2 mm thick sheet steel; powder coated finish.
- .9 End panels and Miscellaneous Trim: 1.52 mm thick sheet steel; complete with necessary clips and other attachment devices; powder coated finish.
- .10 Latching: Single-point, padlock type flange; in recessed chrome-plated steel pocket.
- .11 Coat Hooks: Zinc-plated metal coat hooks.
- .12 Hinges: 1.52 mm continuous hinges integral to frame and secured to door using theft-proof fasteners; powder coated finish.

2.5 FABRICATION

- .1 Verify site dimensions prior to fabrication.
- .2 Fabricate the work true to dimensions, square, plumb, and level.
- .3 Accurately fit members with hairline joints. Secure intersecting members with appropriate fastenings.
- .4 Fabricate the finished work free from distortion and defects detrimental to appearances and performance.
- .5 Incorporate ventilation slots at top and bottom of doors or frames.
- .6 Close door on frame with closure strike the full height of door. Fit outer face of door flush with outside face of frame.
- .7 Provide two rubber door grommets on lock side of frame.

- .8 Form and factory punch bodies with necessary assembly holes.
- .9 Flange tops and shelves on all four sides with channel formation at front shelves.
- .10 Provide two shelves and 3 coat hooks per compartment. Compartment tops and bottoms are not considered shelves.
- .11 Provide recessed, mechanically-fastened number plate on door, numbered as directed by consultant.
- .12 Provide hidden nylon friction door stop to ensure proper door closure and quiet operation.

2.6 FINISHES

- .1 Powder coated finish on Sheet Steel and Metal Components: To AAMA 2605; electrostatically sprayed polymer powder, factory-applied to 0.075 mm dry film thickness; graffiti and abrasion resistant with 4H hardness rating to ASTM D3363; colours as selected by consultant.
- .2 Chrome/Nickel plating on Metal Components: To ASTM B456, Type SC 2; electrodeposited nickel plus chromium coating; polished.

3 Execution

3.1 INSTALLATION

- .1 Install products true to dimensions.
- .2 Accurately secure joints and intersecting members with concealed attachment system.
- .3 Install products square, plumb and forming a rigid structure.

PART 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 Related Work Specified in Other Sections

- | | | |
|------------------|---|--|
| Section 08 10 00 | : | Doors & Frames |
| Section 08 36 00 | : | Insulated Sectional Steel Doors |
| Section 08 42 29 | : | Sliding Automatic Entrances |
| 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 23 | : | 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 & rear openings.
8. Travel (maximum): 100 ft (30 m) (150 fpm)
9. Rated Capacity: 2500 lb.
10. Rated Speed: 150 fpm.
11. Platform Size: 2500 front & rear - 2055mm x 1332mm
12. Clear Inside Dimensions: 2500 front & rear – 2540mm x 1924mm
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 36" (915 mm) or Center-Open Doors 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): $4.59 \pm 1.0 \text{ ft./ sec}^3$ ($1.4 \pm 0.3 \text{ m/ sec}^3$)
 - 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. Firefighter'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 of twelve (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.

PART 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 walls of 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.

PART 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 3.03 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

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END OF SECTION

Part 1 General

1.1 GENERAL INSTRUCTIONS

- .1 Comply with the General Conditions, Supplementary Conditions, and all of General Requirements, Mechanical and Electrical Divisions.

1.2 CASH ALLOWANCES (HST EXCLUDED)

- .1 Refer to CCDC 2 – 2020, GC 4.1 - CASH ALLOWANCES.
- .2 The Contract Price includes the allowances stated below, which allowances shall be expended as the Owner directs through the Consultant. The Consultant may direct the Contractor to bid work for which payment is made from an allowance.
- .3 The Contract Price, and not the cash allowances, includes the Contractor's overhead and profit in connection with such cash allowances.
- .4 Where the actual cost of the *Work* under any cash allowance is less than the amount of the allowance, the *Owner* shall be credited for the unexpended portion of the cash allowance, but not for the *Contractor's* overhead and profit on such amount.
- .5 The value of the work performed under a cash allowance is eligible to be included in progress payments.

1.3 FEES

- .1 The contractor is to determine general inspection fees with Electrical Safety Authority and include as part of tender.
- .2 A submission has been made (if required by this scope of project) by the consultant to the Electrical Safety Authority for review of this project. The payment of the required review costs will be coordinated by the consultant. A copy of the Electrical Safety Authority review report will be forwarded to the successful contractor for information and action. Contractor will not be responsible for these review costs.

1.4 ADDITIONAL INSTALLED EQUIPMENT

- .1 The electrical contractor is to review all specification sections forming part of the electrical bid documents and include additional equipment or components, as well as all associated installation costs and testing costs as noted, in the electrical bid price.

END OF SECTION

Part 1 General

1.1 GENERAL

- .1 **This Section covers items common to Electrical Divisions.**
- .2 This section supplements requirements of Division 1.
- .3 Furnish labour, materials, and equipment necessary for completion of work as described in contract documents.

1.2 INTENT

- .1 Mention herein or indication on Drawings of articles, materials, operations, or methods requires: supply of each item mentioned or indicated, of quality, or subject to qualifications noted; installation according to conditions stated: and, performance of each operation prescribed with furnishing of necessary labour, equipment, and incidentals for electrical work.
- .2 Where used, words "Section" and "Division" shall also include other Subcontractors engaged on site to perform work to make building and site complete in all respects.
- .3 Where used, word "supply" shall mean furnishing to site in location required or directed complete with accessory parts.
- .4 Where used, word "install" shall mean secured in place and connected up for operation as noted or directed.
- .5 Where used, word "provide" shall mean supply and install as each is described above.

1.3 TENDERS

- .1 Submit tender based on specified described equipment or Alternates listed.
- .2 State in Tender, names of all Subcontractors proposed for work under this Division.

1.4 LIABILITY INSURANCE

- .1 This contractor must maintain and produce at the request of the consultant proof of proper insurance to fully protect the Owner, the Consultant and the Contractor from any and all claims due to accidents, misfortunes, acts of God, etc.

1.5 DRAWINGS

- .1 Electrical Drawings do not show structural and related details. Take information involving accurate measurement of building from building drawings, or at building. Make, without additional charge, any necessary changes or additions to runs of conduits and ducts to accommodate structural conditions. Location of conduits and other equipment may be altered by the Consultant without extra charge provided change is made before installation and does not necessitate major additional material.

- .2 As work progresses and before installing fixtures and other fittings and equipment which may interfere with interior treatment and use of building, provide detail drawings or obtain directions for exact location of such equipment and fitments.
- .3 Electrical drawings are diagrammatic. Where required work is not shown or only shown diagrammatically, install same at maximum height in space to conserve head room (minimum 2200 mm (88") clear) and interfere as little as possible with free use of space through which they can pass. Conceal wiring, conduits and ducts in furred spaces, ceilings and walls unless specifically shown otherwise. Install work close to structure so furring will be small as practical.
- .4 Before commencing work, check and verify all sizes, locations, grades, elevations, levels and dimensions to ensure proper and correct installation. Verify existing/municipal services.
- .5 Locate all electrical equipment in such a manner as to facilitate easy and safe access to and maintenance and replacement of any part.
- .6 In every place where there is indicated space reserved for future or other equipment, leave such space clear, and install services so that necessary installation and connections can be made for any such apparatus. Obtain instructions whenever necessary for this purpose.
- .7 Relocate equipment and/or material installed but not co-ordinated with work of other Sections as directed, without extra charge.
- .8 Where drawings are done in metric and product not available in metric, the corresponding imperial trade size shall be utilized.

1.6 INTERFERENCE AND COORDINATION DRAWINGS

- .1 Prepare interference and equipment placing drawings to ensure that all components will be properly accommodated within the constructed spaces provided.
- .2 Prepare drawings to indicate coordination and methods of installation of a system with other systems where their relationship is critical. Ensure that all details of equipment apparatus, and connections are coordinated.
- .3 Ensure that clearances required by jurisdictional authorities and clearances for proper maintenance are indicated on drawings.
- .4 Upon consultant's request submit copies of interference drawings to the consultant.
- .5 Due to the nature of the building and the complexity of the building systems provide the following:
 - .1 Interference drawings, showing coordination of architectural, structural, mechanical, and electrical systems for the consultant's review prior to fabrication.
 - .2 Detailed equipment room drawings clearly showing all distribution equipment.
 - .3 Detailed layout drawings clearly showing conduit/feeder runs 78mm diameter or larger, including hangers or tray.

-
- .6 Provide CAD drawings (minimum file version AutoCAD 2013) in addition to hard copies.

1.7 QUALITY ASSURANCE

- .1 The installations of the division must conform to the latest edition of the Electrical Safety Code as well as its supplemental bulletins and instructions. Provide materials and labour necessary to comply with rules, regulations, and ordinances.
- .2 Abbreviations for electrical terms: to CSA Z85-1983.
- .3 In case of differences between building codes, provincial laws, local ordinances, utility company regulations, and Contract Documents, the most stringent shall govern. Promptly notify Consultant in writing of such differences.

1.8 ALTERNATES AND SUBSTITUTIONS

- .1 Throughout these sections are lists of "Alternate Equipment" manufacturers acceptable to Consultant if their product meets characteristics of specified described equipment.
- .2 Each bidder may elect to use "Alternate Equipment" from lists of Alternates where listed. Include for any additional costs to suit Alternated used. Prices are not required in Tender for Alternates listed.
- .3 When two or more suppliers/manufacturers are named in the Bid Documents, only one supplier/manufacturer of the products named will be acceptable; however, it is the responsibility of this Division to ensure "Alternate Equipment" fits space allocated and gives performance specified. If an "Alternate Equipment" unit is proposed and does not fit space allotted nor equal specified product in Consultant's opinion, supply of specified described equipment will be required without change in Contract amount. Only manufacturers listed will be accepted for their product listing. All other manufacturers shall be quoted as substitution stating conditions and credit amount.
- .4 If item of material specified is unobtainable, state in Tender proposed substitute and amount added or deducted for its use. Extra monies will not be paid for substitutions after Contract has been awarded.

1.9 EXAMINATION

- .1 Site Reviews
 - .1 Examine premises to understand conditions, which may affect performance of work of this Division before submitting proposals for this work.
 - .2 No subsequent allowance for time or money will be considered for any consequence related to failure to examine site conditions.

- .2 Drawings:
- .1 Electrical Drawings show general arrangement of fixtures, power devices, equipment, etc. Follow as closely as actual building construction and work of other trades will permit.
 - .2 Consider Architectural, Mechanical, and Structural Drawings part of this work insofar as these drawings furnish information relating to design and construction of building. These drawings take precedence over Electrical Drawings.
 - .3 Because of small scale of Drawings, it is not possible to indicate all offsets, fittings, and accessories, which may be required. Investigate structural and finish conditions affecting this work and arrange work accordingly, providing such fittings, valves, and accessories required to meet conditions.
 - .3 Ensure that items to be furnished fit space available. Make necessary field measurements to ascertain space requirements including those for connections and furnish and install equipment of size and shape so final installation shall suit true intent and meaning of Contract Documents. If approval is received by Addendum or Change Order to use other than originally specified items, be responsible for specified capacities and for ensuring that items to be furnished will fit space available.

1.10 SEQUENCING AND SCHEDULING

- .1 It is understood that while Drawings are to be followed as closely as circumstances permit, this Division will be held responsible for installation of systems according to the true intent and meaning of Contract Documents. Anything not clear or in conflict will be explained by making application to Consultant. Should conditions arise where certain changes would be advisable, secure Consultant's approval of these changes before proceeding with work.
- .2 Coordinate work of various trades in installing interrelated work. Before installation of electrical items, make proper provision to avoid interferences in a manner approved by Consultant. Changes required in work specified in these sections caused by neglect to do so shall be made at no cost to Owner.
- .3 Arrange fixtures, conduit, ducts, and equipment to permit ready access to junction boxes, starters, motors, control components, and to clear openings of doors and access panels.
- .4 Furnish and install inserts and supports required by these sections unless otherwise noted. Furnish sleeves, inserts, supports, and equipment that are an integral part of other Divisions of the Work to Sections involved in sufficient time to be built into construction as the Work proceeds. Locate these items and see that they are properly installed. Expense resulting from improper location or installation of items above shall be borne by the electrical trade.

- .5 Adjust locations of ducts, conduits, equipment, fixtures, etc, to accommodate work from interferences anticipated and encountered. Determine exact route and location of each conduit and duct prior to installation.
 - .1 Make offsets, transitions, and changes in direction of ducts, and electrical raceways as required to maintain proper head room and pitch of sloping lines whether or not indicated on Drawings.
 - .2 Supply and install pull boxes, etc, as required to effect these offsets, transitions, and changes in direction.

1.11 REQUEST FOR INFORMATION (RFI) PROCEDURES

- .1 RFIs shall be submitted to the consultant minimum two (2) weeks prior to answer being required. Failure to submit an RFI in a timely manner will forfeit delay claims and schedule extension requests by the contractor.
- .2 All RFIs will be submitted with the following information:
 - .1 RFI number
 - .2 Name of project
 - .3 Date of initiation
 - .4 Date response required by (minimum two (2) weeks)
 - .5 Subject
 - .6 Submitter's name
 - .7 Drawing/specification reference
 - .8 Photograph of the issue (if applicable)
 - .9 Description of the issue
 - .10 Contractor's proposed resolution

1.12 DRAW BREAKDOWN

- .1 This Contractor MUST submit a breakdown of the tender price into classifications to the satisfaction of the Consultant, with the aggregate of the breakdown totaling the total contract amount. **Each item must be broken out into material and labour costs.** Progress claims, when submitted are to be itemized against each item of the draw breakdown. This shall be done in table form showing contract amount, amount this draw, total to date, % complete and balance.
- .2 Breakdown shall be as follows:
 - .1 Permits and fees
 - .2 Mobilization (maximum 1%)
 - .3 Demolition
 - .4 Panelboards and miscellaneous distribution equipment
 - .5 Feeder conduits
 - .6 Branch conduits
 - .7 Feeder cables

- .8 Branch wiring
- .9 Lighting fixtures (interior)
- .10 Emergency lighting
- .11 Exterior lighting
- .12 Fire alarm system
- .13 Voice/Data system rough in
- .14 Starters, contactors and control devices
- .15 Electric heating
- .16 Wiring for mechanical equipment
- .17 Commissioning and Integrated System Testing**
- .18 Electrical contractor closeout requirements (minimum of 3% but not less than \$5,000.00)

- .3 The breakdown must be approved by the Consultant prior to submission of the first draw.
- .4 Breakdowns not complying to the above will not be approved.
- .5 Breakdown must indicate total contract amount.
- .6 Mobilization amount may only be drawn when all required shop drawings have been reviewed by the consultant.**

1.13 SHOP DRAWINGS AND PRODUCT DATA

- .1 General
 - .1 Furnish complete catalog data for manufactured items of equipment to be used in the Work to Consultant for review within 14 days after award of Contract.
 - .2 Upon receipt of reviewed shop drawing, product is to be ordered immediately.
 - .3 Provide a complete list of shop drawings to be submitted prior to first submission.
 - .4 Before submitting to the Consultant, review all shop drawings to verify that the products illustrated therein conform to the Contract Documents. By this review, the Contractor agrees that it has determined and verified all field dimensions, field construction criteria, materials, catalogue numbers, and similar data and that it has checked and coordinated each shop drawing with the requirements of the work and of the Contract Documents. The Contractor's review of each shop drawings shall be indicated by stamp, date and signature of a qualified and responsible person possessing by the appropriate authorization.
 - .5 If material or equipment is not as specified or submittal is not complete, it will be rejected by Consultant.
 - .6 Additional shop drawings required by the contractor for maintenance manuals, site copies etc., shall be photocopies of the "reviewed" shop drawings. All costs to provide additional copies of shop drawings shall be borne by the contractor.

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- .7 **Submit all shop drawings for the project as a package. Partial submittals will not be accepted.**
 - .8 Catalog data or shop drawings for equipment, which are noted as being reviewed by Consultant or his Engineer shall not supersede Contract Documents.
 - .9 Review comments of Consultant shall not relieve this Division from responsibility for deviations from Contract Documents unless Consultant's attention has been called to such deviations in writing at time of submission, nor shall they relieve this Division from responsibility for errors in items submitted.
 - .10 Check work described by catalog data with Contract Documents for deviations and errors.
 - .11 Shop drawings and product data shall show:
 - .1 Mounting arrangements.
 - .2 Operating and maintenance clearances. e.g. access door swing spaces.
 - .12 Shop drawings and product data shall be accompanied by:
 - .1 Detailed drawings of bases, supports, and anchor bolts.
 - .2 Manufacturer test data where requested.
 - .3 Manufacturer to certify as to current model production.
 - .4 Certification of compliance to applicable codes.
 - .13 State sizes, capacities, brand names, motor HP, accessories, materials, gauges, dimensions, and other pertinent information. List on catalog covers page numbers of submitted items. Underline applicable data.
 - .14 **If a shop drawing is returned “reviewed as noted” this Contractor must provide written indication that the comments have been complied with.**
 - .15 A partial list of shop drawings includes:
 - .1 Switchboards, panelboards, and transformers
 - .2 Fire alarm system
 - .3 Luminaires
 - .4 Emergency battery units and fixtures
 - .5 Electrical heaters
 - .6 Starters, contactors and control devices
 - .7 Firestopping materials
 - .8 Wiring devices
 - .9 Occupancy sensors
 - .10 Roof cone
 - .11 Integrated Life Safety System Testing Plan (ITP)

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- .2 Submissions shall be submitted electronically as per the following directions:
- .1 Electronic Submissions:
- .1 Electronically submitted shop drawings shall be prepared as follows:
- .1 Use latest software to generate PDF files of submission sheets.
- .2 Scanned legible PDF sheets are acceptable. Image files are not acceptable.
- .3 PDF format shall be of sufficient resolution to clearly show the finest detail.
- .4 PDF page size shall be standardized for printing to letter size (8.5"x11"), portrait with no additional formatting required by the consultant. Submissions requiring larger detail sheets shall not exceed 11"x17".
- .5 Submissions shall contain multiple files according to section names as they appear in Specification.
- .6 File names shall include consultant project number and description of shop drawing section submitted.
- .7 Each submission shall contain an index sheet listing the products submitted, indexed in the same order as they appear in the Specification. Include associated PDF file name for each section.
- .8 On the shop drawing use an "electronic mark" to indicate what is being provided.
- .9 **Each file shall bear an electronic representation of the "company stamp" of the contractor. If not stamped the file submission will not be reviewed.**
- .2 Email submissions shall include subject line to clearly identify the consultants' project number and the description of the shop drawings submitted.
- .3 Electronic attachments via email shall not exceed 10MB. For submissions larger than 10MB, multiple email messages shall be used. Denote related email messages by indicating "1 of 2" and "2 of 2" in email subject line for the case of two messages.
- .4 Electronic attachments via web links (URL) shall directly reference PDF files. Provide necessary access credentials within link or as username/password clearly identified within body of email message.
- .5 On site provide one copy of the "reviewed" shop drawings in a binder as noted above.
- .6 Contractor to print copies of "reviewed" shop drawings and compile into maintenance manuals in accordance with requirements detailed in this section.

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- 1.14 CARE, OPERATION AND START-UP**
- .1 Instruct Consultant and operating personnel in the operation, care and maintenance of equipment.
 - .2 Arrange and pay for services of manufacturer's factory service engineer to supervise start-up of installation, check, adjust, balance and calibrate components.
 - .3 Provide these services for such period, and for as many visits as necessary to put equipment in operation, and ensure that operating personnel are conversant with all aspects of its care and operation.
- 1.15 VOLTAGE RATINGS**
- .1 Operating voltages: to CAN3-C235-83.
 - .2 Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard. Equipment to operate in extreme operating conditions established in above standard without damage to equipment.
- 1.16 PERMITS, FEES AND INSPECTION**
- .1 A submission has been made (if required by this scope of project) by the consultant to the Electrical Safety Authority for review of this project. The payment of the required review costs will be co-ordinated by the consultant. A copy of the Electrical Safety Authority review report will be forwarded to the successful contractor for information and action.
 - .2 The contractor is required to include in his tender all required inspection costs by the Electrical Safety Authority. Permit application is the responsibility of the contractor.
 - .3 Reproduce drawings and specifications required by Electrical Safety Authority at no cost.
 - .4 Notify Consultant of changes required by Electrical Safety Authority prior to making changes.
 - .5 Furnish Certificates of Acceptance to Engineer from Electrical Safety Authority and other authorities having jurisdiction upon completion of work.
 - .6 This contractor must furnish any certificates required to indicate that the work completed conforms with laws and regulations of authorities having jurisdiction.
- 1.17 MATERIALS AND EQUIPMENT**
- .1 Equipment and material to be CSA certified. Where there is no alternative to supplying equipment which is not CSA certified, obtain special approval from Electrical Safety Authority.
 - .2 Factory assemble control panels and component assemblies.
- 1.18 ELECTRIC MOTORS, EQUIPMENT, AND CONTROLS**
- .1 Supplier and installer responsibility is indicated in the Equipment Wiring Schedule on electrical drawings.

- .2 Control wiring and conduit is specified in the Electrical specifications except for conduit, wiring and connections below 50 V, which are related to control systems specified in the Mechanical specifications.

1.19 FINISHES

- .1 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two coats of finish enamel.
.1 Paint indoor switchgear and distribution enclosures light grey.
.2 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.
.3 Clean and prime exposed non-galvanized hangers, racks, fastenings, and conduits etc. to prevent rusting.

1.20 EQUIPMENT IDENTIFICATION

- .1 Identify electrical equipment with nameplates as follows:
.2 Nameplates:
.1 Lamicoid 3 mm (1/8") thick plastic engraving sheet, black face, white core, mechanically attached with self tapping screws.

NAMEPLATE SIZES

Size 1	9 mm x 50 mm (3/8" x 2")	1 line	3 mm (1/8") high letters
Size 2	12 mm x 70 mm (1/2" x 2 1/2")	1 line	5 mm (3/16") high letters
Size 3	12 mm x 70 mm (1/2" x 2 1/2")	2 lines	3 mm (1/8") high letters
Size 4	20 mm x 90 mm (3/4" x 3 1/2")	1 line	9 mm (3/8") high letters
Size 5	20 mm x 90 mm (3/4" x 3 1/2")	2 lines	5 mm (3/16") high letters
Size 6	25 mm x 100 mm (1" x 4")	1 line	12 mm (1/2") high letters
Size 7	25 mm x 100 mm (1" x 4")	2 lines	6 mm (1/4") high letters

- .3 Wording on nameplates labels to be approved by Consultant prior to manufacture.
.4 Allow for average of twenty-five (25) letters per nameplate.
.5 Identification to be English.
.6 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.
.7 Nameplates for disconnects, starters and contactors must indicate equipment being controlled and voltage.
.8 Nameplates for transformers must indicate transformer label as indicated and capacity, primary, and secondary voltages.

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- 1.21 WIRING IDENTIFICATION**
- .1 Identify wiring with permanent indelible identifying markings, either numbered or coloured plastic tapes, on both ends of phase conductors of feeders and branch circuit wiring.
 - .2 Maintain phase sequence and colour coding throughout.
 - .3 Colour code: to CSA C22.1.
 - .4 Use colour coded wires in communication cables, matched throughout system.
- 1.22 CONDUIT AND CABLE IDENTIFICATION**
- .1 Colour code conduits, boxes and metallic sheathed cables.
 - .2 Code with plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor, and at 15 m (45') intervals.
 - .3 Colour bands must be 25 mm (1") wide.

	<u>Prime</u>
up to 208 V	yellow
209 to 600 V	white
Voice system	green
Data System	orange
Fire alarm	red
 - .4 This contractor must paint all system junction boxes and covers in conformance with the above schedule.
- 1.23 PROTECTION OF OPENINGS**
- .1 Protect equipment and systems openings from dirt, dust, and other foreign materials with materials appropriate to system.
- 1.24 WIRING TERMINATIONS**
- .1 Lugs, terminals, screws used for termination of wiring to be suitable for either copper or aluminum conductors.
- 1.25 MANUFACTURERS AND CSA LABELS**
- .1 All labels must be visible and legible after equipment is installed.
- 1.26 WARNING SIGNS**
- .1 To meet requirements of Electrical Safety Authority and Consultant.
 - .2 Provide porcelain enamel signs, with a minimum size of 175 mm x 250 mm (7" x 10").

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- 1.27 LOCATION OF OUTLETS**
- .1 Do not install outlets back-to-back in wall; allow minimum 150 mm (6") horizontal clearance between boxes.
 - .2 Change location of outlets at no extra cost or credit, providing distance does not exceed 3 m (10'), and information is given before installation.
 - .3 Locate light switches on latch side of doors. Locate disconnect devices in mechanical and elevator machine rooms on latch side of door.
- 1.28 MOUNTING HEIGHTS**
- .1 Mounting height of equipment is from finished floor to centreline of equipment unless specified or indicated otherwise. Coordinate with block coursing (if applicable).
 - .2 If mounting height of equipment is not specified or indicated, verify before proceeding with installation.
 - .3 Install electrical equipment at following heights unless indicated otherwise.
 - .1 Local switches: 1100 mm (43.3").
 - .2 Wall receptacles:
 - .1 General: 400 mm (16").
 - .2 Above top of continuous baseboard heater: 200 mm (8").
 - .3 Above top of counters or counter splash backs: 100 mm (4").
 - .4 In mechanical rooms: 1200 mm (48").
 - .3 Panelboards: as required by Code or 1400 mm (56").
 - .4 Voice/Data outlets: At height of adjacent outlet or at 400 mm (16").
 - .5 Fire alarm stations: 1200 mm (3' - 11").
 - .6 Fire alarm visual and signal devices: 2250 mm (88 ½").
 - .7 Heaters: 200 mm (8" AFF) to bottom of heater.
- 1.29 LOAD BALANCE**
- .1 Measure phase current to panelboards with normal loads (lighting) operating at time of acceptance. Adjust branch circuit connections as required to obtain best balance of current between phases and record changes.
 - .2 Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment.
 - .3 Submit, at completion of work, report listing phase and neutral currents on panelboards, dry-core transformers and motor control centres, operating under normal load. State hour and date on which each load was measured, and voltage at time of test.

1.30 CONDUIT AND CABLE INSTALLATION

- .1 Install conduit and sleeves prior to pouring of concrete. Sleeves through concrete shall be schedule 40 steel pipe, sized for free passage of conduit, and protruding 50 mm (2") beyond either side.
- .2 Install cables, conduits and fittings to be embedded or plastered over, neatly and close to building structure so furring can be kept to minimum.

1.31 FIELD QUALITY CONTROL

- .1 Conduct and pay for following tests:
 - .1 Power distribution system including phasing, voltage, grounding, and load balancing.
 - .2 Circuits originating from branch distribution panels.
 - .3 Lighting and its control.
 - .4 Motors, heaters and associated control equipment including sequenced operation of systems where applicable.
 - .5 Systems: fire alarm system, communications, security.
- .2 Furnish manufacturer's certificate or letter confirming that entire installation as it pertains to each system has been installed to manufacturer's instructions.
- .3 Insulation resistance testing.
 - .1 Megger circuits, feeders and equipment up to 350 V with a 500 V instrument.
 - .2 Megger 350-600 V circuits, feeders and equipment with a 1000 V instrument.
 - .3 Check resistance to ground before energizing.
- .4 Carry out tests in presence of Consultant.
- .5 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.
- .6 Submit test results for Consultant's review.

1.32 CO-ORDINATION OF PROTECTIVE DEVICES

- .1 Ensure circuit protective devices such as overcurrent trips, relays and fuses are installed to required values and settings as indicated on drawings or as determined from co-ordination study.

1.33 GUARANTEE AND WARRANTY

- .1 At ready for takeover of this project this Contractor must provide a written guarantee indicating that any defects, not due to ordinary wear and tear or improper use which occur within the first year from the date of ready for takeover will be corrected at the contractors expense.

- .2 If the electrical sub-contractor's office is 50 kilometers (30 miles) or more from the project site, the sub-contractor is to provide a service/warranty work agreement for warranty period with a local electrical sub-contractor approved by Consultant. Include copy of service/warranty agreement in warranty section of operation and maintenance manual.
- .3 Warranty period shall start from date of ready for takeover completion.
- .4 Refer to individual specification sections for information on any special manufacturer's equipment warranties.

1.34 SYSTEM START UP

- .1 Provide consultant with written notice verifying all equipment operation and installation is complete prior to scheduled start-up period.
- .2 Start up shall be in presence of the following: owner or representative, contractor, and manufacturer's representative. Each person shall witness and sign off each piece of equipment. Consultant's attendance will be determined by consultant.
- .3 Arrange with all parties and provide 72 hours notice for start up procedure.
- .4 Simulate system start up and shut down and verify operation of each piece of equipment.
- .5 These tests are to demonstrate that the systems and equipment installed are operational as specified.
- .6 The contractor must describe during the start up session the required maintenance for each piece of equipment according to the manufacturer.
- .7 The contractor must provide all necessary tools (including a digital multimeter) to successfully complete the start up procedure.

1.35 OPERATION AND MAINTENANCE MANUAL

- .1 Provide operation and maintenance data for incorporation into manual as specified in other Sections of this Division.
- .2 Operation and maintenance manual to be approved by, and final copies deposited with, Consultant before final inspection.
 - .1 Submit 1 copy of Operation and Maintenance Manual to Consultant for approval. Submission of individual data will not be accepted unless so directed by Consultant. Submission can be done electronically in pdf format or as a hardcopy.
 - .1 Electronic submission/pdf file is required to be bookmarked. Any submission received without bookmarking will be immediately returned as unacceptable.
 - .2 Hardcopy submission shall be in a three-ring binder (minimum 50 mm (2") ring) and labelled as 'Operation and Maintenance Manual' with project name and location. Dividers are to be used for binder organization.

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- .2 Make changes as required and re-submit as directed by Consultant.
 - .3 Each manual must include (in "tabbed" sections) the following:
 - .1 Index
 - .2 List of General, Mechanical, Electrical Contractors and all associated sub-contractor names, addresses and contact numbers.
 - .3 List of suppliers and equipment wholesalers local to the project.
 - .4 Letter of contractor's warranty and guarantee for all parts, equipment and workmanship.
 - .5 List of manufacturers, spare parts list and source.
 - .6 Copy of typewritten schedules for all new and renovated panels.
 - .7 Copy of all substantial performance final certificates.
 - .8 Copy of electrical shop drawings which have been stamped and reviewed by Consultant.
 - .9 Electrical As-built drawings including contractor company's as built stamp.
 - .10 Coordination study/Arc flash hazard study shop drawings
 - .11 Any special warranties on equipment required (i.e. LED lighting, digital lighting control).
 - .12 Certificate of completion from all associated sub-contractors.
 - .13 System commissioning certificate and report.

1.36 AS-BUILT DRAWINGS

- .1 Site records:
 - .1 Contractor shall provide 2 sets of reproducible electrical drawings. Provide sets of white prints as required for each phase of the work. Mark thereon all changes as work progresses and as changes occur. This shall include field and contract changes to electrical systems.
 - .2 On a weekly basis, transfer information to reproducibles, revising reproducibles to show all work as actually installed.
 - .3 Use different colour waterproof ink for each service.
 - .4 Make available for reference purposes and inspection at all times.
- .2 As-built drawings:
 - .1 Identify each drawing in lower right hand corner in letters at least 3 mm (1/8") high as follows: - "AS-BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW ELECTRICAL SYSTEMS AS INSTALLED" (Signature of Contractor) (date).
 - .2 Submit hard copy to Consultant for approval. When returned, make corrections (if any) as directed.
 - .3 Once approved, submit completed reproducible paper as-built drawings as well as a scanned pdf file copy on USB stick with Operating and Maintenance Manuals.

1.37

DEMONSTRATION AND OPERATING AND MAINTENANCE INSTRUCTIONS

- .1 Supply tools, equipment and personnel to demonstrate and instruct operating and maintenance personnel in operating, controlling, adjusting, trouble-shooting and servicing of all systems and equipment during regular work hours, prior to acceptance.
- .2 Manufacturers or their representatives are to provide demonstrations and instructions.
- .3 Use operation and maintenance manual, As-built drawings, audio visual aids, etc. as part of instruction materials.
- .4 Instruction duration time requirements as specified in appropriate sections.
- .5 Where deemed necessary, Consultants may record these demonstrations on video tape for future reference.

1.38

OCCUPANCY REQUIREMENTS

- .1 The contractor shall provide the following documentation to the consultant's satisfaction prior to receiving occupancy. Failure to provide the proper documentation will result in the occupancy not being granted. List of required documentation:
 - .1 Final Certificates (required prior to consultant's release of conformance letter).
 - .1 Electrical Safety Authority.
 - .2 Emergency Lighting.
 - .3 Integrated Life Safety Systems Commissioning.
 - .4 Testing of Integrated Fire Protection and Life Safety Systems Certificate.
 - .5 Fire Alarm Verification Certificate.

1.39

READY FOR TAKEOVER

- .1 Complete the following to the satisfaction of the consultant prior to request for ready for takeover.
 - .1 As-built Drawings.
 - .2 Maintenance Manuals.
 - .3 System Start up.
 - .4 Instructions to Owners.
 - .5 Security.
 - .6 Coordination Study / Arc Flash Hazard (including photos of each breaker).
 - .7 Lighting Control System.

1.40

TRIAL USAGE

- .1 Consultant or owner may use equipment and systems for test purposes prior to acceptance. Supply labour, material, and instruments required for testing.

1.41 REVISION TO CONTRACT

- .1 Provide the following for each item in a given change notice:
 - .1 Itemized list of material with associated costs.
 - .2 Labour rate and itemized list of labour for each item.
 - .3 Copy of manufacturers/suppliers invoice if requested.

1.42 EQUIPMENT SUPPORTS

- .1 Equipment supports supplied by equipment manufacturer: shall be installed by the electrical contractor.
- .2 Equipment supports not supplied by equipment manufacturer: fabricate from structural grade steel meeting requirements of - Structural Steel Section. Submit structural calculations with shop drawings if necessary.
- .3 Mount base mounted equipment on chamfered edge housekeeping pads, minimum of 100 mm (4") high and 150 mm (6") larger than equipment dimensions all around. This installation of this pad shall be the responsibility of the electrical contractor.
- .4 This contractor shall be responsible for providing all anchor bolts and associated formed concrete bases for lighting standards as detailed.

1.43 SLEEVES

- .1 Pipe sleeves: at points where pipes pass through masonry, concrete, or fire rated assemblies and as indicated.
- .2 Schedule 40 steel pipe.
- .3 Sleeves with annular fin continuously welded at midpoint:
 - .1 Through foundation walls.
 - .2 Where sleeve extends above finished floor.
- .4 Sizes: minimum 6 mm (1/4") clearance all around, between sleeve and conduit.
- .5 Terminate sleeves flush with surface of concrete and masonry walls, concrete floors on grade and 25 mm (1") above other floors.
- .6 Through foundation walls PVC sleeves are acceptable.
- .7 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 Fill future-use sleeves with easily removable filler.

1.44

FIRESTOPPING

- .1 Firestopping material and installation within annular space between conduits, ducts, and adjacent fire separation.
- .2 Provide materials and systems capable of maintaining effective barrier against flame, smoke, and gases.
- .3 Comply with the requirements of CAN4-S115-M35, and do not exceed opening sized for which they have been tested.
- .4 Systems to have an F or FT rating (as applicable) not less than the fire protection rating required for closures in a fire separation.
- .5 The firestopping materials are not to shrink, slump or sag and be free of asbestos, halogens and volatile solvents.
- .6 Firestopping materials are to consist of a component sealant applied with a conventional caulking gun and trowel.
- .7 Firestop materials are to be capable of receiving finish materials in those areas, which are exposed and scheduled to receive finishes.
- .8 Firestopping shall be inspected and approved by local authority prior to concealment or enclosure.
- .9 Install material and components in accordance with ULC certification, manufacturers instructions and local authority.
- .10 **Submit product literature and installation material on firestopping in shop drawing and product data manual.**
- .11 Acceptable manufacturers:
 - .1 Rectorseal Corporation (Metacaulk)
 - .2 Proset Systems
 - .3 3M
 - .4 Hilti
 - .5 STI Firestop
- .12 Ensure firestop manufacturer representative performs on site inspections and certifies installation. Submit inspection reports/certification at time of ready for takeover.

1.45

PAINTING

- .1 Refer to Section Interior Painting and specified elsewhere.
- .2 Apply at least one coat of corrosion resistant primer paint to ferrous supports and site fabricated work.

- .3 Prime and touch up marred finished paintwork to match original.
- .4 Restore to new condition, or replace equipment at discretion of consultant, finishes which have been damaged too extensively to be merely primed and touched up.

1.46 ACCESS DOORS

- .1 Supply access doors to concealed electrical equipment for operating, inspecting, adjusting and servicing.
- .2 Flush mounted 600 mm x 600 mm (24" x 24") for body entry and 300 mm x 300 mm (12" x 12") for hand entry unless otherwise noted. Doors to open 180°, have rounded safety corners, concealed hinges, screwdriver latches and anchor straps.
- .3 Material:
 - .1 Special areas such as tiled or marble surfaces: use stainless steel with brushed satin or polished finish as directed by Consultant.
 - .2 Remaining areas: use prime coated steel.
 - .3 Fire rated areas: provide ULC listed access doors
- .4 Installation:
 - .1 Locate so that concealed items are accessible.
 - .2 Locate so that hand or body entry (as applicable) is achieved.
 - .3 Installation is specified in applicable sections.
- .5 Acceptable materials:
 - .1 Le Hague
 - .2 Zurn
 - .3 Acudor
 - .4 Nailor Industries Inc.

1.47 DELIVERY STORAGE & HANDLING

- .1 Follow Manufacturer's directions in delivery, storage, and protection, of equipment and materials. Contractor to include all costs associated with delivery storage and handling in tender price.
- .2 Deliver equipment and material to site and tightly cover and protect against dirt, water, and chemical or mechanical injury, but have readily accessible for inspection. Store items subject to moisture damage (such as controls) in dry, heated space.

1.48 REPAIR, CUTTING, CORING AND RESTORATION

- .1 Be responsible for required digging, cutting, and patching incident to work of this Division and make required repairs afterwards to satisfaction of Consultant. Cut carefully to minimize necessity for repairs to existing work. Do not cut beams, columns, or trusses.

- .2 Patch and repair walls, floors, ceilings, and roofs with materials of same quality and appearance as adjacent surfaces unless otherwise shown. Surface finishes shall exactly match existing finishes of same materials.
- .3 Each Section of this Division shall bear expense of cutting, patching, repairing, and replacing of work of other Sections required because of its fault, error, tardiness, or because of damage done by it.
- .4 Slots, cores and openings through floors, walls, ceilings, and roofs shall be provided by this contractor but performed by a trade specializing in this type of work. This Division shall see that they are properly located and do any cutting and patching caused by its neglect to do so.

1.49 EXISTING SYSTEMS

- .1 Connections into existing systems to be made at time approved by Consultant. Request written approval of time when connections can be made.
- .2 Be responsible for damage to existing plant by this work.

1.50 CLEANING

- .1 Clean interior and exterior of all electrical equipment provided including light fixture lenses.
- .2 In preparation for final acceptance, clean and refurbish all equipment and leave in operating condition.

1.51 ASBESTOS

- .1 If asbestos is suspected or identified cease all work in the immediate area in accordance with OHSA and notify consultant.
- .2 Each contractor and on site employee of the contractor shall have "asbestos awareness training".
- .3 The Contractor shall ensure that employees who may come into contact with asbestos due to the nature of the work that they perform, have received training that enables them to recognize asbestos and that enables them to react in accordance with the Occupational Health and Safety Act and regulations thereto should contact with asbestos occur during the course of their work.
- .4 **It is the responsibility of the contractor to review the asbestos book in the building prior to starting any work.**
- .5 Existing occupied buildings (depending upon their age) may contain asbestos in thermal insulating materials and some manufactured products, such as vinyl asbestos floor tile. Any insulating materials, on pipes, fittings, boilers, tanks, ductwork, etc. may contain asbestos and shall not be disturbed.
- .6 **A survey of each building documenting the location and condition of asbestos-containing materials is available for your mandatory review prior to commencing any work on premises.**

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- 1.52 DISCONNECTION AND REMOVAL**
- .1 Disconnect and/or remove equipment as indicated.
 - .2 Cap and conceal all redundant and obsolete connections.
 - .3 Provide a list of equipment to be removed to the owner, for his acceptance of same. Remove all equipment from site, which the owner does not retain.
 - .4 Store equipment to be retained by owner on site where directed by consultant.
- 1.53 OWNER SUPPLIED EQUIPMENT**
- .1 Connect to equipment supplied by the owner and make operable.
 - .2 Design drawings are diagrammatic and do not necessarily indicate all specific final connection requirements. For the purposes of bidding, electrical trade shall include but not be limited to provision of a junction box to connect equipment wiring tail, provision of suitable disconnecting means, and flexible connection directly to equipment.
- 1.54 ENCLOSURES**
- .1 This contractor must ensure that all electrical equipment mounted in sprinklered areas is provided with an enclosure in conformance with the Electrical Safety Code.
- 1.55 PHASING OF WORK**
- .1 This work for this project shall be constructed in phases. Refer to the architectural drawings for phasing information and details. Misinterpretation of the drawings with respect to the extent of the phasing of the work shall not relieve the contractor of the work required to complete the entire contract.

END OF SECTION

Part 1 General

1.1 GENERAL PROVISIONS

- .1 Conform to the General Provisions of Division 1 and Electrical General Requirements Section.
- .2 This project is one of a retrofit nature in part, and which will require extensive demolition.
- .3 Allow for all remedial work in areas indicated on the drawings and as generally defined in the relevant sections of the specifications.

1.2 SCOPE OF WORK

- .1 The scope of work is essentially the selected disconnection and/or removal of services and/or equipment, devices etc. as indicated or required to complete the work.
- .2 The intent of the scope is the selective demolition and removal of electrical services and equipment within existing building except for some items noted to remain.
- .3 The reference drawings indicate some of the services which shall remain and some may have to be retained through construction and a phased changeover to help construction i.e. electrical service, phone service, winter heat, and temporary construction services i.e. washroom facility. This co-ordination remains the responsibility of the contractors.

Part 2 Products

2.1 GENERAL

- .1 This Division is to liaise with the Owners or Consultant for equipment being removed that may be suitable for reuse to that specified or handed over to the owner.
- .2 This Division to take full responsibility for any special tools or equipment required to disassemble or remove material from building.

Part 3 Execution

3.1 GENERAL

- .1 The general requirements are indicated on the drawings and on the outline specification in Division 1.
- .2 The general execution of the demolition is to be carried out in a clean and efficient manner.
- .3 Demolition of existing ceiling, walls etc., to facilitate removal of existing services or equipment or installation of new to be kept to a minimum and then restored to match existing.

- .4 All openings or holes created by removal of existing electrical systems which are not being reused are to be patched with the same material surrounding surfaces.
- .5 All new holes and openings to facilitate electrical systems are to be patched to match surrounding surfaces.
- .6 Protect all existing furnishings materials and equipment. Any damage occurring as a result of the work of this Division shall be repaired or replaced at the expense of this Division.
- .7 Where work involves breaking into or connecting to existing services, carry out work at times directed by the Owners in an expedient manner with minimum disruption to the facility and systems downtime.
- .8 Where unknown services are encountered immediately advise Consultant and confirm findings in writing.
- .9 Where the location of any services has been shown on the plans, such information is not guaranteed. It is this Division's responsibility to verify locations, etc., immediately after moving on site. Should for any reason the information obtained necessitates changes in procedure or design, advise the Consultant at once. If verification of existing conditions is not done at the outset and any problems arise, the responsibility for same is entirely this Division's.
- .10 Disconnect and/or remove equipment, devices, cabling, services, etc. as indicated.
- .11 Remove all redundant and obsolete systems, connections, and wiring.
- .12 Provide a list of equipment to be removed to the owner, for their acceptance of same. Remove all equipment from site that the owner does not retain.
- .13 Maintain equipment to be retained by owner on site where directed by consultant.
- .14 Demolition of all parts of the work must be completed within the confines of the work area and in such a way as the dust produced and risk to injury of will not adversely affect the building users.
- .15 Demolished areas of the existing building will remain in their current use in some cases. Demolition in these areas must be kept to the minimum required to complete the work.
- .16 Demolition shall take place within areas isolated from all other areas with appropriate hoarding, scaffolding, netting, fencing or other means of security between building users and the work.

END OF SECTION

Part 1 General

1.1 INTENT

- .1 Life safety and fire protection systems are to be installed to comply with the provisions of the current Ontario Building and Fire Codes. As a result, testing of these integrated systems must be performed as a whole to ensure the proper operation and inter-relationship between systems (functional testing).
- .2 The testing is to provide functional verification and documented confirmation that these building systems satisfy the intent of the Building Code.
- .3 These systems as applicable to any given project include but are not limited to fire alarm, smoke and carbon monoxide alarms, elevator recalls, and emergency lighting.

1.2 GENERAL

- .1 This testing process is the responsibility of the Integrated Testing Firm as a sub-contractor to the electrical trade. Electrical trade to include all costs associated with the Integrated Testing Coordinator in contract.
- .2 This process must be co-ordinated with suppliers and sub-contractors associated with these systems (mechanical and/or electrical).
- .3 This process must be co-ordinated with the project construction schedule and be completed, including all associated documentation, prior to the consultant's certification of the project for occupancy.
- .4 All applicable contractors, sub-contractors, and suppliers are to include all required costs in their respective tender costs.
- .5 All work is to be performed in accordance with CAN/ULC S1001-2011. Special consideration is to be given to the Sample Integrated Testing Plan (ITP), the review of life safety system design documents, and the provision of test plans and reports.
- .6 The work to be performed by this contractor is also described in CAN/ULC S1001-2011.
- .7 Refer to CAN/ULC S1001-11 Rev1-2019 Informative Annex (C) for Sample Integrated Testing Plan (ITP).

1.3 QUALITY ASSURANCE

- .1 The following criteria must be met in order to be considered an acceptable Integrated Testing Coordinator for this project:
 - .1 Manufacturers: Firms regularly engaged in functional testing and implementation of life safety and fire protection systems for not less than five years.
 - .2 Qualifications: Firms with at least five years of successful experience in facility construction, inspection, acceptance testing or commissioning as it relates to fire protection and life safety and equipment similar to that required for this project.
 - .3 The Contractor shall be an established commissioning contractor that has had and currently maintains a locally run and operated business for at least five years.
 - .4 The Contractor shall show satisfactory evidence, upon request, that he maintains a fully equipped service organization capable of furnishing adequate inspection and service to the systems.
 - .2 For bidder information only, experienced Life Safety Systems Testing Firms include these listed below or local branches of the companies noted in the vicinity of this project:
 - .1 ITC Solutions
20 Hanson Ave Unit 3
Kitchener, ON, N2C 2E2
 - .2 Troy Life and Fire Safety
805 Boxwood Dr., Unit #201
Cambridge, Ontario N3E 1A4
 - .3 Control Tech Systems
31 Regal Road
Guelph, Ontario N1K 1B6
 - .4 Lonergan Engineering
4 Industrial Parkway South
Aurora, Ontario L4G 3W1
 - .5 Guardian Fire Consulting Group
55-346 Northfield Dr.
Waterloo, Ontario N2K 3T6
- NOTE: This agent must be a third party firm NOT associated with this project in any way and be under contract with the electrical sub-contractor not the fire alarm supplier.**

- .3 Other firms to those listed above, who feel they are capable, must submit in writing, to the Consultant's office confirmation of the items listed in the criteria above, a minimum of one week prior to tender close in order to be considered as a bidder.

1.4 GENERAL REQUIREMENTS

- .1 The Commissioning Process shall generally encompass and co-ordinate the following key areas:
- .1 Integrated systems testing planning.
 - .2 Integrated systems testing implementation (functional testing).
 - .3 Integrated systems testing documentation

1.5 RESPONSIBILITIES

- .1 General Contractor:
- .1 The general contractor shall verify completeness of the building envelope, perimeter and interior items which affect proper operation of the noted systems.
 - .2 The general contractor will assure participation and co-operation of Sub-Contractors and Specialty Contractors (mechanical, electrical, building management, etc.) under the General Contractor's jurisdiction as required for the commissioning process.
- .2 Mechanical Contractor:
- .1 Verify Functional performance of associated mechanical systems for compliance with design intent as specified in the appropriate Specification sections.
 - .2 Provide the documentation with standard Functional performance reports on completion of the testing.
 - .3 Verify submissions for system operation and maintenance manuals, as-built documents, spare parts listing, special tools listing, and other items as may be specified.
- .3 Electrical Contractor:
- .1 The Integrated Life Safety Systems Testing Coordinator (ITC) is being retained by the electrical contractor, however; this contractor's work to satisfy the ITC requirements shall be included in the tender price.
 - .2 Verify Functional performance of electrical systems for compliance with design intent as specified in the appropriate Specification sections.
 - .3 Provide the documentation with standard Functional performance reports on completion of the testing.
 - .4 Verify submissions for electrical system operation and maintenance manuals, as-built documents, spare parts listing, special tools listing, and other items as may be specified.

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- .5 As a minimum this contractor must include for:
 - .1 Providing the ITC with documentation of design and shop drawings.
 - .2 Provide documents for sequence of operation and maintenance of system.
 - .3 Testing of all components and accessories to confirm Alarm/Supervisory/Trouble at the fire panel.
 - .4 Testing and operation of any generator (s) as applicable to the project.
 - .5 Other items that may be requested by the ITC.
 - .6 Re-commissioning of any items that may have failed.
 - .7 Re-setting of the system to proper operation after tests are completed.
 - .8 **Provide documentation of compliance with OBC 3.2.7.3 'Emergency Lighting'.**
 - .9 Provide written confirmation that life safety systems are installed in accordance with applicable codes and standards, as well as the scope of the project engineering documents.
 - .4 Equipment Manufacturers:
 - .1 The equipment manufacturers shall be responsible for providing labour, material, equipment, etc., required within the scope of the respective equipment to facilitate the commissioning process.
 - .2 The equipment manufacturers will perform Pre-Functional and Functional Performance Tests required by the commissioning process.
 - .5 Design Engineer:
 - .1 The design engineer shall review and provide written confirmation of acceptance of the Integrated Testing Plan (ITP).
 - .2 The design engineer shall observe Functional Performance Testing, at his discretion.
 - .3 The design engineer shall provide technical capabilities for resolution of deficiencies, where required.
 - .4 The design engineer shall provide necessary information to assist Integrated Test Coordinator including written confirmation of life safety systems installation in accordance with project engineering documents and are ready for integrated testing.

Part 2 Commissioning Process

2.1 OPERATIONS AND MAINTENANCE MANUALS

- .1 Furnish Final, reviewed Operation and Maintenance Manuals to the Consultant fourteen (14) days prior to scheduled Functional Performance Tests.

2.2 FUNCTIONAL PERFORMANCE TEST

- .1 The contractor shall be responsible for the Functional Performance Tests. These tests ensure that all equipment and systems are installed in accordance with the Specifications, Drawings and manufacturers' requirements.
- .2 The contractor shall be responsible for co-ordinating schedule for Functional tests of various equipment and systems.
- .3 In the Functional Test, all noted systems and sub-systems shall be checked for the following:
- .1 Verify that each element has been properly installed, properly identified, and that all connections have been made correctly.
 - .2 Verify that tests, meter readings, and specific mechanical/electrical performance characteristics agree with those required by equipment or system manufacturer.
 - .3 Re-commission any item(s) that may have failed.
 - .4 Notify the consultant in writing, at least fourteen (14) days prior to the date of Functional Performance Testing. Schedule the Functional performance tests over a period of consecutive business days.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 CSA C22.2 No.0.3-92, Test Methods for Electrical Wires and Cables.

1.2 PRODUCT DATA

- .1 Submit product data in accordance with Electrical General Requirements Section.

Part 2 Products

2.1 BUILDING WIRES

- .1 Conductors: stranded for 10 AWG and larger. Minimum size: 12 AWG
- .2 Copper conductors: size as indicated, with 600 V insulation of chemically cross-linked thermosetting polyethylene material 90°C (194°F) rated T90 for indoor above grade installations and RW90 for below grade installations.

2.2 ARMOURED CABLES

- .1 Conductors: insulated, copper minimum size as indicated above.
- .2 Type: AC90 (minimum size 12 AWG).
- .3 Armour: interlocking type fabricated from aluminum strip.
- .4 Connectors must be suitable for installed environment and approved for use with armoured cable.

Part 3 Execution

3.1 INSTALLATION OF BUILDING WIRES

- .1 Install wiring from source to load through raceways as specified.
- .2 Provide separate neutral conductors for all lighting circuits and circuits originating from surge protected panels. Size raceways accordingly.

3.2 INSTALLATION OF ARMOURED CABLES

- .1 Group cables wherever possible.
- .2 Terminate cables in accordance with Wire and Box Connectors - 0 - 1000 V Section.
- .3 These cables are to be installed in concealed locations only. These concealed locations are considered to be stud walls and "drops" to stud walls, lighting fixtures, and ceiling mounted devices.
- .4 **These "drops' shall not be permitted to exceed 2.4 m (8'-0"). To limit these "drops" to lengths noted above provide additional branch wiring in conduit.**

END OF SECTION

Part 1 General

1.1 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data for cabinets in accordance with Electrical General Requirements Section.

Part 2 Products

2.1 MATERIALS

- .1 Splitters must conform to CSA C22.2 No. 76 (latest edition).
- .2 Junction and pull boxes must conform to CSA C22.2 No. 40 (latest edition)

2.2 JUNCTION AND PULL BOXES

- .1 Welded steel construction with screw-on flat covers for surface mounting.
- .2 Covers with 25 mm (1") minimum extension all around, for flush-mounted pull and junction boxes.

Part 3 Execution

3.1 JUNCTION AND PULL BOXES INSTALLATION

- .1 Install pull boxes in inconspicuous but accessible locations.
- .2 Install junction and pull boxes so as not to exceed 30 m (100') of conduit run between pull boxes and in conformance with the Electrical Safety Code.

3.2 IDENTIFICATION

- .1 Provide equipment identification in accordance with General Electrical Requirements Section.
- .2 Install size 2 identification labels indicating system name, voltage and phase.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 Outlet boxes, conduit boxes, and fittings must conform to CSA C22.2 No. 18 (latest edition).

Part 2 Products

2.1 OUTLET AND CONDUIT BOXES GENERAL

- .1 Size boxes in accordance with CSA C22.1.
- .2 102 mm (4") square or larger outlet boxes as required for special devices.
- .3 Gang boxes where wiring devices are grouped.
- .4 Blank cover plates for boxes without wiring devices.
- .5 347 V outlet boxes for 347 V switching devices.
- .6 Combination boxes with barriers where outlets for more than one system are grouped.

2.2 SHEET STEEL OUTLET BOXES

- .1 Electro-galvanized steel single and multi gang flush device boxes for flush installation, minimum size 76 mm x 50 mm x 64 mm (3" x 2" x 2½") or as indicated. 102 mm (4") square outlet boxes when more than one conduit enters one side with extension and plaster rings as required. Iberville 1104 Series.
- .2 Electro-galvanized steel utility boxes for outlets connected to surface-mounted EMT conduit **in utility rooms**, minimum size 102 mm x 57 mm x 38 mm (4" x 2¼" x 1½"). Iberville 1110 Series.
- .3 102 mm (4") square or octagonal outlet boxes for lighting fixture outlets.
- .4 102 mm (4") square outlet boxes with extension and plaster rings for flush mounting devices in finished tile walls.

2.3 MASONRY BOXES

- .1 Electro-galvanized steel masonry single and multi gang boxes for devices flush mounted in exposed block walls.

2.4 CONDUIT BOXES

- .1 Cast FS or FD feraloy boxes with factory-threaded hubs and mounting feet for surface wiring of switches and receptacle **in areas (other than utility rooms) where surface conduit is used**.

2.5 FITTINGS- GENERAL

- .1 Bushing and connectors with nylon insulated throats.
- .2 Knock-out fillers to prevent entry of debris.
- .3 Conduit outlet bodies for conduit up to 32 mm (1- 1/4") and pull boxes for larger conduits.
- .4 Double locknuts and insulated bushings on sheet metal boxes.

Part 3 Execution

3.1 INSTALLATION

- .1 Support boxes independently of connecting conduits.
- .2 Fill boxes with paper, sponges or foam or similar approved material to prevent entry of debris during construction. Remove upon completion of work.
- .3 For flush installations mount outlets flush with finished wall using plaster rings to permit wall finish to come within 6 mm (1/4") of opening.
- .4 Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Reducing washers are not allowed.
- .5 Outlets if unwired are to be provided with blank coverplates to suit related sections of this specification.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 CSA C22.2 No.65-1956(R1965) Wire Connectors.

Part 2 Products

2.1 MATERIALS

- .1 Pressure type wire connectors: with current carrying parts of copper sized to fit copper conductors as indicated.
- .2 Fixture type splicing connectors: with current carrying parts of copper sized to fit copper conductors 10 AWG or less.
- .3 Clamps or connectors for armoured cable, mineral insulated cable, and flexible conduit, as required.

Part 3 Execution

3.1 INSTALLATION

- .1 Remove insulation carefully from ends of conductors and:
- .1 Apply coat of zinc joint compound on aluminum conductors prior to installation of connectors.
- .2 Install mechanical pressure type connectors and tighten screws with appropriate compression tool recommended by manufacturer. Installation shall meet secureness tests in accordance with CSA C22.2 No.65.
- .3 Install fixture type connectors and tighten. Replace insulating cap.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 Canadian Standards Association (CSA)
 - .1 CAN/CSA C22.2 No.18-92, Outlet Boxes, Conduit Boxes, and Fittings.
 - .2 CSA C22.2 No.45-M1981(R1992), Rigid Metal Conduit.
 - .3 CSA C22.2 No.56-1977(R1977), Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
 - .4 CSA C22.2 No.83-M1985(R1992), Electrical Metallic Tubing.
 - .5 CSA C22.2 No.211.2-M1984(R1992), Rigid PVC (Unplasticized) Conduit.

Part 2 Products

2.1 CONDUITS

- .1 Rigid metal conduit: to CSA C22.2 No.45, aluminum threaded.
- .2 Epoxy coated conduit: to CSA C22.2 No.45, with zinc coating and corrosion resistant epoxy finish inside and outside.
- .3 Electrical metallic tubing (EMT) with couplings: to CSA C22.2 No.83.
- .4 Rigid PVC conduit: to CSA C22.2 No.211.2.
- .5 Flexible metal conduit: to CSA C22.2 No.56, aluminum and liquid-tight flexible metal.

2.2 CONDUIT FASTENINGS

- .1 One hole steel straps to secure surface conduits 53 mm (2") and smaller. Two hole steel straps for conduits larger than 53 mm (2").
- .2 Beam clamps to secure conduits to exposed steel work.
- .3 Channel type supports for two or more conduits at 1.5 m (5'0") oc.
- .4 Threaded rods, 6 mm (1/4") diameter, to support suspended channels.

2.3 CONDUIT FITTINGS

- .1 EMT fittings shall be set screw style (zinc alloy).
- .2 Flexible metal conduit fittings shall be screw-in type.
- .3 Liquid type flexible metal conduit fittings shall be sealtite type.
- .4 PVC fittings shall be PVC type complete with PVC adaptors at all boxes.
- .5 Rigid conduit and mineral insulated conduit fittings shall be threaded type.

- .6 Coating: same as conduit.
- .7 Factory "ells" where 90° bends are required for 27 mm (1") and larger conduits.
- .8 Where bushings are noted to be provided they must be "screwed" type fastened to a conduit connector. Push-fit or glued in place bushings will NOT be accepted.

2.4 FISH CORD

- .1 Nylon twine.

Part 3 Execution

3.1 INSTALLATION

- .1 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.
- .2 Conceal conduits except in mechanical/ electrical service rooms and in unfinished areas. Where devices are to be installed on existing walls in finished area, which cannot be "fished", install feeds in a surface metal raceway equal to Wiremold V700 series. Coordinate surface installations with consultant prior to rough-in.
- .3 **Use electrical metallic tubing (EMT) for all branch circuits unless specified otherwise.**
- .4 Use rigid aluminum threaded conduit where specified and up to 2.1 m (7'0") above finish floor where exposed to mechanical injury.
- .5 Use rigid PVC conduit underground and in kitchen areas.
- .6 Use flexible metal conduit for connection to motors in dry areas, connection to recessed fixtures without a prewired outlet box, connection to surface or recessed fixtures, work in movable metal partitions.
- .7 Conduits terminating at electrical equipment in sprinklered areas are to be provided with insulated compression style connectors equal to Thomas & Betts Cat. #TC8XXSC or approved equal.
- .8 **Minimum conduit size for branch circuits shall be 21 mm (3/4").** Single drops from ceiling mounted junction boxes down to a light switch or duplex receptacle may be reduced to 16 mm (1/2").
- .9 Bend conduit cold. Replace conduit if kinked or flattened more than 1/10th of its original diameter.
- .10 Mechanically bend steel conduit over 27 mm (1") diameter.
- .11 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.
- .12 Install fish cord in empty conduits.
- .13 Run 2- 27 mm (1") spare conduits up to accessible ceiling space from each flush panel. Terminate these conduits in 152 mm x 152 mm x 102 mm (6" x 6" x 4") junction boxes in ceiling space.

- .14 Remove and replace blocked conduit sections. Do not use liquids to clean out conduits.
- .15 Dry conduits out before installing wire.

3.2 SURFACE CONDUITS

- .1 Run parallel or perpendicular to building lines.
- .2 Locate conduits behind infrared or gas fired heaters with 1.5 m (5') clearance.
- .3 Run conduits in flanged portion of structural steel.
- .4 Group conduits wherever possible on suspended or surface channels.
- .5 Do not pass conduits through structural members except as indicated.
- .6 Do not locate conduits less than 75 mm (3") parallel to steam or hot water lines with minimum of 25 mm (1") at crossovers.
- .7 **Do not fasten surface conduit to roof deck. Provide standoffs or supports as manufactured by Caddy or use unistrut trapeze fastened to structure.**

3.3 CONCEALED CONDUITS

- .1 Do not install horizontal runs in masonry walls.
- .2 Do not install conduits in terrazzo or concrete toppings.

END OF SECTION

Part 1 General

1.1 SHOP DRAWINGS

- .1 Submit shop drawings for each system in Conformance with The Electrical General Requirements Section.

1.2 PRODUCT/MAINTENANCE DATA

- .1 Submit product/maintenance data for each system for inclusion in maintenance manual conforming to The General Electrical Requirements Section.

1.3 SCOPE

- .1 The scope of this Section will include the following systems.

- .1 Security and access control rough-in.
- .2 Telecommunication network system rough-in.
- .3 Line voltage power packs and low voltage occupancy sensors.

Part 2 Products

2.1 SECURITY AND ACCESS CONTROL ROUGH-IN

- .1 Provide conduit from device and outlet locations to cable management systems as noted on drawings.
- .2 Outlets if unwired are to be provided with blank coverplates to suit related sections of this specification.
- .3 Provide grounding of equipment as noted on drawings.
- .4 Security and access control systems installation shall be by Owner's approved vendor as part of separate tender.

2.2 TELECOMMUNICATION NETWORK SYSTEM ROUGH-IN

- .1 Outlets where noted shall be single gang flush mounted in wall or surface raceways.
- .2 Outlets if unwired are to be provided with blank coverplates to suit related sections of this specification.
- .3 Provide a #6 insulated green ground conductor from main service ground to voice equipment backboard located on drawings.
- .4 Telecommunication Network installation shall be by Owner's approved vendor as part of separate tender.

- 2.3 LINE VOLTAGE POWER PACKS AND LOW VOLTAGE OCCUPANCY SENSORS**
- .1 Line voltage power packs and occupancy sensors shall be one manufacturer throughout the project.
 - .2 Line Voltage Power packs shall be provided to match the room lighting load, control requirements, and lighting voltage. Power packs shall have the following features:
 - .1 Mount to standard junction box.
 - .2 Simple replacement. It shall be capable to replace the unit without requiring any configuration or set-up.
 - .3 Plenum rated
 - .4 120VAC or 347V, 60HZ operation.
 - .5 Acceptable materials:
 - .1 Sensorswitch Cat. #PP20 Series
 - .2 Legrand Cat. #BZ-250 Series
 - .3 Greengate Cat. #SP15 Series
 - .3 Low voltage / analog occupancy sensors shall be complete with the following features:
 - .1 Coverage pattern to suit room ceiling height.
 - .2 Suitable to detect minor and medium motion patterns within rooms less than 2000 sq. ft.
 - .3 Mount to standard junction box.
 - .4 Simple replacement. It shall be capable to replace the unit without requiring any configuration or set-up.
 - .5 Relays shall not be integrated within the occupancy sensor. Relays shall be provided within separate power pack.
 - .6 Acceptable materials
 - .1 Sensorswitch Cat. #CM-PDT Series
 - .2 Legrand Cat. #CI-205
 - .3 Greengate Cat. #OAC-DT-2000

- Part 3 Execution**
- 3.1 SECURITY AND ACCESS CONTROL ROUGH-IN**
- .1 Outlets are to be provided for devices with conduit as detailed on drawings.
 - .2 Conduits terminated into ceiling spaces must be within 1m of cable management of tray.
- 3.2 TELECOMMUNICATION NETWORK SYSTEM ROUGH-IN**
- .1 Install incoming service ducts and terminate as noted.
 - .2 Provide backboard as noted complete with ground connection to main service ground.
 - .3 Conduits terminated into ceiling spaces must be within 3m (10') of zone conduits (if applicable).

- .4 Ensure specified zone conduits are installed back to service backboard.
- .5 Outlets are to be installed complete with 25 mm (1") conduit to corridor ceiling space or nearest zone conduit (if applicable).
- .6 Provide insulated bushings on all conduits terminated in ceiling space.
- .7 A 25mm (1") conduit is to be installed from elevator machine room to voice service backboard.

3.3 LINE VOLTAGE POWER PACKS AND LOW VOLTAGE OCCUPANCY SENSORS

- .1 Install power packs in accessible maintenance areas.
- .2 Provide access doors if power packs are installed above drywall ceilings.
- .3 Sensors installed in areas of high abuse shall be complete with wire guards.
- .4 It shall be the contractor's responsibility to locate and aim sensors in the correct location required for complete and proper coverage within the range of coverage as per the manufacturer's recommendations. The locations and quantities of sensors shown on the drawings are diagrammatic and indicate only the rooms which are to be provided with sensors. The contractor shall provide additional sensors if required to properly and completely cover the respective rooms.
- .5 It is the contractor's responsibility to arrange a pre-installation meeting with the manufacturer's factory authorized representative, at the facility, to verify placement to sensors and installation criteria.
- .6 The contractor shall also provide the on-site training necessary to familiarize the owner's personnel with the operation, use, adjustment and problem solving diagnosis of the occupancy sensing devices systems.
- .7 Upon completion of the installation, the system shall be completely commissioned by the manufacturer's factory authorized technician who will verify all adjustments and sensor placement to ensure a trouble-free occupancy-based lighting control. Submit commissioning report with closeout documents.
- .8 **All lighting controls shall be provided with functional testing and documentation conforming to Ashrae 90.1, latest adoption. This cost shall be included in the Tender Price.**

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 Heaters must conform to CSA 22.2 No.46 (latest edition).

1.2 PRODUCT DATA

- .1 Submit product data in accordance with the Electrical General Requirements Section.
- .2 Product data to include:
- .1 Suspension of heating element.
 - .2 Physical size.
 - .3 Thermostat control if integral.
 - .4 Finish.
 - .5 kW rating, voltage, phase.
 - .6 Cabinet thickness.
 - .7 Cabinet surface temperature.
 - .8 Mounting methods.
 - .9 Auxiliary controls.
 - .10 Replacement data for motor element, thermostat, and switch.

1.3 OPERATION AND MAINTENANCE DATA

- .1 Provide operation and maintenance data for all heating system components for incorporation into manual as specified in the Electrical General Requirements Section.

Part 2 Products

2.1 UNIT HEATERS

- .1 Unit heater shall be horizontal discharge complete with adjustable louvers finished to match cabinet.
- .2 Fan type unit heaters must be provided with built-in high-heat limit protection.
- .3 Fan motor must be permanently lubricated ball bearing type with resilient mount. Built-in fan motor thermal overload protection.
- .4 Hangers shall be as indicated on drawings.
- .5 Elements shall be mineral insulated copper coated steel sheath with aluminum brazed fins.

- .6 Cabinet shall be steel fitted with brackets for rod or wall mounting. Phosphatized and finished with baked enamel finish to suit architect.
- .7 Controls shall be (as indicated) either wall mounted remote thermostats or integral 2 pole thermostats to control load of heater specified. Integral magnetic contactors (if specified) are to be provided to suit load.

2.2 FORCED AIR WALL HEATERS

- .1 Forced air wall heaters, wall or ceiling mounted as noted complete with T-bar mounting frame. Heater shall be commercial type as follows:
 - .1 Enclosure:
 - .1 Steel: 18 gauge.
 - .2 Knockouts for 19 mm (3/4") diameter conduit left, right, bottom and rear.
 - .3 Grill and frame finished to suit architect.
 - .2 Elements and Fan:
 - .1 Mineral insulated.
 - .2 Motor: totally enclosed, shaded pole, impedance protected motor.
 - .2 Controls:
 - .1 Built-in tamperproof controls. 'On-Off-Fan Only' selector switch and temperature control knob.

2.3 THERMOSTATS

- .1 Line voltage thermostats in finished areas as indicated shall be complete with the following features:
 - .1 Full load rating of maximum 18 A at 208 V
 - .2 Temperature range: 10°C to 27°C (50°F to 80.6°F)
 - .3 Temperature range shall be marked on face of thermostat in 5 degree increments.

2.4 APPROVED MANUFACTURERS

- .1 Approved manufacturers shall be:
 - .1 Ouellet
 - .2 Stelpro
 - .3 Westcan

Part 3 Execution

3.1 INSTALLATION

- .1 Suspend unit heaters from ceiling or mount on wall as indicated.
- .2 Install force flow heaters as indicated.

3.2 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Electrical General Requirements Section.
- .2 Ensure that heaters and controls operate correctly.
- .3 On fan powered units:
 - .1 Test cut-out protection when air movement is obstructed.
 - .2 Test fan delay switch to assure dissipation of heat after element shut down.
 - .3 Test unit cut-off when fan motor overload protection has operated.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 Dry type transformers must conform to CSA C22.2 No.47 and C9 (latest edition).
- .2 **Dry type transformers must conform to CSA C802 (latest edition).**
- .3 **Dry type transformers must be in accordance with Ontario Green Energy Act 2018 (NRCan 2018) DOE 2016.**

1.2 PRODUCT DATA

- .1 Submit product data in accordance with Electrical General Requirements Section.

Part 2 Products

2.1 TRANSFORMERS

- .1 Transformers to be of one manufacturer throughout project.
- .2 Ratings and characteristics shall be as indicated on riser diagrams.
- .3 Aluminum winding.
- .4 Transformers are to be ventilated dry type style with 4-2½% taps (2 F.C.B.N. and 2 F.C.A.N.)
- .5 Maximum permissible sound levels shall be as follows:

Transformer Rating (KVA)	Sound Level (dBA)
≤50	45
51 to 150	50

- .6 Transformer enclosure shall be EEMAC/NEMA 3R ventilated complete with removable front panel.
- .7 Provide vibration isolators equal to Korfund R series, Mason ND-B, or approved equal. "Colour" of vibration isolators shall be based on weight of transformers.

Transformer Weight (lbs)	Approximate Rating	Colour (Korfund)
540	15 – 75 kVA	Blue (RD2)
680	112.5 kVA	Black (RD2)

2.2 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Electrical General Requirements Section.
- .2 Label must indicate:
 - .1 transformer "tag" as per riser diagram
 - .2 primary and secondary voltage and phase.

2.3 ACCEPTABLE MANUFACTURERS:

- .1 Acceptable manufacturers are as follows:
 - .1 Hammond
 - .2 Rex
 - .3 Delta
 - .4 Acme
 - .5 Bemag

Part 3 Execution

3.1 INSTALLATION

- .1 Primary and secondary feeders are to be connected using flexible conduit.
- .2 Transformers with a rating up to and including 75 KVA are permitted to be wall mounted provided mounting method is a suitably sized angle iron frame secured to structure (i.e. masonry wall, steel columns, etc. NOT metal siding).
- .3 The above rating of transformers may also be suspended from **structure only** on a unistrut trapeze as detailed.
- .4 Transformers above 75 KVA must be floor mounted.
- .5 Floor mounted transformers are to be mounted/secured to a concrete pad suitably sized to suit the transformer. This pad is the responsibility of this contractor and must be provided in conformance with the standard of Division 1 specifications for poured in place concrete.
- .6 All transformers must be mounted on vibration isolators selected based on transformer weight.
- .7 Ensure adequate clearance around transformer for ventilation as per the Electrical Safety Code.
- .8 Loosen isolation pad bolts until no compression is visible.
- .9 Install transformers in level upright position.

-
- .10 Remove shipping supports only after transformer is installed and just before putting into service.
 - .11 Make primary and secondary connections in accordance with wiring diagram.
 - .12 Energize transformers after installation is complete.

END OF SECTION

Part 1 General

1.1 PRODUCT DATA

- .1 Submit product data in accordance with Electrical General Requirements Section.
- .2 Drawings to include electrical detail of panel, branch breaker type, quantity, ampacity and enclosure dimension.

Part 2 Products

2.1 PANELBOARDS

- .1 Panel boards must conform to CSA C22.2 No. 29 (latest edition).
- .2 Panelboards: product of one manufacturer.
- .3 Install circuit breakers in panelboards before shipment.
- .4 In addition to CSA requirements manufacturer's nameplate must show fault current that panel including breakers has been built to withstand. **Series rating is acceptable – submit information with shop drawings. Provide lamicoid label on feeder breaker. Lamicoid label to state “Series Rating Breaker.” Lamicoid label to be size 2.**
- .5 Bus and breakers must be rated for [10,000] A (symmetrical) interrupting capacity or as indicated.
- .6 Sequence phase bussing with odd numbered breakers on left and even on right, with each breaker identified by permanent number identification as to circuit number and phase.
- .7 Panelboard mains, number of circuits, and number and size of branch circuit breakers as indicated.
- .8 Two keys for each panelboard and key panelboards alike.
- .9 Aluminum bus with neutral of same ampere rating as mains.
- .10 Mains must be suitable for bolt-on breakers. Provide main (if applicable) and branch breakers as bolt-on style.
- .11 Trim with concealed front bolts and hinges.
- .12 Trim and door finish must be baked grey enamel.
- .13 All panels regardless of voltage and amperage must be provided with a lockable door.
- .14 Branch circuit panelboards (250 AMP or smaller) must be one of the following:
 - .1 Eaton Cat # POW-R-LINE-C PRL-1 or PRL-2
 - .2 Schneider Electric Cat # NQ Series for up to 240V or NF Series for up to 600V
 - .3 Siemens Cat #Sentron P1 Series

- .15 Branch circuit panelboards indicated to be complete with an external surge protective device shall include a suitably sized branch circuit breaker for the surge protective device as noted on panel schedule, and per surge protective device manufacturer recommendations.
- .16 Power distribution circuit breaker panelboards (400 AMP or larger) must be one of the following:
 - .1 Eaton CAT# POW-R-Line-C PRL-3A or PRL-4A
 - .2 Schneider Electric CAT# I-Line Series (Bolt-On)

2.2 BREAKERS

- .1 Breakers: to Moulded Case Circuit Breakers Section.
- .2 Breakers with thermal and magnetic tripping in panelboards except as indicated otherwise.
- .3 Main breaker (as specified) must be separately mounted on top or bottom of panel to suit cable entry. When mounted vertically, down position should open breaker.
- .4 Lock-on devices for fire alarm, stairway, exit and night light circuits.

2.3 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Electrical General Requirements Section.
- .2 Nameplate for each panelboard size 4 engraved description as indicated. In finished areas install label on inside of panel, and in service areas install label on exterior of panel.
- .3 Complete circuit directory with typewritten legend showing location of each circuit.
Include a copy of the directories in the maintenance manuals.

Part 3 Execution

3.1 INSTALLATION

- .1 Locate panelboards as indicated and mount securely, plumb, true and square, to adjoining surfaces.
- .2 Install surface mounted panelboards on plywood backboards. Where practical, group panelboards on common backboard. Plywood shall be 21mm (3/4") fire rated or painted with intumescent fire block paint having a minimum of 1h rating, unless noted otherwise.
- .3 Mount panelboards to height specified in Electrical General Requirements Section or as indicated.

- .4 Connect loads to circuits.
- .5 Connect neutral conductors to common neutral bus.
- .6 Install series rating lamicoids adjacent to all breakers utilized to achieve series ratings.

END OF SECTION

Part 1 General

1.1 PRODUCT DATA

- .1 Submit product data in accordance with Electrical General Requirements Section.

Part 2 Products

2.1 BREAKERS GENERAL

- .1 Moulded case circuit breakers must conform to CSA C22.1 No.5.1-M91 (latest edition.)
- .2 Bolt-on moulded case circuit breaker quick-make, quick-break type, for manual and automatic operation.
- .3 Common-trip breakers: with single handle for multi-pole applications.
- .4 Unless otherwise indicated moulded case circuit breaker to operate automatically by means of thermal and magnetic tripping devices to provide inverse time current tripping and instantaneous tripping for short circuit protection.
- .5 Moulded case circuit breakers 250 Amps and above are to operate by means of a solid-state trip unit with associated current monitors and self-powered shunt trip to provide inverse time current trip under overload condition, and long time, short time, instantaneous tripping for phase and ground fault short circuit protection (if indicated or applicable by the Electrical Safety Code versus the breaker amperage). Unless otherwise specified, complete system selective co-ordination shall be provided by the individually adjustable time/current curve shaping elements as following:
- .1 Breakers shall have fixed rating plug determining breaker continuous current rating.
- .2 All breakers shall have adjustable long delay pickup and time, L.
- .3 All breakers shall have individual adjustments for short delay pickup and time, S; including I₂t settings in time adjustment.
- .4 Breakers shall have adjustable instantaneous pickup, I; that if required by co-ordination study can be turned off, (I).
- .5 If required by Electrical Safety Code breakers shall have individually adjustable ground fault current pick-up and time, G; including I₂t settings in time adjustment.

- .6 Unless otherwise specified, for the low voltage systems provide an electronic trip unit as specified above for the following moulded case circuit breakers:
- .1 Mains or ties in main switchboard: LS trip unit with fixed instantaneous over-ride exceeding maximum value of fault at the point of installation.
 - .2 Transformer feeder for the units 225kVA and above: LSI or LS trip unit with fixed instantaneous over-ride, where instantaneous trip setting or instantaneous over-ride allows for transformer inrush of 12xFLA at 0.1s and exceeds maximum value of fault at the transformer secondary.
 - .3 Feeders exceeding 250A trip setting: LS trip unit with fixed instantaneous over-ride exceeding maximum value of fault at downstream panelboard.

Part 3 Execution

3.1 INSTALLATION

- .1 Install circuit breakers as indicated complete with all necessary mounting hardware and filler panels if necessary.
- .2 Provide lamicoid labels for series rating breakers. Lamicoid label to state "Series Rating Breaker." Lamicoid to be size 2.

END OF SECTION

Part 1 General

1.1 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Electrical General Requirements Section.

Part 2 Products

2.1 SWITCHES

.1 Line Voltage Wall Switches

- .1 AC switches must conform to CSA C22.2 No. 111 (latest edition).
.2 AC switches with following features:
.1 Terminal holes approved for No. 10 AWG wire.
.2 Silver alloy contacts.
.3 Urea or melamine molding for parts subject to carbon tracking.
.4 Suitable for back and side wiring.
.5 Toggle style (Rocker style) (architect to select colour).
.3 Toggle operated fully rated for tungsten filament and fluorescent lamps, and up to 80% of rated capacity of motor loads.
.4 AC Switches of one manufacturer throughout project.
.5 Occupancy sensor switches shall be dual technology style (PIR and Ultrasonic) where noted on the drawings.

.6 Acceptable Materials:

- .1 Single Pole : Hubbell Cat #HBL1201
.2 Three Way: Hubbell Cat. #HBL1203
.3 Motor Rated: Hubbell Cat. #HBL1221PL
.4 Single Relay Occupancy Sensor includes:
.1 Legrand Cat. #DW-100
.2 Greengate Cat. #ONW-D-1001
.3 Sensorswitch Cat. #WSXA Series

.7 Acceptable toggle switch alternate manufacturers include:

- .1 Pass & Seymour
.2 Leviton.

.2 Line Voltage 0-10V Dimming Switches

- .1 0-10V Dimmers are to be provided complete with the following features:
.1 Rating of 15A or 20A, 120V or 347V.
.2 0-10V dimming leads
.3 Capable of operation with four switch locations.

- .4 DIP switches or local programming through switch buttons to change mode of operation.
- .5 Integral on/off switch.
- .6 Devices must mount in single gang box or multi-ganged where noted.
- .7 Device and faceplate colour must match other wiring devices.
- .8 Integral dual technology occupancy sensors (PIR and Ultrasonic).
- .2 Acceptable Materials:
 - .1 0-10V Occupancy Wall Sensor Switch (Decora): Legrand Cat. #DW-311
 - .2 0-10V Dimming Switch: Leviton Cat. #ZS057 Series
- .3 Acceptable alternative manufacturer's include:
 - .1 Legrand
 - .2 Leviton
 - .3 Lutron
 - .4 Sensor Switch
 - .5 Greengate
- .3 Digital Interval Timer Switches
 - .1 Where noted supply and install a digital pre-set countdown time switch with the following features:
 - .1 minimum 1/6 HP rated contacts, mounted in recess single gang outlet box.
 - .2 Six (6) pre-set time selection buttons with options up to 1 hour.
 - .3 Unit shall be complete with activation indicator lights.
 - .4 Unit shall have integral On/Off button.
 - .5 White finish unless noted otherwise. (final finish selection by Architect).
 - .2 Acceptable Materials:
 - .1 Legrand Cat. #RT-50
 - .3 Acceptable alternative manufacturer's include:
 - .1 Leviton
 - .2 Lutron
 - .3 Hubbell

2.2 RECEPTACLES

- .1 Receptacles, plugs, and other similar wiring devices must conform to CSA 22.2 No 42 (latest edition).
- .2 Duplex receptacles, CSA type 5-15 R, 125 V, 15 A, U ground, with following features (20A where noted):
 - .1 Urea molded housing (Colour by architect).
 - .2 Suitable for No. 10 AWG for back and side wiring.
 - .3 Break-off links for use as split receptacles.

- .4 Eight back wired entrances, four side wiring screws.
- .5 Triple wipe contacts and rivetted grounding contacts.
- .3 Other receptacles with ampacity and voltage as indicated.
- .4 Receptacles of one manufacturer throughout project.
- .5 Acceptable materials:
 - .1 Standard Devices
 - .1 Standard duplex receptacle: Hubbell Cat # HBL5252CN
 - .2 T-slot receptacles: Hubbell Cat. #HBL5352
 - .3 Tamper resistant receptacle: Hubbell Cat # BR15TR
 - .4 Tamper resistant T-slot receptacle: Hubbell Cat. #BR20TR
 - .5 Automatically Controlled Receptacles (Green): Hubbell Cat. #BR15C2GN(Green)
 - .2 Above 20A
 - .1 Dryer receptacle: Hubbell Cat # HBL9430A
 - .2 Range receptacle: Hubbell Cat # HBL9450A
- .6 Acceptable alternate manufacturers include:
 - .1 Pass & Seymour
 - .2 Leviton
- .7 Residential grade equivalents for materials noted above for use within residential dwelling units.

2.3 COVER PLATES

- .1 Cover plates from one manufacturer throughout project.
- .2 Sheet steel utility box cover for wiring devices installed in surface-mounted utility boxes.
- .3 Stainless steel, brushed, 1 mm (1/32") thick cover plates for wiring devices mounted in flush-mounted outlet box.
- .4 Sheet metal cover plates for wiring devices mounted in surface-mounted FS or FD type conduit boxes.
- .5 Weatherproof cover plates complete with gaskets and "heavy-duty in use" covers in conformance with the Electrical Safety Authority. Provide product equal to Intermatic Cat. #WP5100C.
- .6 Where noted on plans for exterior weatherproof GFCI receptacles at grade, provide extra-duty single gang horizontal die cast receptacle covers. NEMA 3R rated complete with lockable hasp and reinforced hinge. Suitable for use with 12-gauge cord sets. Intermatic Cat. # WP1010HMXD or equal.

Part 3	Execution
3.1	INSTALLATION
.1	Switches: <ul style="list-style-type: none">.1 Install single throw switches with handle in "UP" position when switch closed..2 Install switches in gang type outlet box when more than one switch is required in one location..3 Mount toggle switches at height specified in Electrical General Requirements Section or as indicated.
.2	Receptacles: <ul style="list-style-type: none">.1 Install receptacles in gang type outlet box when more than one receptacle is required in one location..2 Mount receptacles at height specified in Electrical General Requirements Section or as indicated..3 Where split receptacle has one portion switched mount vertically and switch upper portion.
.3	Occupancy sensors: <ul style="list-style-type: none">.1 Occupancy sensors shall be set to 5 minutes "delay to off" unless otherwise noted.
.4	Occupancy sensors and dimmers: <ul style="list-style-type: none">.1 Switches with occupancy sensors and dimmers shall be programmed as follows:<ul style="list-style-type: none">.1 5 minutes "delay to off" unless otherwise noted..2 "Auto on" to 50% dimming level.
.5	Cover plates: <ul style="list-style-type: none">.1 Protect stainless steel cover plate finish with paper or plastic film until painting and other work is finished..2 Install suitable common cover plates where wiring devices are grouped..3 Do not use cover plates meant for flush outlet boxes on surface-mounted boxes.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 Canadian Standards Association (CSA)
 - .1 CSA C22.2 No.248.12/94, Low Voltage Fuses Part 12: Class R (Bi-National Standard with, UL 248-12 (1st Edition).
 - .2 CSA C22.2 No. 106-M92 (latest edition).

1.2 MAINTENANCE MATERIAL

- .1 Three spare fuses of each type and size installed.

1.3 DELIVERY AND STORAGE

- .1 Ship fuses in original containers.
- .2 Store fuses in original containers in moisture free location.

Part 2 Products

2.1 FUSES GENERAL

- .1 Fuses: product of one manufacturer for entire project .
- .2 Fuses specified below must conform to CSA C22.2 No. 106 (latest edition). Fuses conforming to standard C22.2 No. 106-1953 will be rejected.
- .3 Fuses must provide a fully co-ordinated system for both overload and fault conditions.

2.2 FUSE TYPES

- .1 Class J fuses (formerly HRCI- J).
 - .1 Time delay, capable of carrying 500% of its rated current for 10 s minimum.
 - .2 Fast acting as noted.
- .2 Class R fuses (formerly HRCI- R). For UL Class RK1 fuses, peak let-through current and I^2t values not to exceed limits of UL 198E-1982, table 10.2.

2.3 ACCEPTABLE PRODUCTS

- .1 Motor Protection:
 - 1-600 A: Mersen Type AJT
- .2 Other acceptable manufacturers:
 - .1 GEC
 - .2 Little Fuse

Part 3 Execution

3.1 INSTALLATION

- .1 Install fuses in mounting devices immediately before energizing circuit.
- .2 Ensure correct fuses fitted to physically matched mounting devices.
 - .1 Install Class R rejection clips for HRCI-R fuses.
- .3 Ensure correct fuses fitted to assigned electrical circuit.

END OF SECTION

Part 1 General

1.1 PRODUCT DATA

- .1 Submit product data in accordance with Electrical General Requirements Section.

Part 2 Products

2.1 DISCONNECT SWITCHES

- .1 Enclosed manual air break switches must conform to CSA C22.1 No.4 (latest edition).
.2 Fuseholder assemblies must conform to CSA C22.2 No.39 (latest edition).
.3 Fusible, and/or non-fusible, horsepower rated disconnect switches, size as indicated.
.4 Provision for padlocking in off switch position by three locks.
.5 Mechanically interlocked door to prevent opening when handle in ON position.
.6 Fuses: size as indicated, to Fuses - Low Voltage Section.
.7 Fuseholders: relocatable and suitable without adaptors, for type and size of fuse indicated.
.8 Quick-make, quick-break action.
.9 ON-OFF switch position indication on switch enclosure cover.
.10 Disconnects feeding elevator controllers must be equipped with two auxiliary contacts approved by the elevator supplier.

2.2 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Electrical General Requirements Section.
.2 Indicate name of load controlled on size 4 nameplate.

2.3 ACCEPTABLE MANUFACTURERS

<u>Manufacturer</u>	<u>General Purpose</u>	<u>Weather Proof</u>
Eaton	IHD Series	3HD Series
Schneider Electric	Type A Series	Type R Series
Siemens	ID Series	NFR/FR Series

Part 3 Execution

3.1 INSTALLATION

- .1 Install disconnect switches complete with fuses if applicable.
- .2 Connect auxiliary contacts to elevator controller using conduit, wire and route approved by the elevator supplier.

END OF SECTION

Part 1 General

1.1 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings in accordance with Electrical General Requirements Section.
- .2 Indicate:
 - .1 Mounting method and dimensions.
 - .2 Starter/contactor size and type.
 - .3 Layout of identified internal and front panel components.
 - .4 Enclosure types.
 - .5 Wiring diagram for each type of starter.
 - .6 Interconnection diagrams.

1.2 OPERATION AND MAINTENANCE DATA

- .1 Provide operation and maintenance data for incorporation into manual specified in Electrical General Requirements Section.
- .2 Include operation and maintenance data for each type and style of starter/contactor.

1.3 MAINTENANCE MATERIALS

- .1 Provide maintenance materials in accordance with Electrical General Requirements Section.
- .2 Provide listed spare parts for each different size and type of starter:
 - .1 1 operating coil.
 - .2 3 fuses.
 - .3 10% indicating lamp bulbs used.

Part 2 Products

2.1 MATERIALS

- .1 Starters: must conform to CSAC22.2 No. 14 (latest edition) and EEMAC E14-1.
- .2 Control transformers must conform to CSAC22.2 No. 66 (latest edition).
- .3 Auto-transformers must conform to CSAC22.2 No 47 (latest edition).
- .4 Contactors must conform to CSA C22.2 No. 14 (latest edition).
- .5 Half size starters will not be accepted. NEMA and IEC rated starters are acceptable.

2.2 MANUAL MOTOR STARTERS

- .1 Single and Three phase manual motor starters of size, type, rating, and enclosure type as indicated, with components as follows:
- .1 Switching mechanism, quick make and break.
 - .2 One or Three overload heaters, manual reset, trip indicating handle.
 - .3 Toggle switch: standard duty labeled "on"/"off".
 - .4 Indicating light: standard duty type and red colour.
 - .5 Locking tab to permit padlocking in "ON" or "OFF" position.

2.3 CONTROL TRANSFORMER

- .1 Single phase, dry type, control transformer with primary voltage as indicated and secondary voltage to suit remote control device, complete with secondary fuse, installed in with starter as indicated.
- .2 Size control transformer for control circuit load plus 20% spare capacity.

2.4 CONTACTORS

- .1 Electrically held and controlled by pilot devices as indicated and rated for type of load controlled.
- .2 Complete with 2 normally open and 2 normally closed auxiliary contacts unless indicated otherwise.
- .3 Mount in CSA Enclosure 1 unless otherwise indicated.
- .4 Include following options in cover:
 - .1 Red indicating lamp.
 - .2 Hand - Off - Auto selector switch.
- .5 Control transformer: mounted in contactor enclosure.
- .6 Contactors must be definite purpose.

2.5 FINISHES

- .1 Apply finishes to enclosure in accordance with Electrical General Requirements Section.

2.6 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Electrical General Requirements Section.
- .2 Manual starter designation label: black plate, white letters, size 1, engraved as indicated.
- .3 Magnetic starter designation label: black plate, white letters, size 2, engraved as indicated.
- .4 Contactor designation label:
black plate, white letters, size 4, indicating name of load controlled.

2.7 ACCEPTABLE MANUFACTURERS

.1 The acceptable manufacturers are as follows:

- .1 Allen Bradley
- .2 Eaton
- .3 Siemens
- .4 Group Schneider
- .5 Klockner Moeller

Part 3 Execution

3.1 INSTALLATION

- .1 Install starters, connect power and control as indicated.
- .2 Ensure correct fuses and overload devices elements installed.

3.2 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Electrical General Requirements Section.
- .2 Operate switches, contactors to verify correct functioning.
- .3 Perform starting and stopping sequences of contactors and relays.
- .4 Check that sequence controls, interlocking with other separate related starters, equipment, control devices, operate as indicated.
- .5 Install contactors and connect auxiliary control devices.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 American National Standards Institute/Institute of Electrical and Electronics Engineers (ANSI/IEEE)
 - .1 ANSI/IEEE C62.41- 1991, Recommended Practices for Surge Voltages in Low-Voltage AC Power Circuits.
- .2 American Society for Testing and Materials (ASTM)
 - .1 ASTM F1137- 88 (1993), Specification for Phosphate/Oil and Phosphate/Organic Corrosion Protective Coatings for Fasteners.
- .3 United States of America, Federal Communications Commission (FCC)
 - .1 FCC (CFR47) EM and RF Interference Suppression.
- .4 IESNA LM-79-08, IES Electrical Method for the Electrical and Photometric Measurements of Solid State Lighting Products.

1.2 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings in accordance with Electrical General Requirements Section for all light fixtures supplied under this contract.
- .2 Submit complete photometric data prepared by independent testing laboratory for luminaires where specified, for review by Consultant.
- .3 Photometric data to include: VCP Table spacing criterion.

1.3 SCOPE

- .1 This contractor is responsible to supply and install all lighting fixtures as scheduled and/or indicated including lamp and those accessories required for a complete lighting system. This contractor must coordinate lighting installations with all other Divisions of this project.
- .2 All fixtures must be CSA approved or approved at this contractor's expense by the Special Inspection Division of the Electrical Safety Authority.

1.4 GUARANTEE

- .1 Guarantees for materials replacement shall be as follows from date of substantial completion.
 - .1 LED fixtures, and driver: 5 years.
- .2 The labour required to replace these ballasts, lamps or drivers must be included in the above guarantee, however only for the extent of the contract guarantee and warranty period as noted in Electrical General Requirements.

Part 2	Products
2.1	Fixture Construction
.1	Fixtures must be constructed of 20 gauge (minimum) cold rolled steel. All metal edges require smooth finish.
.2	Light leaks must be prevented by providing gasketing, stops, and barriers.
.3	Fixtures must be finished in high reflective baked white enamel. This surface must have a reflectance of not less than 85%.
.4	All fixtures operating on 347 Volts must be provided with an integral disconnecting means.
2.2	Fixture Lens
.1	Unless otherwise noted fixture lenses shall be as follows:
.1	Lens thickness: 3.2 mm (1/8")
.2	Material: injection moulded clear prismatic virgin acrylic
.3	Frame: hinged, latched, steel.
2.3	LED Fixtures
.1	Fixture LED's must be tested in conformance with IESNA LM80 standard.
.2	LED's must be selected using a binning algorithm to ensure colour and lumen output of a given fixture are consistent, as well as meet or surpass ANSI C78.377 specification for the rated lifetime of the fixture. Colour accuracy between products must be within a 2-step MacAdam ellipse.
.3	Luminaires must be tested to IESNA LM79 by an independent approved laboratory.
.4	Luminaires must be tested prior to shipping.
.5	Luminaires must be ULC certified and approved for use in Canada.
.6	Fixtures must maintain a minimum of 90% of their initial light output for 60,000 hours. Submit test results upon request.
.7	Lumen values indicated for fixtures in the project documents are to be considered as "absolute" or "delivered" values.
.8	Other than for specialty fixtures, and unless otherwise indicated, the maximum driver current is to be 750 mA.
2.4	Standard Exit Lighting Units
.1	Exit lighting units must conform to CSA C860, CSA 22.2 No. 141 (latest edition).
.2	Housing: extruded aluminum housing, white finish.
.3	Face and back plates: extruded aluminum.
.4	Lamps: 2W LED.
.5	Operation: 25 years.

- .6 Units are to be provided with three (3) pictogram legends indicating "left from here", "straight from here", and "right from here".
- .7 Face plate to remain captive for relamping.

2.5 SELF-POWERED COMBINATION EXIT/EMERGENCY LIGHTING UNITS

- .1 Exit lighting units must conform to CSA C860, CSA 22.2 No. 141 (latest edition).
- .2 Housing: extruded aluminum housing. White Finish.
- .3 Face and back plates: extruded aluminum.
- .4 Lamps 2W LED (EXIT).
- .5 Operation: 25 year life.
- .6 Units are to be provided with three (3) pictogram legends indicating "left from here", "straight from here", and "right from here".
- .7 Face plate to remain captive for relamping.
- .8 Supply voltage: as noted on drawings.
- .9 Output voltage: 12 V DC.
- .10 Battery: sealed maintenance free 10 year life.

Note: Battery must be capable of supplying the wattage indicated for a minimum of 30 minutes.
- .11 Charger: solid state, voltage/current regulated, inverse temperature compensated, short circuit protected, with regulated output of plus or minus 0.01 V for plus or minus 10% V input variation.
- .12 Solid state transfer circuit.
- .13 Signal lights: "AC Power On" condition and "charging" condition.
- .14 Lamp heads: integral on unit, 345° horizontal and 180° vertical adjustment. Lamp type: minimum 4 watt LED.
- .15 Mounting: suitable for universal mounting directly on junction box and complete with knockouts for conduit. Removable or hinged front panel for easy access to batteries.
- .16 Cabinet: finish: white.
- .17 Auxiliary equipment:
 - .1 Test switch.

2.6 EMERGENCY LIGHTING UNITS

- .1 Emergency lighting units must conform to CSA C22.2 No 141 (latest edition).
- .2 Supply voltage: as noted on drawings.
- .3 Output voltage: 12 V DC.

- .4 Battery: sealed, maintenance free, 10 year life.
Note: Battery units must be capable of supplying the wattage indicated for a minimum of 30 minutes.
- .5 Charger: solid state, multi rate, voltage/current regulated, inverse temperature compensated, short circuit protected with regulated output of plus or minus 0.01 V for plus or minus 10% input variations.
- .6 Solid state transfer circuit.
- .7 Low voltage disconnect: solid state, modular, operates at 80% battery output voltage.
- .8 Signal lights: "AC Power ON" condition and "charging" condition.
- .9 Lamp heads: integral on unit, 345° horizontal and 180° vertical adjustment. Lamp type: minimum 4 watt LED.
- .10 Cabinet suitable for direct or shelf mounting to wall and complete with knockouts for conduit. Removable or hinged front panel for easy access to batteries.
- .11 Auxiliary equipment:
 - .1 Test switch.
 - .2 Ac input and DC output terminal blocks inside cabinet.
 - .3 Shelf.
 - .4 Cord and plug connection for AC. (**Not applicable on 347 V units**).

2.7 REMOTE EMERGENCY LIGHTING FIXTURES

- .1 Remote emergency lighting fixtures must conform to CSA C22.2 No141 (latest edition).
- .2 Fixtures shall be small "micro" size or recessed style as indicated in the Light Fixture Schedule.
- .3 Fixtures must be adjustable type heads with canopy.
- .4 Fixtures are to be provided with protective lexan cube when specified in the Light Fixture Schedule.
- .5 Unless otherwise indicated surface mounted fixtures in washrooms, locker rooms, changerooms, and gymnasiums must be provided with wire guard.

2.8 ACCEPTABLE LIGHTING MANUFACTURERS

- .1 Refer to the light fixture schedule as indicated on drawings.

Part 3 Execution

3.1 INSTALLATION

- .1 Locate and install luminaires as indicated. Luminaires are not to be supported from the roof deck. Provide additional unistrut support channel and/or support from structure. Coordinate with consultant on site.
- .2 Ball align hangers must be provided for rod suspended fixtures.

- .3 Fixtures surface mounted to suspended ceilings must be secured through ceiling assembly to cross member supports. These supports are to be steel channels or angles independently secured **to structure** using # 12 "jack" chain. Each chain must be secured so no fixture weight is added to the ceiling assembly.
- .4 Plaster frames/flange kits must be provided by this Division for fixtures recessed in plaster and/or drywall ceilings.
- .5 Where specified, fixtures to be chain hung shall be hung using "jack" chain with a capacity to suit the fixture weight. Branch circuit wiring feeding these fixtures shall be AC90 cable "ty-wrapped" at 900mm (36") intervals along length of drop. Final appearance must be neat and professional.
- .6 Install exit lighting units with illuminated faces and chevrons/arrows indicating path(s) of exit as indicated. Unless otherwise noted install exit fixtures at 2400 mm (8' 0") above finished floor.
- .7 Install emergency lighting units and associated remote mounted fixtures as indicated.
- .8 Direct "heads" on units and remote mounted fixtures to illuminate path(s) of exit.
- .9 Install emergency lighting units and remote fixtures at 300mm (12") below finished ceiling, unless indicated otherwise.
- .10 Provide a 15 A 120 V duplex receptacle (connected to circuit indicated) adjacent to unit. **Not applicable on 347 V units. This receptacle connection is to be no lower than 8' 0" (2400 mm) AFF.**
- .11 All battery units are to be provided with a visible lamicoid label indicating the unit number as per drawings.

3.2 WIRING

- .1 Connect luminaires to lighting circuits as indicated.
- .2 Connect exit fixtures to exit lighting circuits and unit equipment (if applicable).
- .3 Connect unit equipment to circuits as indicated.
- .4 All wiring of remote emergency fixtures shall be minimum #10 T90 for each circuit and run in conduit. Wiring must be sized in conformance with manufacturer's recommendations for distances required.

3.3 LUMINAIRE ALIGNMENT

- .1 Align luminaires mounted in continuous rows to form straight uninterrupted line.
- .2 Align luminaires mounted individually parallel or perpendicular to building grid lines.

3.4 DELIVERIES

- .1 Fixtures are to be completely assembled at the manufacturer's plant and delivered to the project site in original unitized containers. Ensure that a dry, protected and secure space is available for proper storage before scheduling delivery of fixtures.

3.5 TESTING/CERTIFICATION

- .1 At the completion of the project and in the presence of the consultant, test all exit and emergency fixtures. On company letterhead, the contractor is to prepare a chart indicating:
 - .1 Project
 - .2 Date
 - .3 Equipment type
 - .4 Certification of correct connection
 - .5 Certification of correct operation
 - .6 Duration of test in minutes (minimum 30)
 - .7 Actual period of testing (time of day)
- .2 **Provide “Integrated Testing” of this life safety system in conformance with the noted specification section. Include all associated costs in tender.**

3.6 ADDITIONAL INSTALLED EXIT SIGNS

- .1 The electrical contractor is to include in their bid the cost to add three (3) additional standard exit lighting units to be installed and tested in locations as directed by the consultant. Note: This installation and test will be occurring after the initial testing/certification testing is complete.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 American National Standards Institute/Institute of Electrical and Electronic Engineers (ANSI/IEEE).
- .2 Underwriter Laboratories of Canada (ULC).
- .3 International Electrotechnical Commission.
- .4 International Organization for Standardization (ISO).
- .5 National Electrical Manufacturers Association (NEMA).

1.2 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings in accordance with Section 26 01 16.
- .2 Submit composite wiring diagrams and control schedule for each room control circuit type as proposed to be installed. Include load type, sequence of operation, sensor parameters, time delays, sensitivities and daylighting set points.
- .3 Catalog cut sheets with performance specifications demonstrating compliance with specified requirements.

1.3 SCOPE

- .1 This contractor is responsible to supply and install all equipment and control wiring as specified for the digital occupancy and daylight control systems. This contractor must coordinate these control systems with the lighting fixtures being supplied for the project to ensure intended function as specified.
- .2 Control Intent: Control Intent includes, but is not limited to:
 - .1 Defaults and initial calibration settings for such items as time delay, sensitivity, fade rates, etc.
 - .2 Initial sensor and switching zones.
- .3 All equipment must be CSA approved or approved at this contractor's expense by the Special Inspection Division of the Electrical Safety Authority.
- .4 Reference section 26 51 13 for Lighting information.
- .5 Reference section 26 05 75 for line voltage occupancy sensors and switches (hard wired analog).

1.4 SYSTEM DESCRIPTION AND OPERATION

- .1 The Digital Lighting Control (room level) as defined under this section covers the following equipment:
 - .1 Digital Room Controllers – Self-configuring, digitally addressable one, two or three relay controllers.
 - .2 Digital Occupancy Sensors – Self-configuring, digitally addressable and calibrated occupancy sensors with LCD display and two-way active infrared (IR) communications.
 - .3 Digital Switches – Self-configuring, digitally addressable pushbutton switches, dimmers, and scene switches with two-way active infrared (IR) communications.
 - .4 Configuration Tools – Handheld remote for room configuration provides two-way infrared (IR) communications to digital devices and allows complete configuration and reconfiguration of the device / room from an accessible location.

1.5 LIGHTING CONTROL APPLICATIONS

- .1 Provide a minimum application of intended lighting control functions as detailed on design drawings and specified herein. Control functions shall include the following:
 - .1 Space Control Requirements – Provide occupancy/vacancy sensors with Manual-ON functionality in all spaces except toilet rooms, storerooms, or other applications where hands-free operation is desirable and Automatic-ON occupancy sensors are more appropriate. For spaces with multiple occupants, or where line-of-sight may be obscured, provide ceiling- or corner-mounted sensors.

1.6 WARRANTY

- .1 Provide a five-year complete manufacturer's warranty on all products to be free of manufacturers' defects.
- .2 The labour required to replace these products must be included in the above warranty, however only for the extent of the contract guarantee and warranty period as noted in Electrical General Requirements.

1.7 QUALITY ASSURANCE

- .1 Manufacturer: Minimum 10-years experience in manufacture of lighting controls.

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- | | |
|---------------|-----------------|
| Part 2 | Products |
|---------------|-----------------|
- 2.1 MANUFACTURERS**
- .1 Basis of design product: WattStopper Digital Lighting Management (DLM). Acceptable alternates are subject to compliance and prior approval with specified requirements of this section, as one of the following:
- .1 Cooper Controls (Greengate).
- .2 Acuity Controls (nlight).
- .2 Substitutions:
- .1 All proposed substitutions (clearly delineated as such) must be submitted in writing for approval by the design professional a minimum of 7 working days prior to the bid date and must be made available to all bidders.
- .2 By using pre-approved substitutions, the contractor accepts responsibility and associated costs for all required modifications to circuitry, devices, and wiring.
- 2.2 DIGITAL WALL OR CEILING MOUNTED OCCUPANCY SENSOR SYSTEM**
- .1 Wall or ceiling mounted (to suit installation) passive infrared (PIR), ultrasonic or dual technology digital (passive infrared and ultrasonic) occupancy sensor. Furnish the Company's system which accommodates the square-foot coverage requirements for each area controlled, utilizing room controllers, digital occupancy sensors and accessories which suit the lighting and electrical system parameters.
- .2 Digital Occupancy Sensors shall provide calibration and electronic documentation for the following features:
- .1 Digital calibration and pushbutton programming for the following variables:
- .1 Sensitivity – 0-100% in 10% increments
- .2 Time delay – 1-30 minutes in 1 minute increments
- .3 Test mode – Five second time delay
- .4 Detection technology – PIR, Ultrasonic or Dual Technology activation and/or re-activation.
- .5 Walk-through mode
- .6 Load parameters including Auto/Manual-ON, blink warning, and daylight enable/disable when photosensors are included in the DLM local network.
- .2 Two-way infrared (IR) transceiver to allow remote programming through handheld commissioning tool and control by remote personal controls.
- .3 Device Status LEDs including:
- .1 PIR Detection
- .2 Ultrasonic detection
- .3 Configuration mode
- .4 Load binding

- .4 Manual override of controlled loads.
- .5 One or two RJ-45 port(s) for connection to DLM local network.
- .3 Multiple occupancy sensors may be installed in a room by simply connecting them to the free topology DLM local network. No additional configuration will be required.

WattStopper product numbers: LMPX, LMDX, LMPC, LMUC, LMDC

2.3 DIGITAL WALL SWITCHES

- .1 Low voltage momentary pushbutton switches in 1, 2, 3, 4, 5, and 8 button configuration; colour per architect, compatible with wall plates with decorator opening. Wall switches shall include the following features:
 - .1 Two-way infrared (IR) transceiver for use with personal and configuration remote controls.
 - .2 Removable buttons for field replacement with engraved buttons and/or alternate color buttons. Button replacement may be completed without removing the switch from the wall.
- .2 Multiple digital wall switches may be installed in a room by simply connecting them to the free topology DLM local network. No additional configuration will be required to achieve multi-way switching.
- .3 The following switch attributes may be changed or selected using a wireless configuration tool:
 - .1 Load and Scene button function may be reconfigured for individual buttons (from Load to Scene, and vice versa).
 - .2 Individual button function may be configured to Toggle, On only or Off only.
 - .3 Individual scenes may be locked to prevent unauthorized change.
 - .4 Switch buttons may be bound to any load on a room controller and are not load type dependent; each button may be bound to multiple loads.
- .4 Two RJ-45 ports for connection to DLM local network.
- .5 Multiple digital wall switches may be installed in a room by simply connecting them to the free topology DLM local network. No additional configuration will be required to achieve multi-way switching.
- .6 WattStopper product numbers: LMSW-101, LMSW-102, LMSW-103, LMSW-104, LMSW-105, LMSW-108, LMDM-101.

2.4 DIGITAL POWER PACKS (ROOM CONTROLLERS)

- .1 Room Controllers automatically bind the room loads to the connected devices in the space without commissioning or the use of any tools. Room Controllers shall be provided to match the room lighting load and control requirements. The controllers will be simple to install and will not have, dip switches, potentiometers or require special configuration. The control units will include the following features:
 - .1 Automatic room configuration to the most energy-efficient sequence of operation based upon the devices in the room.
 - .2 Simple replacement – Using the default automatic configuration capabilities, a room controller may be replaced with an off-the-shelf unit without requiring any configuration or setup.
 - .3 Device Status LEDs to indicate:
 - .1 Data transmission
 - .2 Device has power
 - .3 Status for each load
 - .4 Configuration status
 - .4 Quick installation features including:
 - .1 Standard junction box mounting
 - .5 Plenum rated
 - .6 Manual override and LED indication for each load
 - .7 120 VAC, 60 Hz operation.
 - .8 Zero cross circuitry for each load.
- .2 On/Off Room Controllers shall include:
 - .1 One or multiple relay configuration to suit control details
 - .2 Efficient 150 mA switching power supply
 - .3 Sufficient sensor connection points to suit indicated function without the requirement for additional hardware
 - .4 Discrete model listed for connection to receptacles, for schedule-based control of plug loads within the space.
 - .1 One relay configuration only.
 - .2 Automatic-ON/OFF configuration.
 - .3 Optional Network Bridge for BACnet MS/TP communications
 - .5 Three RJ-45 DLM local network ports.
 - .6 WattStopper product numbers: LMRC-101, LMRC-102, LMPL-101, LMPL-201.

- .3 On/Off Room/Dimming enhanced Room Controllers shall include:
- .1 One or multiple relay configuration to suit control details.
 - .2 Efficient 250 mA switching power supply.
 - .3 One 0-10 volt analog output per relay for control of compatible ballasts and LED drivers.
 - .4 The following dimming attributes may be changed or selected using a wireless configuration tool:
 - .1 Establish preset level for each load from 0-100%.
 - .2 Set high and low trim for each load.
 - .3 Set lamp burn in time for each load up to 100 hours.
 - .5 Four RJ-45 DLM local network ports.
 - .6 Optional Network Bridge for BACnet MS/TP communications.
 - .7 WattStopper product numbers: LMRC-211, LRMC-212, LRMC-213, LMPL-201, LMRC-311, LMRC-312, LMRC-313.

2.5 DIGITAL ROOM CONTROL SYSTEMS

- .1 Digital occupancy and daylight control system designed to control a small area of a building (room level). Digital devices connect to the room controller(s) using CAT 5e cables (LMRJ) with RJ-45 connectors which provide both data and power to room devices. Features of the system shall include:
- .1 Plug n' Go automatic configuration and binding of occupancy sensors, switches and lighting loads to the most energy-efficient sequence of operation based upon the device attached.
 - .2 Simple replacement of any device in the system with a standard off the shelf unit without requiring commissioning, configuration or setup.
 - .3 Push n' Learn configuration to change the automatic configuration, including binding and load parameters without tools, using only the buttons on the digital devices which are part of the local system.
 - .4 Two-way infrared communications for control by handheld remotes, and configuration by a handheld tool including adjusting load parameters, sensor configuration and binding, within a line of sight of up to 30 feet from a sensor, wall switch or IR receiver.

2.6 CONFIGURATIONS TOOLS

- .1 A configuration tool facilitates optional customization of digital lighting control system featuring infrared communications.
- .2 Features and functionality of the wireless configuration tool shall include:
 - .1 Two-way infrared (IR) communication with DLM IR-enabled devices within a range of approximately 30 feet.
 - .2 Read, modify and send parameters for occupancy sensors, daylighting sensors, room controllers and buttons on digital wall switches.
 - .3 Save up to nine occupancy sensor setting profiles, and apply profiles to selected sensors.
- .3 WattStopper Product Numbers: LMCT-100, LMCI-100/LMCS-100

2.7 PROGRAMMING, CONFIGURATION AND DOCUMENTATION SOFTWARE

- .1 PC-native application for optional programming of detailed technician-level parameter information for all DLM products, including all parameters not accessible via BACnet and the handled IR configuration tool. Software must be capable of accessing room-level parameter information locally within the room when connected via the optional LMCI-100 USB programming adapter, or globally for many segment networks simultaneously utilizing standard BACnet/IP communication.
- .2 Additional parameters exposed through this method include but are not limited to:
 - .1 Occupancy sensor detection LED disable for performance and other aesthetic spaces where blinking LEDs present a distraction.
 - .2 Six occupancy sensor action behaviors for each controlled load, separately configurable for normal hours and after hours modes. Modes include: No Action, Follow Off Only, Follow On Only, Follow On and Off, Follow On Only with Override Time Delay, Follow Off Only with Blink Warn Grace Time, Follow On and Off with Blink Warn Grace Time.
 - .3 Separate fade time adjustments per load for both normal and after hours from 0 - 4 hours.
 - .4 Configurable occupancy sensor re-trigger grace period from 0 - 4 minutes separate for both normal hours and after hours.
 - .5 Separate normal hours and after hours per-load button mode with modes including: Do nothing, on only, off only, on and off.
 - .6 Load control polarity reversal so that on events turn loads off and vice versa.
 - .7 Per-load DR (demand response) shed level in units of percent.
 - .8 Load output pulse mode in increments of 1second.
 - .9 Fade trip point for each load for normal hours and after hours that establishes the dimmer command level at which a switched load closes its relay to allow for staggered On of switched loads in response to a dimmer.

- .3 Generation of reports at the whole file, partial file, or room level. Reports include but are not limited to:
 - .1 Device list report: All devices in a project listed by type.
 - .2 Load binding report: All load controller bindings showing interaction with sensors, switches, and daylighting.
 - .3 BACnet points report: Per room Device ID report of the valid BACnet points for a given site's BOM.
 - .4 Room summary report: Device manifest for each room, aggregated by common BOM, showing basic sequence of operations.
 - .5 Device parameter report: Per-room lists of all configured parameters accessible via hand held IR programmer for use with O&M documentation.
 - .6 Scene report: All project scene pattern values not left at defaults (i.e. 1 = all loads 100 percent, 2 = all loads 75 percent, 3 = all loads 50 percent, 4 = all loads 25 percent, 5-16 = same as scene 1).
 - .7 Occupancy sensor report: Basic settings including time delay and sensitivities for all occupancy sensors.
- .4 Network-wide programming of parameter data in a spreadsheet-like programming environment including but not limited to the following operations:
 - .1 Set, copy/paste an entire project site of sensor time delays.
 - .2 Set, copy/paste an entire project site of sensor sensitivity settings.
 - .3 Search based on room name and text labels.
 - .4 Filter by product type (i.e. LMRC-212) to allow parameter set by product.
 - .5 Filter by parameter value to search for product with specific configurations.
- .5 Network-wide firmware upgrading remotely via the BACnet/IP network.
 - .1 Mass firmware update of entire rooms.
 - .2 Mass firmware update of specifically selected rooms or areas.
 - .3 Mass firmware upgrade of specific products
- .6 Wattstopper Product Number: LMCS-100, LMCI-100

Part 3 Execution

3.1 INSTALLATION

- .1 Install the work of this Section in accordance with manufacturer's printed instructions unless otherwise indicated.
- .2 When using wire for connections other than the DLM local network (LMRJ Cat 5e with RJ-45 connectors), provide detailed point to point wiring diagrams for every termination. Provide wire specifications and wire colors to simplify contactor termination requirements.

- .3 Calibrate all sensor time delays and sensitivity to guarantee proper detection of occupants and energy savings.
 - .1 Adjust time delay so that controlled area remains lighted for 5 minutes after occupant leaves area.
- .4 Install power packs in accessible maintenance areas unless noted otherwise. Provide access doors if power packs are installed above drywall ceilings.
- .5 It shall be the contractor's responsibility to locate and aim sensors in the correct location required for complete and proper coverage within the range of coverage as per the manufacturer's recommendations. The locations and quantities of sensors shown on the drawings are diagrammatic and indicate only the rooms which are to be provided with sensors. The contractor shall provide additional sensors if required to properly and completely cover the respective rooms.
- .6 Provide written or computer-generated documentation on the commissioning of the system including room by room description including:
 - .1 Sensor parameters, time delays, sensitivities, and daylighting setpoints.
 - .2 Sequence of operation, (e.g. manual ON, Auto OFF. etc.)
 - .3 Load Parameters (e.g. blink warning, etc.)
- .7 Re-commissioning – After 30 days from occupancy re-calibrate all sensor time delays and sensitivities to meet the Owner's Project Requirements. Provide a detailed report to the Architect / Owner of re-commissioning activity.

3.2 FACTORY COMMISSIONING

- .1 Upon completion of the installation, the system shall be commissioned by the manufacturer's factory authorized representative who will verify a complete fully functional system.
- .2 The electrical contractor shall provide both the manufacturer and the electrical engineer with ten working days written notice of the system startup and adjustment date.
- .3 Upon completion of the system commissioning the factory-authorized technician shall provide the proper training to the owner's personnel on the adjustment and maintenance of the system.
- .4 Factory commissioning shall include functional testing and documentation of the control system conforming to the "Functional Testing" requirements included in the current ASHRAE standard. This cost shall be included in the Tender Price.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 CAN/ULC-S524 (latest edition), Installation of Fire Alarm Systems.
- .2 ULC-S525-1978, Audible Signal Appliances for Fire Alarm Systems.
- .3 CAN/ULC-S526-M87, Visual Signal Appliances, Fire Alarm.
- .4 CAN/ULC-S527-M87Control Units, Fire Alarm.
- .5 CAN/ULC-S528 (latest edition), Manual Pull Stations.
- .6 CAN/ULC-S529 (latest edition), Smoke Detectors.
- .7 CAN/ULC-S530 (latest edition), Heat Actuated Fire Detectors, Fire Alarm.
- .8 CAN/ULC-S536 (latest edition), Inspection and Testing of Fire Alarm Systems.
- .9 CAN/ULC-S537-(latest edition), Verification of Fire Alarm Systems.
- .10 OBC-2012, Ontario Building Code.

1.2 DESCRIPTION OF SYSTEM

- .1 System includes:
 - .1 Existing control panel to carry out fire alarm and protection functions including receiving alarm signals, initiating general alarm, supervising system continuously, actuating zone annunciators, and initiating trouble signals.
 - .2 Trouble signal devices.
 - .3 Power supply facilities.
 - .4 Manual alarm stations.
 - .5 Automatic alarm initiating devices.
 - .6 Audible and visual signal devices.
 - .7 End-of-line devices.
 - .8 Ancillary devices.

1.3 REQUIREMENTS OF REGULATORY AGENCIES

- .1 This system is subject to review by: local building department officials, local fire department officials. **Therefore, submission of verification certificate and field technician device verification sheets is required prior to inspection by these officials. Schedule accordingly.**

1.4 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with the Electrical General Requirements Section.

1.5 OPERATION AND MAINTENANCE DATA

- .1 Provide operation and maintenance data for Fire Alarm System for incorporation into manual specified in the Electrical General Requirements Section.
- .2 Include:
 - .1 Operation and maintenance instructions for complete fire alarm system to permit effective operation and maintenance.
 - .2 Technical data - illustrated parts lists with parts catalogue numbers.
 - .3 Copy of approved shop drawings.
 - .4 List of recommended spare parts for system.

1.6 MAINTENANCE MATERIALS

- .1 Include:
 - .1 10 % spare glass rods for total number of manual pull box stations if applicable.

1.7 TRAINING

- .1 Arrange and pay for on-site demonstrations by fire alarm equipment manufacturer to train operational personnel in use and maintenance of fire alarm system. **Obtain written receipt of training session and include in maintenance manual.**

Part 2 Products

2.1 MATERIALS

- .1 Equipment and devices: ULC listed and labeled and supplied by single manufacturer.
- .2 Power supply: to CAN/ULC-S524.
- .3 Audible signal devices: to ULC-S525.
- .4 Visual signal devices: to CAN/ULC-S526.
- .5 Control unit: to CAN/ULC-S527.
- .6 Manual pull stations: to CAN/ULC-S528.
- .7 Thermal detectors: to CAN/ULC-S530.
- .8 Smoke detectors: to CAN/ULC-S529.

2.2 SYSTEM OPERATION

- .1 Single stage operation. Operation of any alarm initiating device to:
 - .1 Cause audible signal devices to sound throughout building.
 - .2 Transmit signal to fire department via monitoring station.
 - .3 Cause zone of alarm device to be indicated on control panel and remote annunciator[s].

2.3 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 gel cell batteries minimum expected life of 4 years, sized in accordance with OBC section 3.2.7.8 for the type of occupancy in which it is installed.

2.4 MANUAL ALARM STATIONS

- .1 Pull lever style, wall mounted semi-flush type, non-coded single pole normally open contact for single stage, English signage.
.2 Where noted on drawings, stations are to be equipped with tamperproof guard equal to Stopper II Cat. # STI-1100.

2.5 AUTOMATIC ALARM INITIATING DEVICES

- .1 Thermal fire detectors: fixed temperature, non-restorable, rated 57°C (135°F) or 88°C (194°F) as indicated.
.2 Thermal fire detectors, combination fixed temperature and rate of rise, non-restorable fixed temperature element, self-restoring rate of rise, fixed temperature 57°C (135°F) or 88°C (194°F), rate of rise 8.3°C (15°F) per minute.
.3 Smoke detector: ceiling mounted, photo electric type, visual alarm indicator, complete with relay base where noted.
.4 Smoke detector: photo electric type air duct type with sampling tubes with protective housing.
.1 Plug-in type with fixed base.
.2 Wire-in base assembly with integral red alarm LED, and terminals for remote alarm LED.

2.6 AUDIBLE/VISUAL SIGNAL DEVICES

- .1 150 mm (6") Bells: surface mounted bell, vibration type 24Vdc, 6", 92dBA rating at 10', red finish, FM and ULC listed.
.2 250 mm (10") Bells: surface mounted bell, vibration type 24Vdc, 10", 94dBA rating at 3 m (10'), red finish, FM and ULC listed.
.3 Strobe: Semi-recessed, 24Vdc operation, complete with selectable 15/30/75/110 candela output (unless otherwise noted set at 75 cd), synchronized strobe, red finish, FM and ULC listed. Suitable for mounting on a single gang box.

NOTE:

- .1 **Signal devices with integral strobe lights in high abuse areas (i.e. change rooms, etc.) must be provided with protective wireguards.**
.2 **Any surface mounted signal devices must be provided with suitable backboxes supplied by the manufacturer.**
.3 **Provide synchronization modules to suit signal devices (if required by manufacturer).**

2.7 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 at annunciators.
- .2 End-of-line resistors shall be mounted on a stainless steel plate for mounting on a standard single gang box and bear the ULC label.

2.8 REMOTE ANNUNCIATOR PANELS

- .1 LED type with designation cards to indicate zone.
- .2 LEDs to annunciate alarm and trouble.
- .3 Wired in multiple with main control panel and with other remote annunciator panels.
- .4 Supervised, including trouble signal for open circuit.
- .5 LED test button under lockable cover.
- .6 Annunciator must be keyed similar to control panel.

2.9 ANCILLARY DEVICES

- .1 Relay unit to facilitate elevator recall functions as indicated.

2.10 APPROVED EQUIPMENT

DEVICE	NOTIFIER
Manual Alarm Stations	NBG-12 Series
Thermal Detectors	HD-600 Series
Carbon Monoxide Alarm 120V with Battery Backup	Kidde 900-0128-001 (Pro Series CO)
Smoke Detectors (System Type)	2451 Series
Smoke Detectors (System Type c/w Relay Base)	2451/B404B

150 mm (6") Bells	MB-G6-24-R
250 mm (10)" Bells	MB-G10-24-R
Strobe	SRA (System Sensor)

Part 3 Execution

3.1 INSTALLATION

- .1 Install systems in accordance with CAN/ULC-S524 (latest edition).
- .2 Locate and install manual alarm stations and connect to alarm circuit wiring.
- .3 Locate and install detectors and connect to alarm circuit wiring. **Do not mount detectors within 1 m (39") of air outlets.** Maintain at least 600 mm (24") radius clear space on ceiling, below and around detectors. Locate duct type detectors in straight portions of ducts.
- .4 Connect alarm circuits to main control panel.
- .5 Locate and install signal devices and connect to signaling circuits.

Note: Any required surface mounted signalling devices must be provided with proper surface mounted boxes from fire alarm manufacturer.
- .6 Connect signaling circuits to main control panel.
- .7 Install end-of-line devices at end of alarm and signaling circuits no higher than 2.4 m (8' 0") above finish floor.
- .8 Install remote annunciator panels and connect to annunciator circuit wiring.
- .9 Elevator controllers are to be connected with 4 #14 conductors in conduit from fire alarm control panel to signal elevator recall in the event of a general alarm.
- .10 **Connect smoke damper integral detector outputs to noted zones and include dual voltage relay for supervision of AC power to smoke damper.**

3.2 PROTECTION

- .1 Contractor is to ensure all fire protection system detectors are protected from dust, dirt, humidity, and water at all times during construction. This applies to detectors installed, stored on site or stored in storage containers. Any detectors that are damaged or dirty shall be replaced at the contractor's expense.

3.3 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Electrical General Requirements Section and CAN/ULC-S537 (latest edition).

NOTE: Entire fire alarm system and components are to be tested as per the noted code.

- .2 Fire alarm system:

- .1 Test each device and alarm circuit to ensure noted devices transmit alarm to control panel and actuate general alarm and ancillary devices.

- .2 Check annunciator panels to ensure zones are shown correctly.

- .3 Simulate grounds and breaks on alarm and signaling circuits to ensure proper operation of system.

- .4 Class B circuits.

- .1 Test each conductor on all 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 all 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.

- .3 Qualifications:

- .1 Persons performing any work on this fire alarm system must be CFAA certified. Submit certification upon request.

- .2 **Provide “Integrated Testing” of this life safety system in conformance with the noted specification section. Include all associated costs in tender.**

- .4 Audibility Testing:

- .1 The contractor is to coordinate an audibility test prior to occupancy of the facility. The test is to be performed by the representatives of the fire alarm manufacturer in the presence of the consultant. The test report is to be in chart form indicating:

- .1 Project

- .2 Date of test

- .3 Room name and number

- .4 Ambient dB level

- .5 Alarm dB level

- .6 Name of testing technician

- .2 The test results are to be submitted to the consultant for review prior to issuing to owner's representatives and/or authorities having jurisdiction.

3.4 ADDITIONAL INSTALLED FIRE ALARM SYSTEM COMPONENTS

- .1 The electrical contractor is to include in their bid the cost to add five (5) additional signalling devices to be installed and verified in locations as directed by the consultant.
Note: This installation and verification and subsequent audibility test will be occurring after the initial audibility testing is complete.
- .2 The electrical contractor is to include in their bid the cost to add five (5) additional fire detection devices (heat or smoke detectors) to be installed and verified in locations as directed by the consultant.

END OF SECTION

Division 20

Common Requirements for Mechanical

20 00 01	Mechanical Specification Index
Common Contract Requirements for Mechanical	
20 02 41	Mechanical Allowances
20 02 51	Mechanical Contract Requirements
Common Work Results for Mechanical	
20 05 11	Mechanical General Work Requirements
20 05 31	Expansion Fittings and Loops
20 05 32	Thermometers and Pressure Gauges
20 05 34	Bases, Hangers and Supports
20 05 49	Vibration Control Measures
20 05 53	Identification of Mechanical Services
Testing, Adjusting, and Balancing	
20 06 11	Testing, Adjusting, and Balancing (TAB) of Mechanical Systems
Commissioning for Mechanical	
20 08 11	Mechanical Contractor Commissioning Requirements

Division 22

Plumbing

Common Work Results for Plumbing	
22 05 33	Heat Tracing for Plumbing & Drainage
Plumbing Insulation	
22 07 16	Plumbing Equipment Insulation
22 07 19	Plumbing Piping Insulation
Facility Water Distribution	
22 11 16	Domestic Water Piping - Copper
22 11 22	Domestic Water Circulation Pump
22 11 31	Potable Water Auxiliary Equipment
Facility Sanitary Sewerage	
22 13 13	Sanitary Drains
22 13 16	Sanitary Waste and Vent Piping – Cast Iron and Copper
Domestic Water Softeners	
22 31 13	Domestic Water Softeners
Fuel-Fired Domestic Water Heaters	
22 34 36	Fuel-Fired Domestic Water Heaters
Plumbing Auxiliary Equipment	
22 36 13	Plumbing Auxiliary Equipment
Fire Extinguishers	
22 37 13	Portable Fire Extinguishers
Plumbing Fixtures Combined With Drawing Schedule	
22 44 13	Plumbing Fixtures Combined With Drawing Schedule

Division 23 Heating, Ventilating, and Air Conditioning (HVAC)

Common Work Results for HVAC

23 05 33 Heat Tracing for HVAC Piping

HVAC Insulation

23 07 13 Duct Insulation

23 07 16 HVAC Equipment Insulation

23 07 19 HVAC Piping Insulation

Hydronic Piping and Pumps

23 21 11 Hydronic Accessories

23 21 13 Hydronic Piping - Screwed/Welded

23 21 14 Hydronic Piping - Rolled Grooved

23 21 23 Pumps Hydronic

HVAC Water Treatment

23 25 13 Water Treatment for Closed-Loop Hydronic Systems

HVAC Ducts and Casings

23 31 13 Metal Ducts

Air Duct Accessories

23 33 13 Duct Accessories

23 33 13.13 Volume-Control Dampers

23 33 16 Fire Dampers

23 33 17 Smoke Control Dampers

23 33 18 Operating Dampers

23 33 46 Flexible Ducts

23 33 53 Duct Liners

HVAC Fans

23 34 23 Packaged Exhausters

Air Outlets and Inlets

23 37 13 Diffusers, Registers, and Grilles

23 37 23 Louvres, Intakes and Exhaust

Custom Outdoor HVAC Equipment

23 75 24 Custom Outdoor, Indirect Fired Make-up Air Unit with Energy Recovery

Convection Heating and Cooling Units

23 82 16 Water to Air Coils

23 82 29 Radiators, Convector, and Cabinet Heaters

Division 25 Integrated Automation

Common Work Results for Integrated Automation

25 05 11 Variable Frequency Drives

25 05 21 Gas Detection Devices

Control Systems

25 40 11 Standalone Controls

END OF SECTION

Part 1 General

1.1 GENERAL INSTRUCTIONS

- .1 Comply with the General Conditions, Supplementary Conditions, and all of Division 1, General Requirements of Mechanical and Electrical Divisions.

1.2 CASH ALLOWANCES (HST EXCLUDED)

- .1 Refer to CCDC 2 – 2008, GC 4.1 - CASH ALLOWANCES.
- .2 The Contract Price includes the allowances stated below, which allowances shall be expended as the Owner directs through the Consultant. The Consultant may direct the Contractor to bid work for which payment is made from an allowance.
- .3 The *Contract Price*, and not the cash allowances, includes the *Contractor's* overhead and profit in connection with such cash allowances.
- .4 Where the actual cost of the *Work* under any cash allowance exceeds the amount of the allowance, the *Contractor* shall be compensated for the excess incurred and substantiated plus an amount for overhead and profit on the excess as set out in the *Contract Documents*. Where the actual cost of the *Work* under any cash allowance is less than the amount of the allowance, the *Owner* shall be credited for the unexpended portion of the cash allowance, but not for the *Contractor's* overhead and profit on such amount. Multiple cash allowances shall not be combined for the purpose of calculating the foregoing.
- .5 The *Contract Price* shall be adjusted by *Change Order* to provide for any difference between the amount of each cash allowance and the actual cost of the work under that cash allowance.
- .6 The value of the work performed under a cash allowance is eligible to be included in progress payments.
- .7 HST (Harmonized Sales Tax) is not included in cash allowance(s).
- .8 Testing & Balancing Allowance (HST Excluded)
- .1 This cash allowance covers the net cost to the Contractor or Sub-contractor of services, and equipment, and other authorized expenses incurred in performing the work.
- .2 Provide a cash allowance of \$40,000.00 in the tender price.

END OF SECTION

Part 1 General

1.1 GENERAL PROVISIONS

- .1 This section covers items common to all sections of Mechanical Division.
- .2 Conform to Division 1 General Conditions.
- .3 Furnish labour, materials, and equipment necessary for completion of work as described in contract documents.
- .4 Unless specifically indicated, all materials and equipment provided under this contract shall be new and shall be manufactured in the project year.

1.2 INTENT

- .1 Mention herein or indication on Drawings of articles, materials, operations or methods requires: supply of each item mentioned or indicated, of quality, or subject to qualifications noted; installation according to conditions stated: and, performance of each operation prescribed with furnishing of necessary labour, equipment, and incidentals for mechanical work.
- .2 Where used, words "Section" and "Division" shall also include other Subcontractors engaged on site to perform work to make building and site complete in all respects.
- .3 Where used, word "supply" shall mean furnishing to site in location required or directed complete with accessory parts.
- .4 Where used, word "install" shall mean secured in place and connected up for operation as noted or directed.
- .5 Where used, word "provide" shall mean supply and install as each is described above.

1.3 REGULATIONS, PERMITS AND FEES

- .1 All materials and quality of work shall meet all current and latest Provincial, Municipal and Fire Marshall requirements, regulations, codes and by-laws in force in the area of the project.
- .2 Each contractor shall give all necessary notices, obtain all necessary permits, and pay all fees in order that the work shown or specified may be carried out. Each contractor shall furnish any certificates necessary as evidence that the work installed conforms with the laws and regulations of all authorities having jurisdiction.
- .3 In the event that changes or alterations are required on completed work by authorized inspectors, these changes shall be made at the contractor's expense.

- .4 Special equipment which does not have a standard CSA label shall be inspected by the local electrical authority having jurisdiction and the Approval Certificate shall be submitted to the Consultant as soon as possible. All costs and fees for inspections shall be borne by this contractor.
- .5 Submit a copy of all final certificates in the maintenance manuals.

1.4 DRAWINGS

- .1 Mechanical Drawings do not show structural and related details. Take information involving accurate measurement of building from building drawings, or at building. Make, without additional charge, any necessary changes or additions to runs of piping, conduits and ducts to accommodate structural conditions. Location of pipes, ducts, conduits and other equipment may be altered by Consultant without extra charge provided change is made before installation and does not necessitate major additional material.
- .2 As work progresses and before installing piping, ductwork, heating units, registers, diffusers, fixtures and any other fittings and equipment which may interfere with interior treatment and use of building, provide detail drawings or obtain directions for exact location of such equipment and fittings.
- .3 Mechanical Drawings indicate general location and route of pipes, ducts and conduits which are to be installed. Where required work is not shown or only shown diagrammatically, install same at maximum height in space to conserve head room (minimum 2200 mm (88") clear) and interfere as little as possible with free use of space through which they can pass. Follow building lines, conceal piping, conduits and ducts in furred spaces, ceilings and walls unless specifically shown otherwise. Install work close to structure so furring will be small as practical.
- .4 Install piping and ductwork to clear structural members and any fireproofing. Locate mechanical work to permit installation of specified insulation. Do not remove or damage structural fireproofing. Leave space to permit fireproofing and insulation to be inspected and repaired.
- .5 Before commencing work, check and verify all sizes, locations, grade and invert elevations, levels and dimensions to ensure proper and correct installation. Verify existing/municipal services.
- .6 Locate all mechanical and electrical equipment in such a manner as to facilitate easy and safe access to and maintenance and replacement of any part.
- .7 In every place where there is indicated space reserved for future or other equipment, leave such space clear, and install piping and other work so that necessary installation and connections can be made for any such apparatus. Obtain instructions whenever necessary for this purpose.

- .8 Relocate equipment and/or material installed but not co-ordinated with work of other Sections and/or installed incorrectly as directed, without extra charge.
- .9 Where drawings are done in metric and product not available in metric, the corresponding imperial trade size shall be utilized.

1.5 INTERFERENCE AND COORDINATION DRAWINGS

- .1 Prepare interference and equipment placing drawings to ensure that all components will be properly accommodated within the constructed spaces provided.
- .2 Prepare drawings to indicate coordination and methods of installation of a system with other systems where their relationship is critical. Ensure that all details of equipment apparatus, and connections are coordinated.
- .3 Ensure that clearances required by jurisdictional authorities and clearances for proper maintenance are indicated on drawings.
- .4 Upon consultant's request submit copies of interference drawings to consultant.
- .5 Due to the nature of the building and the complexity of the building systems provide the following:
 - .1 Interference drawings, showing coordination of architectural, structural, mechanical and electrical systems for the consultant's review prior to fabrication.
 - .2 Detailed layout drawings, clearly showing fasteners and hangers.
- .6 Provide Revit model in addition to hard copies.

1.6 QUALITY ASSURANCE

- .1 Perform work in accordance with applicable provisions of local Plumbing Code, Gas Ordinances, and adoptions thereof for all mechanical systems. Provide materials and labor necessary to comply with rules, regulations, and ordinances.
- .2 In case of differences between building codes, provincial laws, local ordinances, utility company regulations, and Contract Documents, the most stringent shall govern. Promptly notify Consultant in writing of such differences.

1.7 ALTERNATES AND SUBSTITUTIONS

- .1 Throughout Mechanical Division are lists of "Alternate Equipment" manufacturers acceptable to Consultant if their product meets characteristics of specified described equipment. Submitted Bids shall be based on the supply of named articles and or products as specified in the Bid Documents.
- .2 Each bidder may elect to use "Alternate Equipment" from lists of Alternates where listed. Include for any additional costs including all costs for revisions to electrical contract to suit Alternate used. Prices are not required in Tender for Alternates listed except where specifically noted as "Separate Price". Complete the Supplementary Tender Form.

- .3 When two or more suppliers/manufacturers are named in the Bid Documents, only one supplier/manufacturer of the products named will be acceptable; however, it is the responsibility of this Division to ensure "Alternate Equipment" fits space allocated and gives performance specified. If an "Alternate Equipment" nor "equal" specified product unit is proposed and does not fit space allotted in Consultant's opinion, supply of specified described equipment will be required without change in Contract amount. Should electrical characteristics for "alternate" or "equal" equipment differ from equipment specified it shall be the responsibility of the equipment manufacturer to pay all costs associated with the revisions to the electrical contract. Only manufacturers listed will be accepted for their product listing. All other manufacturers shall be quoted as substitution stating conditions and credit amount.
- .4 If item of material specified is unobtainable, state in Tender proposed substitute and amount added or deducted for its use. Extra monies will not be paid for substitutions after Contract has been awarded.
- .5 If pipe or item, of size or weight indicated, is unobtainable, supply next larger size or heavier weight without additional charge.

1.8 EXAMINATION

- .1 Site Inspection
 - .1 Examine premises to understand conditions, which may affect performance of work of this Division before submitting proposals for this work.
 - .2 No subsequent allowance for time or money will be considered for any consequence related to failure to examine site conditions.
- .2 Drawings:
 - .1 Mechanical Drawings show general arrangement of piping, ductwork, equipment, etc. Follow as closely as actual building construction and work of other trades will permit.
 - .2 Consider Architectural and Structural Drawings part of this work insofar as these drawings furnish information relating to design and construction of building. These drawings take precedence over Plumbing, Mechanical, and Fire Protection Drawings.
 - .3 Because of small scale of Drawings, it is not possible to indicate all offsets, fittings, and accessories, which may be required. Investigate structural and finish conditions affecting this work and arrange work accordingly, providing such fittings, valves, and accessories required to meet conditions.
- .3 Ensure that items to be furnished fit space available. Make necessary field measurements to ascertain space requirements including those for connections and furnish and install equipment of size and shape so final installation shall suit true intent and meaning of Contract Documents. If approval is received by Addendum or Change Order to use other than originally specified items, be responsible for specified capacities and for ensuring that items to be furnished will fit space available.

1.9

SEQUENCING SCHEDULING AND COORDINATION

- .1 It is understood that while Drawings are to be followed as closely as circumstances permit, this Division will be held responsible for installation of systems according to the true intent and meaning of Contract Documents. Anything not clear or in conflict will be explained by making application to Consultant. Should conditions arise where certain changes would be advisable, secure Consultant's approval of these changes before proceeding with work.
- .2 Coordinate work of various trades in installing interrelated work. Before installation of mechanical items, make proper provision to avoid interferences in a manner approved by Consultant. Each Contractor shall refer to all sections of the specification for their responsibilities with other trades. Changes required in work specified in Mechanical Division caused by neglect to do so shall be made at no cost to Owner.
- .3 Arrange pipes, ducts, and equipment to permit ready access to valves, unions, traps, starters, motors, control components, and to clear openings of doors and access panels.
- .4 Furnish and install inserts and supports required by Mechanical Division unless otherwise noted. Furnish sleeves, inserts, supports, and equipment that are an integral part of other Divisions of the Work to Sections involved in sufficient time to be built into construction as the Work proceeds. Locate these items and see that they are properly installed. Expense resulting from improper location or installation of items above shall be borne by Mechanical Division.
- .5 Be responsible for required excavation, backfilling, cutting, and patching incident to work of this Division and make required repairs afterwards to satisfaction of Consultant. Cut carefully to minimize necessity for repairs to existing work. Do not cut beams, columns, or trusses.
 - .1 Patch and repair walls, floors, ceilings, and roofs with materials of same quality and appearance as adjacent surfaces unless otherwise shown. Surface finishes shall exactly match existing finishes of same materials.
 - .2 Each Section of this Division shall bear expense of cutting, patching, repairing, and replacing of work of other Sections required because of its fault, error, tardiness, or because of damage done by it.
 - .3 Cutting, patching, repairing, and replacing pavements, sidewalks, roads, and curbs to permit installation of work of this Division is responsibility of Section installing work.
- .6 Adjust locations of pipes, ducts, equipment, fixtures, etc, to accommodate work from interferences anticipated and encountered. Determine exact route and location of each pipe and duct prior to fabrication.
 - .1 Make offsets, transitions, and changes in direction of pipes, ducts, and electrical raceways as required to maintain proper head room and pitch of sloping lines whether or not indicated on Drawings.
 - .2 Furnish and install traps, air vents, sanitary vents, pull boxes, etc, as required to effect these offsets, transitions, and changes in direction.

- .7 Slots and openings through floors, walls, ceilings, and roofs shall be provided by this contractor but performed by a trade specializing in this type of work. This Division shall see that they are properly located and do any cutting and patching caused by its neglect to do so.

1.10 CONTRACT BREAKDOWN

- .1 Provide breakdown of contract exclusive of HST to acceptance of consultants prior to first draw submission.
- .2 Provide labour and material cost for each item.
- .3 Breakdown shall indicate total contract amount.
- .4 Contract breakdown shall be as follows as a minimum.
- Mobilization and shop drawings (max. \$20,000.00)
Demolition
Inside buried plumbing and drainage
Above grade rough-in plumbing and drainage
Plumbing Fixtures
Specialty Piping
Circulation pumps
Heating piping
Piping Insulation
Ductwork
Duct Insulation
Grilles & Diffusers
Fire Stopping
Fans & Equipment
Testing Adjusting and Balancing
HVAC system commissioning
Mechanical contractor closeout requirements (min. of 3% but not less than \$5,000.00)
- .5 Progress claims, when submitted are to be itemized against each item of the contract breakdown, this shall be done in table form showing contract amount, work complete to date, previous draw, amount this draw and balance.

1.11 COMMISSIONING CONTRACT BREAKDOWN

- .1 This contractor shall work with the HVAC system commissioning Consultant as specified elsewhere. The following commissioning breakdown shall be indicated on the contract breakdown draw.

1.12 SHOP DRAWINGS AND PRODUCT DATA

- .1 Furnish complete catalog data for manufactured items of equipment to be used in the Work to Consultant for review within 30 days after award of Contract.
- .2 Provide a complete list of shop drawings to be submitted prior to first submission.

- .3 Before submitting to the Consultant, review all shop drawings to verify that the products illustrated therein conform to the Contract Documents. By this review, the Contractor agrees that it has determined and verified all field dimensions, field construction criteria, materials, catalogue numbers, and similar data and that it has checked and coordinated each shop drawing with the requirements of the work and of the Contract Documents. The Contractor's review of each shop drawings shall be indicated by stamp, date and signature of a qualified and responsible person possessing by the appropriate authorization.
- .4 If material or equipment is not as specified or submittal is not complete, it will be rejected by Consultant.
- .5 Additional shop drawings required by the contractor for maintenance manuals, site copies etc., shall be photocopies of the "reviewed" shop drawings. All costs to provide additional copies of shop drawings shall be borne by the contractor.
- .6 **Submit all shop drawings for the project as a package. Partial submittals will not be accepted.**
- .7 Catalog data or shop drawings for equipment, which are noted as being reviewed by Consultant or his Engineer shall not supersede Contract Documents.
- .8 Review comments of Consultant shall not relieve this Division from responsibility for deviations from Contract Documents unless Consultant's attention has been called to such deviations in writing at time of submission, nor shall they relieve this Division from responsibility for errors in items submitted.
- .9 Check work described by catalog data with Contract Documents for deviations and errors.
- .10 Shop drawings and product data shall show:
 - .1 Mounting arrangements.
 - .2 Operating and maintenance clearances. e.g. access door swing spaces.
- .11 Shop drawings and product data shall be accompanied by:
 - .1 Detailed drawings of bases, supports, and anchor bolts.
 - .2 Acoustical sound power data, where applicable.
 - .3 Points of operation on performance curves.
 - .4 Manufacturer to certify as to current model production.
 - .5 Certification of compliance to applicable codes.
- .12 State sizes, capacities, brand names, motor HP, accessories, materials, gauges, dimensions, and other pertinent information. List on catalog covers page numbers of submitted items. Underline applicable data.

.13 Shop drawings shall be submitted electronically as per the following directions:

.1 Electronic Submissions:

- .1 Electronically submitted shop drawings shall be prepared as follows:
 - .1 Use latest software to generate PDF files of submission sheets.
 - .2 Scanned legible PDF sheets are acceptable. Image files are not acceptable.
 - .3 PDF format shall be of sufficient resolution to clearly show the finest detail.
 - .4 PDF page size shall be standardized for printing to letter size (8.5"x11"), portrait with no additional formatting required by the consultant. Submissions requiring larger detail sheets shall not exceed 11"x17".
 - .5 Submissions shall contain multiple files according to section names as they appear in Specification.
 - .6 File names shall include consultant project number and description of shop drawing section submitted.
 - .7 Each submission shall contain an index sheet listing the products submitted, indexed in the same order as they appear in the Specification. Include associated PDF file name for each section.
 - .8 On the shop drawing use an "electronic mark" to indicate what is being provided.
 - .9 **Each file shall bear an electronic representation of the "company stamp" of the contractor. If not stamped the file submission will not be reviewed.**
- .2 Email submissions shall include subject line to clearly identify the consultants project number and the description of the shop drawings submitted.
- .3 Electronic attachments via email shall not exceed 10MB. For submissions larger than 10MB, multiple email messages shall be used. Denote related email messages by indicating "1 of 2" and "2 of 2" in email subject line for the case of two messages.
- .4 Electronic attachments via web links (URL) shall directly reference PDF files. Provide necessary access credentials within link or as username/password clearly identified within body of email message.
- .5 On site provide one copy of the "reviewed" shop drawings in a binder as noted above.
- .6 Contractor to print copies of "reviewed" shop drawings and compile into maintenance manuals in accordance with requirements detailed in this section.

1.13 OPERATION AND MAINTENANCE MANUAL

- .1 Provide operation and maintenance data for incorporation into manual as in submittals' requirements.
- .2 Operation and maintenance manual to be approved by, and final copies deposited with, Consultant before final inspection.
- .3 Operation data to include:
 - .1 Control schematics for 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.
 - .8 Spare parts equipment list.
 - .9 Manufacturers standard or extended warranty information.
- .4 Maintenance data shall include:
 - .1 Servicing, maintenance, operation and trouble-shooting instructions for each item of equipment.
 - .2 Data to include schedules of tasks, frequency, tools required and task time.
- .5 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 Testing, Adjusting and Balancing Section.
- .6 Miscellaneous data to include:
 - .1 Letter of contractors warranty and guarantee.
 - .2 Index sheet.
 - .3 Tabbed format for each section.
 - .4 Manufacturers approved shop drawings.
 - .5 Spare parts list and source.
 - .6 List of Manufacturers and suppliers address for each piece of equipment.

- .7 Approvals:
 - .1 Submit 1 copy of draft Operation and Maintenance Manual to Consultant for approval. Submission of individual data will not be accepted unless so directed by Consultant.
 - .2 Make changes as required and re-submit as directed by Consultant.
- .8 Additional data:
 - .1 Prepare and insert into operation and maintenance manual when need for same becomes apparent during demonstrations and instructions specified above.

1.14 AS-BUILT DRAWINGS

- .1 Site records:
 - .1 Contractor shall provide 2 sets of reproducible mechanical drawings. Provide sets of white prints as required for each phase of the work. Mark thereon all changes as work progresses and as changes occur. This shall include changes to existing mechanical systems, control systems and low voltage control wiring.
 - .2 On a weekly basis, transfer information to reproducibles, revising reproducibles to show all work as actually installed.
 - .3 Use different colour waterproof ink for each service.
 - .4 Make available for reference purposes and inspection at all times.
- .2 As-Built drawings:
 - .1 Prior to start of Testing, Adjusting and Balancing (TAB), finalize production of as-built drawings.
 - .2 Identify each drawing in lower right hand corner in letters at least 3 mm (1/8") high as follows: - "AS-BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW MECHANICAL SYSTEMS AS INSTALLED" (Signature of Contractor) (date).
 - .3 TAB to be performed using record drawings.
 - .1 Submit hard copy to Consultant for approval. When returned, make corrections as directed.
 - .2 Once approved, submit completed reproducible paper as-built drawings as well as a scanned pdf file copy on USB stick with Operating and Maintenance Manuals.

1.15 WARRANTIES

- .1 In addition to guarantee specified in General Conditions, guarantee heating, cooling, and plumbing systems to be free from noise in operation that may develop from failure to construct system in accordance with Contract Documents.
- .2 Provide certificates of warranty for each piece of equipment made out in favor of Owner. Clearly record "start-up" date of each piece of equipment on certificate. Include certificates as part of Operation & Maintenance Manual.

- .3 If mechanical sub-contractor with offices located more than 80 km (50 miles) from Project site is used, provide service/warranty work agreement for warranty period with local mechanical sub-contractor approved by Consultant. Include copy of service/warranty agreement in warranty section of Operation & Maintenance Manual.
- .4 Warranty period shall start from date of substantial completion.

1.16 SUBSTANTIAL PERFORMANCE

- .1 Complete the following to the satisfaction of the consultant prior to request for submission of substantial performance.
 - .1 Record Drawings.
 - .2 Maintenance Manuals
 - .3 System Start up
 - .4 TAB Reports
 - .5 HVAC System Commissioning
 - .6 Instructions to Owners
 - .7 Final Certificates (required prior to consultant's release of conformance letter).
 - .1 NFPA-13 Contractors Material and Test Certificate (sprinkler)
 - .2 Sprinkler Design Engineers' Letter
 - .3 NFPA-13 Fire Protection Bypass Flow Test
 - .4 Potable Water Test (Refer to domestic water piping – Copper section – Part 3)
 - .5 Backflow Test Certificate (for all testable devices)
 - .6 Mandatory TSSA Gas Pressure Test (CSA B149.1)

1.17 OCCUPANCY REQUIREMENTS

- .1 The contractor shall provide the following documentation to the consultant prior to receiving occupancy. Failure to provide the proper documentation will result in the occupancy not being granted. List of required documentation:
 - .1 Final Certificates (required prior to consultant's release of conformance letter).
 - .1 NFPA-13 Contractors Material and Test Certificate (sprinkler)
 - .2 Sprinkler Design Engineers' Letter
 - .3 NFPA-13 Fire Protection Bypass Flow Test
 - .4 Potable Water Test (Refer to domestic water piping – Copper section – Part 3)
 - .5 Backflow Test Certificate (for all testable devices)
 - .6 Mandatory TSSA Gas Pressure Test (CSA B149.1)

1.18 REVISION TO CONTRACT

- .1 Provide the following:
 - .1 Itemized list of material with associated costs.
 - .2 Labour rate and itemized list of labour for each item.
 - .3 Copy of manufacturers/suppliers invoice if requested.

1.19 DELIVERY STORAGE & HANDLING

- .1 Follow Manufacturer's directions in delivery, storage, and protection, of equipment and materials.
- .2 Deliver equipment and material to site and tightly cover and protect against dirt, water, and chemical or mechanical injury but have readily accessible for inspection. Store items subject to moisture damage (such as controls) in dry, heated space.

1.20 PHASING OF WORK

- .1 This work for this project shall be constructed in phases. Refer to the architectural drawings for phasing information and details. Misinterpretation of the drawings with respect to the extent of the phasing of the work shall not relieve the contractor of the work required to complete the entire contract.
- .2 Provide all necessary services or temporary services to suit phasing of construction with respect to all mechanical services and fire protection.
- .3 Life safety systems in the building are to remain fully operational in occupied areas for building staff and occupants during renovations.
- .4 Provide all necessary tests and certificates at completion of each phase to suit requirements of local authorities and consultants for occupancy of completed areas.

1.21 TSSA INSPECTION

- .1 Prior to final completion of the project, this contractor shall make application, arrange, and pay for a TSSA inspection of all piping systems and equipment installations, including, but not limited to medical gasses, refrigeration, fuel piping, compressed air, heating plant, cooling plant, and associated equipment installed under the contract.
- .2 Provide a copy of the TSSA report in the maintenance manuals for each system.

1.22 CONFINED SPACES

- .1 Certain areas of the building may be defined as a "Confined Space". Any personnel working in these areas must have confined space training, appropriate equipment and undertake all work in conformance with appropriate codes and standards.
- .2 Refer to building documentation for any spaces deemed "Confined Space".

1.23 ENERGY EFFICIENCY

- .1 The mechanical systems of this building must achieve the energy efficiency levels by conforming to ANSI/ASHRAE/IESNA 90.1 "Energy Standard for Buildings Except Low-Rise Residential Buildings" and Chapter 2 of Division 3 of SB-10 prescriptive method from the Ontario Building Code.
- .2 All equipment, products, and installations must conform to the Codes and Standards.

END OF SECTION

Part 1 General

1.1 TESTS

- .1 Give 48 hours written notice of date for tests.
- .2 Insulate or conceal work only after testing and approval by Consultant.
- .3 Conduct tests in presence of Consultant.
- .4 Bear costs including retesting and making good.
- .5 Piping:
 - .1 General: maintain test pressure without loss for 4 h unless otherwise specified.
 - .2 Hydraulically test steam and hydronic piping systems at 1-1/2 times system operating pressure or minimum 860 kPa, whichever is greater.
 - .3 Test natural gas systems to CSA-B149.1-00, TSSA requirements and requirements of authorities having jurisdiction.
 - .4 Test fuel oil systems to CSA B139 1976, CSA B139S1-1982 and authorities having jurisdiction.
 - .5 Test drainage, waste and vent piping to Ontario Building Code and authorities having jurisdiction.
 - .6 Test domestic hot, cold and recirculation water piping at 1-1/2 times system operating pressure or minimum 860 kPa (124.8 psi), whichever is greater.
 - .7 Test fire systems in accordance with authorities having jurisdiction and as specified elsewhere.
- .6 Equipment: test as specified in relevant sections.
- .7 Prior to tests, isolate all equipment or other parts which are not designed to withstand test pressures or test medium.

1.2 SYSTEM START UP

- .1 Provide adjusting testing and start up of all equipment prior to testing and balancing (TAB) specified elsewhere.
- .2 Provide consultant with written notice verifying all equipment operation and installation is complete.
- .3 Start up shall be in presence of the following: owner or representative, contractor, building automation systems (BAS) contractor, and manufacturer's representative. Each person shall witness and sign off each piece of equipment. Consultant's attendance will be determined by consultant.
- .4 Simulate system start up and shut down and verify operation of each piece of equipment.

- .5 Arrange with all parties and provide 72 hours notice for start up procedure.
- .6 Arrange with building automation systems contractor to sequence all components and ensure system operation.

1.3 COMMISSIONING

- .1 Co-ordinate and direct each step of the commissioning process, and recommend acceptance or non-acceptance to the Owner/Owner's Representative.
- .2 Prepare, in writing, documentation of any deficiencies discovered during the commissioning process. Submit to consultant and Owner/Owner's Representative.
- .3 The Commissioning Process is detailed in *ASHRAE Guideline 1-1996 HVAC Commissioning Process*. The commissioning plan may be modified to reflect the actual construction schedule and design.
- .4 Provide a pre-functional test of all HVAC mechanical system and sub-system elements, including control devices, shall be checked for the following:
 - .1 Verify that each element has been properly installed, properly identified, and that all connections (including electrical) have been made correctly.
 - .2 Verify that each element has been checked for proper lubrication, drive rotation, belt tension, control sequence, flow direction, or other conditions which may cause damage or reduce system performance.
 - .3 Verify that tests, meter readings, and specific mechanical/electrical performance characteristics agree with those required by equipment or system manufacturer.
 - .4 Controls calibration to be completed in accordance with the specification.
 - .5 The TAB shall be done in accordance with the specifications.
- .5 A functional performance testing shall be done during two separate periods – one during the cooling season and one during the heating season. The first (cooling) testing period shall occur as soon after completion of installation as practical. The heating testing period shall occur as soon as weather conditions make it practical to test warm-up, zone heating and economizer functions. These tests ensure that all equipment and systems operate in accordance with design intent. The tests are dynamic tests, and test the systems through all possible modes of operation.
- .6 Reports:
 - .1 The contractor shall be responsible for recording, documenting, and maintaining detailed inspection and testing data on the test documentation reports. The data record shall be comprehensive and concise.
 - .2 All data must be recorded as soon as possible during the course of the inspection and testing.
 - .3 All documentation shall have the date, time, and names of persons participating in the inspection and testing.
 - .4 All test instruments shall be documented for valid calibration.

- .5 The recording work sheets, inspection check lists, and Performance Testing plans must all be approved by the Engineer and the owner's representative prior to the start of the testing.
- .6 Include all commissioning documentation in the maintenance manuals.
- .7 Mechanical System Execution:
 - .1 Operate equipment and systems shall be tested in the presence of the owner's representative and the consultant to demonstrate compliance with specified requirements. To minimize the time of Commissioning Team members, testing shall be done in four seasonal single blocks of time insofar as possible.
 - .2 Notify the consultant, in writing, fourteen (14) days prior to tests scheduled under requirements of this Section.
 - .3 Testing shall be conducted under specified design operating conditions as recommended or approved by the consultant.
 - .4 All elements of systems shall be tested to demonstrate that total systems satisfy all requirements of these Specifications. Testing shall be accomplished on hierarchical basis. Test each piece of equipment for proper operation, followed by each sub-system, followed by entire system, followed by any inter-ties of other major systems.
 - .5 All special testing materials and equipment shall be provided by the appropriate contractor.
 - .6 Provide three copies of all test reports and records to the consultant.
- .8 The verification testing procedures shall address all operating characteristics of all mechanical equipment and systems, including:

Equipment Checklist	System Checklist
Rooftop Heating/Cooling Unit(s)	Pumps
Exhaust Fans	Heat Recovery Unit(s)
Heat Recovery Unit(s)	
Pumps	
Controllers/Valves/Dampers	
Relays/Sensors/Transducers	

1.4

DEMONSTRATION AND OPERATING AND MAINTENANCE INSTRUCTION

- .1 Supply tools, equipment and personnel to demonstrate and instruct operating and maintenance personnel in operating, controlling, adjusting, trouble-shooting and servicing of all systems and equipment during regular work hours, prior to acceptance.
- .2 Mechanical contractor to schedule and coordinate the demonstration all on the same day, starting at a pre-approved time and continuing consequently until complete.
- .3 Where specified elsewhere in Mechanical Division, qualified manufacturers' representatives who are knowledgeable about the project to provide demonstrations and instructions.
- .4 Use operation and maintenance manual, record drawings, audio visual aids, etc. as part of instruction materials.

- .5 Instruction duration time requirements as specified in appropriate sections.
- .6 Where deemed necessary, Consultants may record these demonstrations on video tape for future reference.

1.5 TRIAL USAGE

- .1 Consultant or owner may use equipment and systems for test purposes prior to acceptance. Supply labour, material, and instruments required for testing.
- .2 Trial usage to apply to following equipment and systems:
 - .1 HVAC
 - .2 Exhaust air
 - .3 Domestic water
 - .4 Plumbing, and drainage.

1.6 DEFICIENCIES

- .1 During the course of construction, the consultants will monitor construction and provide written reports of work progress, discussions, and instruction to correct work.
- .2 Instruction to correct work shall be done within the work period before the next review.
- .3 The contractor shall not conceal any work until inspected.
- .4 The contractor shall expedite 100% complete rough-in work and have inspected prior to concealing services and equipment especially above ceiling.
- .5 Upon completion of the project the consultant will do a final review. Upon receiving the final inspection report, the contractor must correct and sign back the inspection report indicating the deficiencies are completed. A re-inspection will only be done once consultant receives this in writing.

1.7 EQUIPMENT INSTALLATIONS

- .1 Unions or flanges: provide for ease of maintenance and disassembly.
- .2 Space for servicing, disassembly and removal of equipment and components: provide as recommended by manufacturer or as indicated.
- .3 Equipment drains: pipe to floor drains.
- .4 Install equipment, rectangular cleanouts and similar items parallel to or perpendicular to building lines.

1.8 MOUNTING HEIGHTS

- .1 Mounting height of equipment is from finished floor to equipment unless specified or indicated otherwise. Coordinate with block coursing (if applicable).
- .2 If mounting height of equipment is not specified or indicated, verify before proceeding with installation.

.3	Install mechanical equipment at following heights unless indicated otherwise.	
.1	Standard water closets	350 (14") to top of bowl
.2	Barrier-free water closets	400 (16") to top of bowl
.3	Barrier-free water closets	450 (18") to top of seat lid
.4	Wall hung lavatory	787 (31") to rim
.5	Barrier-free wall hung lavatory	840 (33") max to top of rim 737 (29") min underside of rim front
.6	Urinals (Adult)	± 600 (24")
.7	Hose bibbs	+/- 600 (24")
.8	Shower heads	2.0 m (6' – 6")to bottom of head
.9	Barrier-free drinking fountains	840 mm (33") to rim Not less than 686 (27") under unit
.10	Fire extinguisher	1350 (4'- 0") to hanger
.11	Fire extinguisher cabinets	1500 (5'- 0") to top of cabinet
.12	Hydronic heating elements	200 mm (8") to bottom of cabinet
.13	Backflow preventors	900 – 1200 (3'- 4') to centerline of unit
.14	Thermostats: Barrier Free (operable)	1200 mm (47.25")
	Non Barrier Free	1500 mm (59")

Also follow direction of architectural drawings and where discrepancies occur clarify prior to rough-in.

1.9 ANCHOR BOLTS AND TEMPLATES

- .1 Supply anchor bolts and templates for installation by other divisions.

1.10 PROTECTION OF OPENINGS

- .1 Protect equipment and systems openings from dirt, dust, and other foreign materials with materials appropriate to system.

1.11 ELECTRICAL

- .1 Electrical work to conform to Electrical Division including the following:

- .1 Supplier and installer responsibility and related mechanical responsibility is indicated in Equipment Schedule on mechanical and/or electrical drawings
- .2 Control wiring and conduit is specified in Electrical Division except for conduit, wiring and connections below 50 V which are related to control systems specified in Mechanical Division. Refer to Electrical Division for quality of materials and workmanship.
- .3 Electrically operated equipment shall be C.S.A. approved label. Special Inspection Label of Provincial Authority having jurisdiction will be accepted in lieu of C.S.A. approval. Each motor shall have an approved starter. Starter will be supplied and installed by Electrical Division unless otherwise indicated.

.4 All starters for mechanical equipment to be provided by this contractor. Wired by Electrical Division.

1.12 MOTORS

- .1 Provide high efficiency motors for mechanical equipment as specified.
- .2 If delivery of specified motor will delay delivery or installation of any equipment, install motor approved by Consultant for temporary use. Final acceptance of equipment will not occur until specified motor is installed.
- .3 Motors under 373 W, (1/2 hp): speed as indicated, continuous duty, built-in overload protection, resilient mount, single phase, voltage as indicated.
- .4 Motors 373 W, (1/2 hp) and larger: EEMAC Class B, squirrel cage induction, speed as indicated, continuous duty, drip proof, ball bearing, maximum temperature rise 40°C (72°F), 3 phase, voltage as indicated.

1.13 BELT DRIVES

- .1 Fit reinforced belts in sheave matched to drive. Multiple belts to be matched sets.
- .2 Use cast iron or steel sheaves secured to shafts with removable keys unless otherwise specified.
- .3 For motors under 7.5 kW 10 hp: standard adjustable pitch drive sheaves, having plus or minus 10% range. Use mid-position of range for specified r/min.
- .4 For motors 7.5 kW 10 hp and over: sheave with split tapered bushing and keyway having fixed pitch unless specifically required for item concerned. Provide sheave of correct size to suit balancing.
- .5 Minimum drive rating: 1.5 times nameplate rating on motor. Keep overhung loads within manufacturer's design requirements on prime mover shafts.
- .6 Motor slide rail adjustment plates to allow for centre line adjustment.
- .7 Provide sheave changes as required for final air balancing.

1.14 GUARDS

- .1 Provide guards for unprotected devices.
- .2 Guards for belt drives:
 - .1 Expanded metal screen welded to steel frame.
 - .2 Minimum 1.2 mm (18 gauge) thick sheet metal tops and bottoms.
 - .3 40 mm (1 1/2") diameter holes on both shaft centres for insertion of tachometer.
 - .4 Removable for servicing.
- .3 Provide means to permit lubrication and use of test instruments with guards in place.
- .4 Install belt guards to allow movement of motors for adjusting belt tension.

- .5 Guard for flexible coupling:
 - .1 "U" shaped, minimum 1.6 mm (16 gauge) thick galvanized mild steel.
 - .2 Securely fasten in place.
 - .3 Removable for servicing.
 - .6 Unprotected fan inlets or outlets:
 - .1 Wire or expanded metal screen, galvanized, 20 mm (3/4") mesh.
 - .2 Net free area of guard: not less than 80% of fan openings.
 - .3 Securely fasten in place.
 - .4 Removable for servicing.
 - .7 Duct Openings in Floor
 - .1 Provide reinforced expanded mesh grating, style 3 (3 lbs/sq.ft.) cover on accessible unprotected duct openings over 300 mm (12") wide and as indicated. This includes all ductwork terminating in air handling units and plenums.
 - .2 Securely Fasten in place.
 - .3 Removable for servicing.
- 1.15 PIPING AND EQUIPMENT SUPPORTS**
- .1 Equipment supports supplied by equipment manufacturer: specified elsewhere in Mechanical Division.
 - .2 Piping and equipment supports not supplied by equipment manufacturer: fabricate from structural grade steel meeting requirements of - Structural Steel Section. Submit structural calculations with shop drawings.
 - .3 Mount base mounted equipment on chamfered edge housekeeping pads, minimum of 100 mm (4") high and 150 mm (6") larger than equipment dimensions all around. Concrete specified elsewhere.
 - .4 Where housekeeping pads incorporate existing pads provide 10 mm dowels into existing pads. New pad height shall match existing.
- 1.16 ROOF MOUNTED DUCT SUPPORT**
- .1 Provide zero penetration duct support on roof where indicated.
 - .2 Base shall be made of high density polypropylene with UV protection.
 - .3 Frames shall be galvanized. All fastenings, rods, nuts, washers, etc. shall be stainless steel.
 - .4 Provide shop drawings as specified. Install to manufacturers recommendations.
 - .5 Acceptable materials:
 - Portable pipe hanger
 - Bigfoot systems
 - Miro rooftop support
 - Trikon Systems

- 1.17 ROOF MOUNTED PIPE SUPPORT**
- .1 Provide zero penetration pipe support on roof where indicated.
 - .2 Base shall be made of high density polypropylene with UV protection. Maximum loading shall be 50 lb/sq.ft.
 - .3 Frames shall be galvanized. All fastenings, rods, nuts, washers, hangers, etc. shall be stainless steel.
 - .4 Provide shop drawings as specified. Install to manufacturers recommendations.
 - .5 Acceptable material:
Portable pipe hanger
Bigfoot systems
Miro rooftop supports
- 1.18 SLEEVES**
- .1 Pipe sleeves: at points where pipes pass through masonry, concrete or fire rated assemblies and as indicated. Grout sleeves in place.
 - .2 Schedule 40 steel pipe.
 - .3 Sleeves with annular fin continuously welded at midpoint:
 - .1 Through foundation walls.
 - .2 Where sleeve extends above finished floor.
 - .3 Through fire rated walls and floors.
 - .4 Sizes: minimum 6 mm (1/4") clearance all around, between sleeve and uninsulated pipe or between sleeve and insulation.
 - .5 Terminate sleeves flush with surface of concrete and masonry walls, concrete floors on grade and 25 mm (1") above other floors.
 - .6 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 Fill future-use sleeves with lime plaster or other easily removable filler.
 - .5 Coat exposed exterior surfaces of ferrous sleeves with heavy application of zinc rich paint to CGSB 1-GP-181M+Amdt-Mar-78.
 - .7 Provide minimum 20 gauge duct sleeves where ducts pass through masonry concrete or fire rated assemblies. Maintain minimum 25 mm clearance all around or to the requirements of the authority having jurisdiction. Seal at wall as indicated.

- 1.19 FIRE STOPPING**
- .1 This contractor shall work with all other contractors on the project in providing one common method of fire stopping all penetrations made in fire rated assemblies.
 - .2 Approved fire stopping and smoke seal material in all fire separations and fire ratings within annular space between pipes, ducts, insulation and adjacent fire separation and/or fire rating.
 - .3 Do not use cementious or rigid seals around penetrations for pipe, ductwork, or other mechanical items.
 - .4 Insulated pipes and ducts: ensure integrity of insulation and vapour barrier at fire separation.
 - .5 Provide materials and systems capable of maintaining effective barrier against flame, smoke and gases. Ensure continuity and integrity of fire separation.
 - .6 Comply with the requirements of CAN4-S115-M35, and do not exceed opening sized for which they have been tested.
 - .7 Systems to have an F or FT rating (as applicable) not less than the fire protection rating required for closures in a fire separation. Provide "fire wrap" blanket around services penetrating fire walls. Extent of blanket must correspond to ULC recommendations.
 - .8 The fire stopping materials are not to shrink, slump or sag and to be free of asbestos, halogens and volatile solvents.
 - .9 Firestopping materials are to consist of a component sealant applied with a conventional caulking gun and trowel.
 - .10 Fire stop materials are to be capable of receiving finish materials in those areas which are exposed and scheduled to receive finishes. Exposed surfaces are to be acceptable to consultant prior to application of finish.
 - .11 Firestopping shall be inspected and approved by local authority prior to concealment or enclosure.
 - .12 Install material and components in accordance with ULC certification, manufacturers instructions and local authority.
 - .13 Submit product literature and installation material on fire stopping in shop drawing and product data manual. Maintain copies of these on site for viewing by installers and consultant.
 - .14 Manufacturer of product shall provide certification of installation. Submit letter to the consultant.
 - .15 Acceptable Manufacturer:
Minnesota Mining and Manufacturing

- .16 Acceptable Alternate Manufacturers to approval of local authority:
 - Fryesleeve Industries Inc.
 - General Electric Pensil Firestop Systems
 - International Protective Coatings Corp.
 - Rectorseal Corporation (Metacaulk)
 - Proset Systems
 - 3M
 - AD Systems
 - Hilti
- .17 Ensure firestop manufacturer representative performs on site inspections and certifies installation. Submit inspection reports/certification at time of substantial completion.

1.20 ESCUTCHEONS

- .1 On pipes and ductwork passing through walls, partitions, floors and ceilings in exposed finished areas and on water and drain pipes inside millwork and cabinets.
- .2 Chrome or nickel plated brass or Type 302 stainless steel, one piece type with set screws.
- .3 Outside diameter to cover opening or sleeve.
- .4 Inside diameter to fit around finished pipe.

1.21 PAINTING

- .1 Refer to Section Interior Painting and specified elsewhere.
- .2 Apply at least one coat of corrosion resistant primer paint to ferrous supports and site fabricated work.
- .3 Apply two coats of paint to exposed piping service in mechanical room, base colour as specified in Mechanical Identification Section.
- .4 Prime and touch up marred finished paintwork to match original.
- .5 Restore to new condition, or replace equipment at discretion of consultant, finishes which have been damaged too extensively to be merely primed and touched up.

1.22 SPARE PARTS

- .1 Furnish spare parts in accordance with general requirements and as follows:
 - .1 One set of packing for each pump.
 - .2 One casing joint gasket for each size pump.
 - .3 One head gasket set for each heat exchanger.
 - .4 One glass for each gauge glass.
 - .5 One set of belts for each type or each size of machinery.
 - .6 One filter cartridge or set of filter media for each filter or filter bank in addition to final operating set.
- .2 Provide list of equipment in maintenance manuals indicating corresponding spare parts required. List of spare parts to be signed off by receiving personnel.

1.23 SPECIAL TOOLS

- .1 Provide one set of special tools required to service equipment as recommended by manufacturers and in accordance with Maintenance Materials Special Tools and Spare Parts.

1.24 ACCESS DOORS

- .1 Provide access doors to concealed mechanical equipment for operating, inspecting, adjusting and servicing.
- .2 Flush mounted 600 x 600 mm (24" x 24") for body entry and 300 x 300 mm (12" x 12") for hand entry unless otherwise noted. Doors to open 180°, have rounded safety corners, concealed hinges, screwdriver latches and anchor straps.
- .3 Material:
- .1 Special areas such as tiled or marble surfaces: use stainless steel with brushed satin or polished finish as directed by Consultant.
 - .2 Remaining areas: use prime coated steel.
 - .3 Fire rated areas: provide ULC listed access doors
- .4 Installation:
- .1 Locate so that concealed items are accessible.
 - .2 Locate so that hand or body entry (as applicable) is achieved.
- .5 Acceptable materials:
Le Hage
Zurn
Acudor
Nailor Industries Inc.

1.25 DIELECTRIC COUPLINGS

- .1 General:
- .1 To be compatible with and to suit pressure rating of piping system.
 - .2 Where pipes of dissimilar metals are joined.
- .2 Pipes NPS 50 mm (2") and under: isolating unions.
- .3 Pipes NPS 65 mm (2 1/2") and over: isolating flanges.

1.26 DRAIN VALVES

- .1 Locate at low points and at section isolating valves unless otherwise specified.
- .2 Minimum NPS 20 mm (3/4") unless otherwise specified: bronze, with hose end male thread and complete with cap and chain.
- .3 Drain valves on potable water systems shall be complete with vacuum breaker.

- 1.27 REPAIRS, CUTTING, AND RESTORATION**
- .1 Patch and repair walls, floors, ceilings, and roofs with materials of same quality and appearance as adjacent surfaces unless otherwise shown. Surface finishes shall exactly match existing finishes of same materials.
 - .2 Each Section of this Division shall bear expense of cutting, patching, and repairing to install their work and/or replacing of work of other Sections required because of its fault, error, tardiness, or because of damage done by it.
 - .3 Cutting, patching, repairing, and replacing pavements, sidewalks, roads, and curbs to permit installation of work of this Division is responsibility of Section installing work.
 - .4 All patching, painting and making good of the existing walls, floors, ceilings, partitions and roof will be at the expense of this Contractor, but performed by the Contractor specializing in the type of work involved unless otherwise noted.
- 1.28 CLEANING**
- .1 Clean interior and exterior of all systems including strainers. Vacuum interior of ductwork and air handling units prior to turn over to owner.
 - .2 In preparation for final acceptance, clean and refurbish all equipment and leave in operating condition including replacement of all filters in all air and piping systems.
- 1.29 DISCONNECTION AND REMOVAL**
- .1 Disconnect and/or remove equipment, piping, ductwork, etc. as indicated.
 - .2 Cap and conceal all redundant and obsolete connections.
 - .3 Provide a list of equipment to be removed to the owner, for his acceptance of same. Remove all equipment from site, which the owner does not retain.
 - .4 Store equipment to be retained by owner on site where directed by consultant.
- 1.30 OWNER SUPPLIED EQUIPMENT**
- .1 Connect to equipment supplied by the owner and make operable.
- 1.31 VIDEO RECORDING OF NEW UNDERGROUND SERVICES**
- .1 Prior to final acceptance of the new underground plumbing system and prior to pouring the floor this contractor shall retain a qualified contractor to video tape the new, existing and revised sanitary and storm drainage piping and branch piping. Transfer all videotape information to DVD.
 - .2 This contractor shall flush the new and existing storm and sanitary system to remove all debris prior to final video taping of systems.
 - .3 Provide 3 copies of DVD.
 - .4 Identify video routing on Record drawings.

1.32 EXCAVATING AND BACKFILLING

- .1 Provide all excavating and backfilling inside and outside the building for plumbing pipes, drains and equipment. All backfilling shall be new clean granular 'A' fill brought in specifically for the purpose of backfilling to the underside of floor slab. All backfilling shall be compacted at intervals not more than 150 mm (6") layer to the satisfaction of the Consultant.
- .2 Provide excavating and backfilling outside the building with granular A brought in specifically for backfilling to a minimum of 450 mm (18") over the pipe. Backfilling outside building over and above the 450 mm (18") backfill as previously specified herein shall be by the Mechanical Contractor as specified under Division 2. Where backfilling outside the building is not specified under Division 2 the mechanical contractor shall provide new clean granular 'A' fill to grade level.
- .3 Bottoms of trenches shall be excavated so that the pipe will be supported on a 150 mm (6") compacted bed of clean granular 'A' fill. Provide all necessary pumping to maintain excavation free of water.
- .4 Should water be encountered during excavation, the mechanical contractor shall provide all labour and material, including all equipment required for dewatering the excavation. After the water has been removed, this Contractor shall install a 300 mm (12") base of compacted 50 mm (2") clear stone covered with filter cloth before installing backfill as detailed and/or as specified.
- .5 Be responsible for all weather protection required to install piping and/or equipment to the satisfaction of the Consultant.
- .6 Be responsible for providing all clear stone or granular 'A' material suitable for application to replace existing soil not suitable for backfilling above the 450 mm (18") bedding material.

1.33 CONFINED SPACES

- .1 Certain areas of the building may be defined as a "Confined Space". Any personnel working in these areas must have confined space training, appropriate equipment and undertake all work in conformance with appropriate codes and standards.
- .2 Refer to building documentation for any spaces deemed "Confined Space".

1.34 TSSA INSPECTION

- .1 Prior to final completion of the project, this contractor shall make application, arrange, and pay for a TSSA inspection of all piping systems and equipment installations, including, but not limited to medical gasses, refrigeration, fuel piping, compressed air, heating plant, cooling plant, and associated equipment installed under the contract.
- .2 Provide a copy of the TSSA report in the maintenance manuals for each system.

Part 1 General

1.1 REFERENCES

- .1 All codes, standards, etc. as referenced shall be the latest edition.
- .2 American Society for Testing and Materials
 - .1 ASTM A53/A53M, Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
 - .2 ASTM A105/A105M, Specification for Carbon Steel forgings for Piping Applications.

1.2 PRODUCT DATA

- .1 Submit product data in accordance with general requirements.
- .2 Indicate for each item as applicable:
 - .1 Manufacturer, model number, line contents, 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.

1.3 CLOSEOUT SUBMITTALS

- .1 Submit maintenance data in accordance with general requirements.
- .2 Data to include:
 - .1 Servicing requirements, including any special requirements, stuffing box packing, lubrication and recommended procedures.

Part 2 Products

2.1 SLIP TYPE EXPANSION JOINTS

- .1 Application: for axial pipe movement, as indicated.
- .2 Repacking: under full line pressure.
- .3 Body and packing housings: Class 150, 1Mpa carbon steel pipe to ASTM A53/A53M, Grade B. Wall thickness to match pipe and with raised face slip-on flanges to match pipe.
- .4 Slip or traverse sleeves: carbon steel pipe to ASTM A53/A53M, Grade B, [hard chrome plated].
- .5 Anchor base: construction steel, welded to body.
- .6 Guides (internal and external): embody into packing housing with concentric alignment of slip or traverse sleeve with packing housing.

- .7 Extension limit stop: stainless steel, to prevent over-extension with accessible and removable pins.
- .8 Packing rings: 6 minimum, teflon or graphite impregnated asbestos.
- .9 Thermal plastic packing: teflon or graphite impregnated asbestos slug supplied loose.
- .10 Lubricating fittings: pet cocks with grease nipple.
- .11 Plunger body and plunger:
 - .1 Plunger body: heavy wall carbon steel welded to body.
 - .2 Plunger: carbon steel with hex head for use with socket wrench.
- .12 Lubricant: to manufacturer's recommendations.
- .13 Lubricant gun: complete with hose assembly.
- .14 Drip connection: 20 MPa (2900 psi) forged steel to ASTM A105. Include half coupling with drain plug.

2.2 BELLows TYPE EXPANSION JOINTS

- .1 For axial, lateral or angular movements, as indicated.
- .2 Maximum operating pressure: 1034 kPa (150 psi).
- .3 Maximum operating temperature: 200°C (392°F).
- .4 Type A: free flexing, factory tested to 1½ times maximum working pressure. Furnish test certificates.
- .5 Type B: externally pressurized, constant volume, pressure balanced, designed to eliminate pressure thrust, factory tested to 1.5 times maximum working pressure. Furnish test certificates.
- .6 Bellows:
 - .1 Multiple bellows, hydraulically formed, two ply, austenitic stainless steel for specified fluid, pressure and temperature, water treatment and pipeline cleaning procedures.
- .7 Reinforcing or control rings:
 - .1 2 piece nickel iron.
- .8 Ends:
 - .1 Slip-on flanges to match pipe.
- .9 Liner:
 - .1 Austenitic stainless steel in direction of flow.
- .10 Shroud:
 - .1 Carbon steel, painted.

2.3 FLEXIBLE CONNECTION

- .1 Application: to suit motion.
- .2 Minimum length in accordance with manufacturer's recommendations to suit offset.
- .3 Inner hose: stainless steel corrugated.
- .4 Braided wire mesh stainless steel outer jacket.
- .5 Diameter and type of end connection: as indicated.
- .6 Operating conditions:
 - .1 Working pressure: 1034 kPa (150 psi).
 - .2 Working temperature: 250°C (482°F).
 - .3 To match system requirements.

2.4 ANCHORS AND GUIDES

- .1 Anchors:
 - .1 Provide as indicated.
- .2 Alignment guides:
 - .1 Provide as indicated.
 - .2 To accommodate specified thickness of insulation.
 - .3 Vapour barriers, jackets to remain uninterrupted.

2.5 EXPANSION COMPENSATORS (EXP)

- .1 Packless guided construction complete with multi ply stainless steel bellows.
- .2 Operating temperature (750°F).
- .3 Provide model H3 for steel pipe and model HB for copper pipe.
- .4 Material to match piping system.
- .5 Acceptable materials:
Senior Flexonics

Part 3 Execution

3.1 INSTALLATION

- .1 Install expansion joints with cold setting, as indicated as instructed by Consultant. Make record of cold settings.
- .2 Install expansion joints and flexible connections in accordance with manufacturer's instructions.
- .3 Install pipe anchors and guides as indicated. Anchors to withstand 150% of axial thrust.

3.2 APPLICATION

- .1 Provide on all vibration isolated equipment.
- .2 Provide where requested by equipment manufacturers installation manuals.
- .3 Install in accordance with manufacturer's recommendations.
- .4 Provide expansion compensators (exp.) on radiation heating element exceeding 3.6 M (12' – 0") in length. Provide one expansion compensators on each length of return piping in cabinet.

3.3 THERMAL EXPANSION

- .1 Provide in long runs of heating mains exceeding 100 ft. in length.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 All codes, standards, etc. as referenced shall be the latest edition.
- .2 ANSI/ASME B40.100, Pressure Gauges and Gauge Attachments.
- .3 CAN/CGSB-14.4, Thermometers, Liquid-in-Glass, Self Indicating, Commercial/Industrial Type.
- .4 CAN/CGSB-14.5, Thermometers, Bimetallic, Self-Indicating, Commercial/Industrial Type.

1.2 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with general requirements.
- .2 Submit manufacturer's product data for following items:
 - .1 Thermometers.
 - .2 Pressure gauges.
 - .3 Stop clocks.
 - .4 Siphons.
 - .5 Wells.

Part 2 Products

2.1 GENERAL

- .1 Design point to be at mid point of scale or range.
- .2 Ranges: suitable for application.

2.2 DIRECT READING THERMOMETERS

- .1 Industrial, variable angle type, liquid filled, 225 mm (9") scale length: to CAN/CGSB 14.4.
 - .1 Acceptable materials:
 - .1 Trerice
 - .2 Winters 91T
 - .3 Wiess

2.3 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:

.1 Trerice

.2 Winters Contractor

2.4 THERMOMETER WELLS

.1 Copper pipe: copper or bronze.

.2 Steel pipe: brass or stainless steel.

2.5 PRESSURE GAUGES

.1 115 mm (4 1/2"), dial type: to ANSI/ASME B40.100, Grade 2A, stainless steel phosphor bronze bourdon tube having 0.5% accuracy full scale unless otherwise specified.

.1 Acceptable materials:

.1 Winters

.2 Trerice

.3 Wiess

.2 Provide:

.1 Siphon for steam service.

.2 Snubber for pulsating operation.

.3 Diaphragm assembly for corrosive service.

.4 Gasketted pressure relief back with solid front.

.5 Bronze stop cock.

Part 3 Execution

3.1 GENERAL

.1 Install so they can be easily read from floor or platform. If this cannot be accomplished, install remote reading units.

.2 Install between equipment and first fitting or valve.

3.2 THERMOMETERS

.1 Install in wells on all piping. Provide heat conductive material inside well.

.2 Install in locations as indicated and on inlet and outlet of:

.1 Heat exchangers.

.2 Water heating and cooling coils.

- .3 Water Boilers
- .4 Heat Pumps.
- .5 Cooling towers.
- .6 DHW tanks.
- .7 Boiler Room HWS and HWR.
- .8 In other locations indicated.
- .3 Install wells as indicated only for balancing purposes.
- .4 Use extensions where thermometers are installed through insulation.

3.3 PRESSURE GAUGES

- .1 Install in following locations:
 - .1 Suction and discharge of pumps.
 - .2 Upstream and downstream of PRV's.
 - .3 Upstream and downstream of control valves.
 - .4 Inlet and outlet of coils.
 - .5 Inlet and outlet of liquid side of heat exchangers.
 - .6 Outlet of boilers.
 - .7 Inlet and outlet of water meters.
 - .8 Inlet and outlet of backflow prevention.
 - .9 In other locations as indicated.
- .2 Install gauge cocks for balancing purposes, elsewhere as indicated.
- .3 Use extensions where pressure gauges are installed through insulation.

3.4 NAMEPLATES

- .1 Install engraved lamicoid nameplates as specified in elsewhere identifying medium.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 All codes, standards, etc. as referenced shall be the latest edition.
- .2 American National Standards Institute/ American Society of Mechanical Engineers (ANSI/ASME)
 - .1 ANSI/ASME B31.1, Power Piping, (SI Edition).
- .3 American Society for Testing and Materials (ASTM)
 - .1 ASTM A 125, Specification for Steel Springs, Helical, Heat-Treated.
 - .2 ASTM A 307, Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
 - .3 ASTM A 563, Specification for Carbon and Alloy Steel Nuts.
- .4 Manufacturer's Standardization Society of the Valves and Fittings Industry (MSS)
 - .1 MSS SP-58, Pipe Hangers and Supports - Materials, Design, Manufacture Selection, Application, and Installation.

1.2 DESIGN REQUIREMENTS

- .1 Construct pipe hanger and support to manufacturer's recommendations utilizing manufacturer's regular production components, parts and assemblies.
- .2 Base maximum load ratings on allowable stresses prescribed by ASME B31.1 or MSS SP-58.
- .3 Ensure that supports, guides, anchors do not transmit excessive quantities of heat to building structure.
- .4 Design hangers and supports to support systems under all conditions of operation, allow free expansion and contraction, prevent excessive stresses from being introduced into pipework or connected equipment.
- .5 Provide for vertical adjustments after erection and during commissioning. Amount of adjustment to be in accordance with MSS SP-58.

1.3 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with general requirements.
- .2 Submit shop drawings and product data for following items:
 - .1 All bases, hangers and supports.
 - .2 Connections to equipment and structure.
 - .3 Structural assemblies.

1.4 MAINTENANCE DATA

- .1 Provide maintenance data for incorporation into manual specified in general requirements.

Part 2 Products

2.1 GENERAL

- .1 Fabricate hangers, supports and sway braces in accordance with ANSI B31.1 and MSS-SP-58.
- .2 Use components for intended design purpose only. Do not use for rigging or erection purposes.

2.2 PIPE HANGERS

- .1 Finishes:
- .1 Pipe hangers and supports: to ANSI & ULC requirements
- .2 Ensure steel hangers in contact with copper piping are copper plated.
- .2 Upper attachment structural: Suspension from upper flange of I-Beam or joist.
- .1 Cold piping NPS 50 mm (2") maximum: Ductile iron C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip.
- .1 Rod: 10 mm (3/8") UL listed
- .2 Cold piping NPS 65 mm (2 1/2") or greater, all hot piping: Malleable iron beam clamp, eye rod, jaws and extension with carbon steel retaining clip, tie rod, nuts and washers, UL listed & FM approved.
- .3 Upper attachment structural: Suspension from upper flange of I-Beam.
- .1 Cold piping NPS 50 mm (2") maximum: Ductile iron top-of-beam C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip, UL listed.
- .2 Cold piping NPS 65 mm (2 1/2") or greater, all hot piping: Malleable iron top-of-beam jaw-clamp with hooked rod, spring washer, plain washer and nuts.
- .4 Upper attachment to concrete.
- .1 Ceiling: Carbon steel welded eye rod, clevis plate, clevis pin and cotters with weldless forged steel eye nut. Ensure eye 6 mm (1/4") minimum greater than rod diameter.
- .2 Concrete inserts: wedge shaped body with knockout protector plate ULC listed.
Note: Rapidex and Siporex are not considered concrete. Should one of these systems be encountered, piping/ductwork and/or equipment shall be supported from adjacent walls or from supplemental steel provided by this contractor attached to the adjacent walls/structure.

- .5 Shop and field-fabricated assemblies.
 - .1 Trapeze hanger assemblies: ASME B31.1.
 - .2 Steel brackets: ASME B31.1.
- .6 Hanger rods: threaded rod material to MSS SP-58.
 - .1 Ensure that hanger rods are subject to tensile loading only.
 - .2 Provide linkages where lateral or axial movement of pipework is anticipated.
- .7 Pipe attachments: material to MSS SP-58.
 - .1 Attachments for steel piping: carbon steel.
 - .2 Attachments for copper piping: copper plated black steel.
 - .3 Use insulation shields for all piping.
 - .4 Oversize pipe hangers and supports to accommodate thermal insulation.
Provide 1.5 mm (16 gauge) saddles.
- .8 Adjustable clevis: material to MSS SP-58 UL listed, clevis bolt with nipple spacer and vertical adjustment nuts above and below clevis.
 - .1 Ensure "U" has hole in bottom for rivetting to insulation shields.

2.3 RISER CLAMPS

- .1 Steel or cast iron pipe: black carbon steel to MSS-SP-58, type 42, UL listed.
- .2 Copper pipe: carbon steel copper plated to MSS-SP-58, type 42.
- .3 Bolts: to ASTM A 307.
- .4 Nuts: to ASTM A 563.

2.4 INSULATION PROTECTION SHIELDS

- .1 Insulated cold piping:
 - .1 64 kg/m² (13.12 lbs/ft²) density insulation plus insulation protection shield to: MSS SP-69, galvanized sheet carbon steel. Length designed for maximum 3 m (10') span.
- .2 Insulated hot piping:
 - .1 Curved plate 300 mm (12") long, with edges turned up, welded-in centre plate for pipe sizes NPS 300 mm (12") and over, carbon steel to comply with MSS SP-58.

2.5 CONSTANT SUPPORT SPRING HANGERS

- .1 Springs: alloy steel to ASTM A 125, shot peened, magnetic particle inspected, with +/- 5% spring rate tolerance, tested for free height, spring rate, loaded height and provided with CMTR.
- .2 Load adjustability: [10]% minimum adjustability each side of calibrated load. Adjustment without special tools. Adjustments not to affect travel capabilities.

- .3 Provide upper and lower factory set travel stops.
- .4 Provide load adjustment scale for field adjustments.
- .5 Total travel to be actual travel + 20%. Difference between total travel and actual travel 25 mm (1") minimum.
- .6 Individually calibrated scales on each side of support calibrated prior to shipment, complete with calibration record.

2.6 VARIABLE SUPPORT SPRING HANGERS

- .1 Vertical movement: 15 mm (1/2") minimum, 50 mm (2") maximum, use single spring pre-compressed variable spring hangers.
- .2 Vertical movement greater than 50 mm (2"): use double spring pre-compressed variable spring hanger with 2 springs in series in single casing.
- .3 Variable spring hanger to be complete with factory calibrated travel stops. Provide certificate of calibration for each hanger.
- .4 Steel alloy springs: to ASTM A 125, shot peened, magnetic particle inspected, with +/-5% spring rate tolerance, tested for free height, spring rate, loaded height and provided with CMTR.

2.7 EQUIPMENT SUPPORTS

- .1 Fabricate equipment supports not provided by equipment manufacturer from structural grade steel meeting requirements of miscellaneous metals, specified herein. Submit calculations with shop drawings.

2.8 EQUIPMENT ANCHOR BOLTS AND TEMPLATES

- .1 Provide templates to ensure accurate location of anchor bolts.

2.9 HOUSE-KEEPING PADS

- .1 For base-mounted equipment: Reinforced concrete, at least 100 mm (4") high, 150 mm (6") larger all around than equipment, and with chamfered edges as indicated.
- .2 Size of housekeeping pads shall be determined from approved shop drawings.
- .3 Concrete: 30 Mpa concrete with reinforced wire mesh.
- .4 Install all housekeeping pads not indicated on architectural drawings.

2.10 ROOF MOUNTED EQUIPMENT

- .1 Install as per manufacturers' instructions on roof curbs provided by manufacturer as indicated.
- .2 Provide all necessary continuous pressure treated wood blocking and 24 gauge metal liner on all exposed wood as required to install roof curb level.

2.11 OTHER EQUIPMENT SUPPORTS

- .1 From structural grade steel meeting requirements of structural steel section specified herein.
- .2 Submit structural calculations with shop drawings.

2.12 MANUFACTURER

- .1 Acceptable materials:
 - .1 Grinnell
 - .2 Anvil
 - .3 Myatt
 - .4 Taylor

Part 3 Execution

3.1 INSTALLATION

- .1 Install in accordance with:
 - .1 Manufacturer's instructions and recommendations.
- .2 Vibration Control Devices:
 - .1 Install on piping systems at pumps, boilers, chillers, cooling towers, elsewhere as indicated.
- .3 Clamps on riser piping:
 - .1 Support independent of connected horizontal pipework using riser clamps and riser clamp lugs welded to riser.
 - .2 Bolt-tightening torques to be to industry standards.
 - .3 Steel pipes: Install below coupling or shear lugs welded to pipe.
 - .4 Cast iron pipes: Install below joint.
- .4 Clevis plates:
 - .1 Attach to concrete with 4 minimum concrete inserts at each corner.
- .5 Provide supplementary structural steelwork where structural bearings do not exist or where concrete inserts are not in correct locations.

3.2 HANGER SPACING

- .1 Plumbing piping: most stringent requirements of Canadian Plumbing Code, Provincial Code, or authority having jurisdiction.
- .2 Fire protection: to applicable fire code.
- .3 Gas and fuel oil piping: up to NPS 15 mm (1/2"): every 1.8 m (6').
- .4 Copper piping: up to NPS 15 mm (1/2"): every 1.5 m (5').

- .5 Within 300 mm (12") of each elbow and:

Maximum Pipe Size: NPS	Spacing Steel	Maximum Spacing Copper
up to 32 mm (1 1/4")	2.1 m (7')	1.8 m (6')
40 mm (1 1/2")	2.7 m (9')	2.4 m (8')
50 mm (2")	3.0 m (10')	2.7 m (9')
65 mm (2 1/2")	3.6 m (12')	3.0 m (10')
80 mm (3")	3.6 m (12')	3.0 m (10')
90 mm (3 1/2")	3.9 m (13')	3.3 m (11')
100 mm (4")	4.2 m (14')	3.6 m (12')
125 mm (5")	4.8 m (16')	
150 mm (6")	5.1 m (17')	
200 mm (8")	5.7 m (19')	
250 mm (10")	6.6 m (22')	
300 mm (12")	6.9 m (23')	

- .6 Pipework greater than NPS 300 mm (12"): to MSS SP-69.

3.3 HANGER INSTALLATION

- .1 Install hanger so that rod is vertical under operating conditions.
- .2 Adjust hangers to equalize load.
- .3 Support from structural members. Where structural bearing does not exist or inserts are not in suitable locations, provide supplementary structural steel members.
- .4 Do "NOT" support piping, ductwork and equipment from roof deck, on bottom chord of floor and/or roof joist and/or from OWSJ bridging. Provide structural member between joist.

3.4 HORIZONTAL MOVEMENT

- .1 Angularity of rod hanger resulting from horizontal movement of pipework from cold to hot position not to exceed 4mm (5/32") from vertical.
- .2 Where horizontal pipe movement is less than 15 mm (1/2"), offset pipe hanger and support so that rod hanger is vertical in the hot position.

3.5 FINAL ADJUSTMENT

- .1 Adjust hangers and supports:
 - .1 Ensure that rod is vertical under operating conditions.
 - .2 Equalize loads.
- .2 Adjustable clevis:
 - .1 Tighten hanger load nut securely to ensure proper hanger performance.
 - .2 Tighten upper nut after adjustment.

- .3 C-clamps:
 - .1 Follow manufacturer's recommended written instructions and torque values when tightening C-clamps to bottom flange of beam.
- .4 Beam clamps:
 - .1 Hammer jaw firmly against underside of beam.

END OF SECTION

Part 1 General

1.1 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with general requirements.
- .2 Provide separate shop drawings for each isolated system complete with performance and product data.

Part 2 Products

2.1 GENERAL

- .1 Size and shape of bases type and performance of vibration isolation to be as indicated.
- .2 To be of the same manufacturer for all isolation.
- .3 Acceptable materials:
Korfund
Vibro-Acoustics
Vibron

2.2 ELASTOMERIC PADS

- .1 Type EP1 - neoprene waffle or ribbed; 10 mm (3/8") minimum thick; 50 durometer; maximum loading 350 kPa (50.8 psi).
- .2 Type EP2 - rubber waffle or ribbed; 10 mm (3/8") minimum thick; 30 durometer natural rubber; maximum loading 415 kPa (60.2 psi).
- .3 Type EP3 - neoprene-steel-neoprene; 10 mm (3/8") minimum thick neoprene bonded to 1.5 mm (16 gauge) steel plate; 50 durometer neoprene, waffle or ribbed; holes sleeved with isolation washers; maximum loading 350 kPa (50.8 psi).
- .4 Type EP4 - rubber-steel-rubber; 10 mm (3/8") minimum thick rubber bonded to 1.5 mm (16 gauge) steel plate; 30 durometer natural rubber, waffle or ribbed; holes sleeved with isolation washers; maximum loading 415 kPa (60.2 psi).
- .5 Acceptable materials:
Korfund
IAC Acoustics
Vibro-Acoustics
Vibron

2.3 ELASTOMERIC MOUNTS

- .1 Type M1 - colour coded; neoprene in shear; maximum durometer of [60]; threaded insert and two bolt-down holes; ribbed top and bottom surfaces.

Acceptable materials:

Vibro-Acoustics

Korfund

IAC Acoustics

Vibron

2.4 SPRINGS

- .1 Design stable springs so that ratio of lateral to axial stiffness is equal to or greater than 1.2 times the ratio of static deflection to working height. Select for 50% travel beyond rated load. Units to be complete with levelling devices.
- .2 Ratio of height when loaded to diameter of spring to be between 0.8 to 1.0.
- .3 Cadmium plate for all installations.
- .4 Colour code springs.

2.5 SPRING MOUNT

- .1 Zinc or cadmium plated hardware; housings coated with rust resistant paint.
- .2 Type M2 - stable open spring: support on bonded 6 mm (1/4") minimum thick ribbed neoprene or rubber friction and acoustic pad.
- .3 Type M3 - stable open spring: 6 mm (1/4") minimum thick ribbed neoprene or rubber friction and acoustic pad, bonded under isolator and on isolator top plate; leveling bolt for rigidly mounting to equipment.
- .4 Type M4 - restrained stable open spring: supported on bonded 6 mm (1/4") minimum thick ribbed neoprene or rubber friction and acoustic pad; built-in resilient limit stops, removable spacer plates.
- .5 Type M5 - enclosed spring mounts with snubbers for isolation up to 950 kg (2100 lbs) maximum.
- .6 Performance: as indicated.
- .7 Acceptable materials:
- Korfund
- IAC Acoustics
- Vibron
- Vibro-Acoustics

2.6 HANGERS

- .1 Colour coded springs, rust resistant, painted box type hangers. Arrange to permit hanger box or rod to move through a 30° arc without metal to metal contact.
- .2 Type H1 - neoprene - in-shear, molded with rod isolation bushing, which passes through hanger box.
- .3 Type H2 - stable spring, elastomeric washer, cup with molded isolation bushing which passes through hanger box.
- .4 Type H3 - stable spring, elastomeric element with pre-compression washer and nut [with deflection indicator].
- .5 Performance as indicated.
- .6 Acceptable materials:
 - Vibron
 - IAC Acoustics
 - Korfund
 - Vibro-Acoustics

2.7 ACOUSTIC BARRIERS FOR ANCHORS AND GUIDES

- .1 Acoustic barriers: between pipe and support, consisting of 25 mm (1") minimum thick heavy-duty duct and neoprene isolation material.
- .2 Acceptable materials:
 - Vibron
 - IAC Acoustics
 - Vibro-Acoustics

2.8 HORIZONTAL THRUST RESTRAINT

- .1 Spring and elastomeric element housed in box frame; assembly complete with rods and angle brackets for equipment and ductwork attachment; provision for adjustment to limit maximum start and stop movement to 10 mm (3/8").
- .2 Arrange restraints symmetrically on either side of unit and attach at centerline of thrust.
- .3 Acceptable materials:
 - Korfund
 - IAC Acoustics
 - Vibron
 - Vibro-Acoustics

2.9 STRUCTURAL BASES

- .1 Type B1 - Prefabricated steel base: integrally welded on sizes up to 2400 mm (96") on smallest dimension, split for field welding on sizes over 2400 mm (96") on smallest dimension and reinforced for alignment of drive and driven equipment; without supplementary hold down devices; complete with isolation element attached to base brackets arranged to minimize height; pre-drilled holes to receive equipment anchor bolts; and complete with adjustable built-in motor slide rail where indicated.
- .2 Type B2 - Steel rail base: structural steel, positioned for alignment of drive and driven equipment; without supplementary hold down devices; complete with isolation element attached to base brackets arranged to minimize height; and pre-drilled holes to receive equipment anchor bolts.
- .3 Bases to clear housekeeping pads by 25 mm (1") minimum.
- .4 Acceptable materials:
Korfund
IAC Acoustics
Vibron
Vibro-Acoustics

2.10 INERTIA BASE

- .1 Provide inertia base for all floor mounted pumps.
- .2 Type B3 - Full depth perimeter structural or formed channels, frames: welded in place reinforcing rods running in both directions; spring mounted, carried by gussetted height-saving brackets welded to frame; and clear housekeeping pads by 50 mm (2") minimum.
- .3 Pump bases: "T" shaped, where applicable, to provide support for elbows.
- .4 Concrete: to Section Cast-in-Place Concrete.
- .5 Acceptable materials:
Korfund
IAC Acoustics
Vibron
Vibro-Acoustics

2.11 ROOF CURB ISOLATION RAIL

- .1 Provide a curb isolation rail for all rooftop equipment.
- .2 General: complete factory assembled without need for sub-base.
- .3 Lower member: continuous extruded aluminum channel.
- .4 Upper member: continuous extruded aluminum channel to provide continuous support for equipment, complete with all-directional neoprene rubber bushings 6 mm (1/4") thick to resist wind [and seismic] forces.

- .5 Springs: steel, adjustable, removable, selected for 25 mm (1") maximum static deflection plus 50% additional travel to solid, cadmium plated, sized and positioned to ensure uniform deflection.
- .6 High frequency isolation: 6 mm (1/4") minimum thick [continuous gasket on top and bottom of complete assembly] [or] [pads on top and bottom of each spring]. Material: closed cell neoprene.
- .7 Weatherproofing: continuous flexible counterflashing to curb and providing access to springs. Material: [aluminum] [neoprene].
- .8 Hardware: cadmium plated or galvanized.

Part 3 Execution

3.1 INSTALLATION

- .1 Install vibration isolation equipment in accordance with manufacturers instructions and adjust mountings to level equipment.
- .2 Ensure piping, ducting and electrical connections to isolated equipment do not reduce system flexibility and that piping, conduit and ducting passage through walls and floors do not transmit vibrations.
- .3 Unless indicated otherwise, support piping connected to isolated equipment with spring mounts or spring hangers with 25 mm (1") minimum static deflection as follows:
 - .1 Up to NPS 100 mm (4"): first 3 points of support. NPS 125 mm (5") to NPS 200 mm (8"): first 4 points of support. NPS 250 mm (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 (2").
- .4 Where isolation is bolted to floor use vibration isolation rubber washers.
- .5 Block and shim level 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.

3.2 SITE VISIT

- .1 Manufacturer to visit site and provide written certification that installation is in accordance with manufacturer's instructions and submit report to Consultant.
- .2 Provide Consultant with notice 24 h in advance of visit.
- .3 Make adjustments and corrections in accordance with written report.

3.3 TESTING

- .1 Experienced and competent sound and vibration testing professional engineer to take vibration measurement for HVAC systems after start up and TAB of systems to Testing Adjusting and Balancing Section.
- .2 Vibration measurements shall be taken for equipment-listed below:
- .3 Provide Consultant with notice 48 h in advance of commencement of tests.
- .4 Establish adequacy of equipment isolation and acceptability of noise levels in occupied areas and where appropriate, remedial recommendations including sound curves.
- .5 Submit complete report of test results including sound curves.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 All codes, standards, etc. as referenced shall be the latest edition.
- .2 Canadian General Standards Board (CGSB).
 - .1 CAN/CGSB-1.60, Interior Alkyd Gloss Enamel.
 - .2 CAN/CGSB-24.3, Identification of Piping Systems.
- .3 Canadian Standards Association (CSA).
 - .1 Natural Gas and Propane Installation Code CSA B149.1.
- .4 National Fire Protection Association
 - .1 NFPA 13, Installation of Sprinkler Systems.
 - .2 NFPA 14, Standpipe and Systems.

1.2 PRODUCT DATA

- .1 Submit product data in accordance with General Requirements.
- .2 Product data to include paint colour chips, all other products specified in this section.

1.3 PRODUCT LITERATURE

- .1 Submit product literature in accordance with General Requirements.
- .2 Product literature to include nameplates, labels, tags, lists of proposed legends.

Part 2 Products

2.1 MANUFACTURER'S EQUIPMENT NAMEPLATES

- .1 Metal or plastic lamicoid nameplate mechanically fastened to each piece of equipment by manufacturer.
- .2 Lettering and numbers to be raised or recessed.
- .3 Information to include, as appropriate:
 - .1 Equipment: Manufacturer's name, model, size, serial number, capacity.
 - .2 Motor: voltage, Hz, phase, power factor, duty, frame size.

2.2 SYSTEM NAMEPLATES

- .1 Colours:
 - .1 Hazardous: red letters, white background.
 - .2 Elsewhere: black letters, white background (except where required otherwise by applicable codes).

.2 Construction:

- .1 3 mm (1/8") thick laminated plastic, matte finish, with square corners, letters accurately aligned and machine engraved into core.

.3 Sizes:

- .1 Conform to following table:

Size	No. of Sizes mm ("")	Height of Line mm ("")	Letters mm ("")
1	10 x 50 (3/8" x 2")	1 (3/64")	3 (1/8")
2	15 x 75 (1/2" x 3")	1 (3/64")	6 (1/4")
3	15 x 75 (1/2" x 3")	2 (5/64")	3 (1/8")
4	20 x 100 (3/4" x 4")	1 (3/64")	10 (3/8")
5	20 x 100 (3/4" x 4")	2 (6/64")	6 (1/4")
6	20 x 200 (3/4" x 8")	1 (3/64")	10 (3/8")
7	25 x 125 (1" x 5")	1 (3/64")	15 (1/2")
8	25 x 125 (1" x 5")	2 (5/64")	10 (3/8")
9	32 x 200 (1¼" x 8")	1 (3/64")	20 (3/4")

- .2 Use maximum of 25 letters/numbers per line.

.4 Locations:

- .1 Terminal cabinets, control panels: Use size #5.
.2 Equipment in Mechanical Rooms: Use size #9.
.3 Roof top equipment: use size #9.
.4 Equipment above ceiling: use size #1 riveted to ceiling suspension system.

2.3 FIRE DAMPER/FIRE STOP FLAP NAMEPLATES

.1 Colours:

- .1 Black letters, yellow background.

.2 Construction:

- .1 Self adhesive 50 mm x 25 mm, matte finish, with round corners.

.3 Locations:

- .1 Install on adjacent ceiling grid. Where fire stop flap is installed in gypsum ceiling install on diffuser/grille frame. Where fire damper is installed above gypsum ceiling install on adjacent wall.

2.4 EXISTING IDENTIFICATION SYSTEMS

- .1 Apply existing identification system to new work.
.2 Where existing identification system does not cover for new work, use identification system specified this section.
.3 Before starting work, obtain written approval of identification system from Consultant.

- .4 Upon completion of this project all references to room names and numbering shall be to the Owner's requirements which may or may 'NOT' be the numbering system used on the drawings. Each contractor shall verify the proper numbering scheme to be used prior to project completion.
- .5 All equipment shall be identified in sequence from the existing equipment and "NOT" duplicate numbering of equipment.

2.5 PIPING SYSTEMS GOVERNED BY CODE

- .1 Identification:
 - .1 Natural and propane gas: To CSA B149.1-00 and authority having jurisdiction and as indicated elsewhere.
 - .2 Sprinklers: To NFPA 13.
 - .3 Standpipe and hose systems: To NFPA 14.

2.6 IDENTIFICATION OF PIPING SYSTEMS

- .1 Identify contents by background colour marking, pictogram (as necessary), legend; direction of flow by arrows. To CAN/CGSB 24.3 except where specified otherwise.
- .2 Legend:
 - .1 Block capitals to sizes and colours listed in CAN/CGSB-24.3.
- .3 Arrows showing direction of flow:
 - .1 Outside diameter of pipe or insulation less than 75 mm (3"): 100 mm (4") long x 50 mm (2") high.
 - .2 Outside diameter of pipe or insulation 75 mm (3") and greater: 150 mm (6") long x 50 mm (2") high.
 - .3 Use double-headed arrows where flow is reversible.
- .4 Extent of background colour marking:
 - .1 To full circumference of pipe or insulation.
 - .2 Length to accommodate pictogram, full length of legend and arrows.
- .5 Materials for background colour marking, legend, arrows:
 - .1 Pipes and tubing 20 mm (3/4") and smaller: Waterproof and heat-resistant pressure sensitive plastic marker tags.
 - .2 All other pipes: Pressure sensitive vinyl with protective overcoating, waterproof contact adhesive undercoating, suitable for ambient of 100% RH and continuous operating temperature of 150°C (300°F) and intermittent temperature of 200°C (395°F).

.6 Colours and Legends:

- .1 Where not listed, obtain direction from Consultant.
.2 Colours for legends, arrows: To following table:
Background colour: Legend: Arrows:
Yellow White Black
Green White Black
Red White Black

.7 Pictograms:

- .1 **Where required, to Workplace Hazardous Materials Information System (WHMIS) regulations.**
.8 Background colour marking and legends for piping systems:

CONTENTS	BACKGROUND COLOUR MARKING	LEGEND
City water	Green	CITY WATER
Brine	Green	BRINE
Heat Pump Supply	Green	HP WTR SUPPLY
Heat Pump Return	Green	HP WTR RETURN
Condenser water supply	Green	COND. WTR. SUPPLY
Condenser water return	Green	COND. WTR. RETURN
Hot water heating supply	Yellow	HEATING SUPPLY
Hot water heating return	Yellow	HEATING RETURN
Make-up water	Yellow	MAKE-UP WTR
Glycol heating water supply	Yellow	GLYCOL HEATING WATER SUPPLY
Glycol heating water return	Yellow	GLYCOL HEATING WATER RETURN
Domestic hot water supply	Green	DOM. HW SUPPLY
Dom. HW recirculation	Green	DOM. HW CIRC
Domestic cold water supply	Green	DOM. CWS
Domestic tempered supply	Green	DOM. TEMPERED
Trap Primer	Green	TRAP PRIMER
Waste water	Green	WASTE WATER
Storm water	Green	STORM
Sanitary	Green	SAN
Plumbing vent	Green	SAN. VENT
Condensate	Green	CONDENSATE
Refrigeration suction	Yellow	REF. SUCTION
Refrigeration liquid	Yellow	REF. LIQUID
Refrigeration hot gas	Yellow	REF. HOT GAS
Fire protection water	Red	FIRE PROT. WTR
Sprinklers	Red	SPRINKLERS
Conduit for low voltage		
Control wiring	White	CONTROL WIRING ____ VOLTS

-
- 2.7 IDENTIFICATION DUCTWORK SYSTEMS**
- .1 50 mm (2") high stencilled letters and directional arrows 150 mm (6") long x 50 mm (2") high.
 - .2 Colours: Black, or co-ordinated with base colour to ensure strong contrast.
- 2.8 VALVES, CONTROLLERS**
- .1 Brass tags with 15 mm (1/2") stamped identification data filled with black paint.
 - .2 Include flow diagrams for each system, of approved size, showing charts and schedules with identification of each tagged item, valve type, service, function, normal position, location of tagged item.
 - .3 Provide adhesive coloured tab (max. size 15 mm) indication on ceiling to locate valves/equipment above. Same applies to grid. Colour to be approved by consultant.
- 2.9 CONTROLS COMPONENTS IDENTIFICATION**
- .1 Identify all systems, equipment, components, controls, sensors with system nameplates specified in this section.
 - .2 Inscriptions to include function and (where appropriate) fail-safe position.
 - .3 Provide equipment identification and/or indication on ceiling to locate devices/equipment above ceiling. Install identification on grid. Colours to be approved by consultant.
- 2.10 LANGUAGE**
- .1 Identification to be in English.
- Part 3 Execution**
- 3.1 TIMING**
- .1 Provide identification only after all painting specified has been completed.
- 3.2 INSTALLATION**
- .1 Perform work in accordance with CAN/CGSB-24.3 except as specified otherwise.
 - .2 Provide ULC and/or CSA registration plates as required by respective agency.
- 3.3 NAMEPLATES**
- .1 Locations:
 - .1 In conspicuous location to facilitate easy reading and identification from operating floor.
 - .2 Standoffs:
 - .1 Provide for nameplates on hot and/or insulated surfaces.

- .3 Protection
 - .1 Do not paint, insulate or cover in any way.
- 3.4 LOCATION OF IDENTIFICATION ON PIPING AND DUCTWORK SYSTEMS**
 - .1 On long straight runs in open areas in boiler rooms, equipment rooms, galleries, tunnels not more than 1.7 m (5'-8") intervals and more frequently if required to ensure that at least one is visible from any one viewpoint in operating areas and walking aisles.
 - .2 Adjacent to each change in direction.
 - .3 At least once in each small room through which piping or ductwork passes.
 - .4 On both sides of visual obstruction or where run is difficult to follow.
 - .5 On both sides of separations such as walls, floors, partitions.
 - .6 Where system is installed in pipe chases, ceiling spaces, galleries, other confined spaces, at entry and exit points, and at each access opening.
 - .7 At beginning and end points of each run and at each piece of equipment in run.
 - .8 At point immediately upstream of major manually operated or automatically controlled valves, dampers, etc. Where this is not possible, place identification as close as possible, preferably on upstream side.
 - .9 Identification to be easily and accurately readable from usual operating areas and from access points.
 - .1 Position of identification to be approximately at right angles to most convenient line of sight, considering operating positions, lighting conditions, risk of physical damage or injury and reduced visibility over time due to dust and dirt.

3.5 VALVES, CONTROLLERS

- .1 Valves and operating controllers, except at plumbing fixtures, radiation, or where in plain sight of equipment they serve: Secure tags with non-ferrous chains or closed "S" hooks.
- .2 Install one copy of flow diagrams, valve schedules mounted in frame behind non-glare glass where directed by Consultant. Provide one copy (reduced in size if required) in each operating and maintenance manual.
- .3 Number valves in each system consecutively. Where existing numbering system is installed start new numbering system at 100.

END OF SECTION

Part 1 General

1.1 CONTRACT REQUIREMENTS

- .1 TAB contractor will work for the owner from the cash allowance in the Architectural Allowances section.
- .2 This contractor must co-ordinate their work with that of the TAB contractor.
- .3 Prequalified TAB contractors are to submit quotes to the engineers on or before the tender closing time specified in Division 1.
- .4 Should the Engineer's Office not receive the quotes it will be the successful mechanical contractor's responsibility to obtain the quotations.
- .5 If required, the successful mechanical contractor shall:
 - .1 Provide copies of specified drawings and addendums to the NEBB certified Testing and Balancing contractors listed below.
 - .2 Obtain quotations for Testing and Balancing services.
 - .3 Submit quotations to the engineer's office for review.
- .6 The Engineer's Office will issue required instruction for the initiation of Testing and Balancing agency's work.

1.2 GENERAL

- .1 TAB means to test, adjust and balance to perform in accordance with requirements of Contract Documents and to do all other work as specified in this section including all air handling systems and equipment, all plumbing systems and equipment and all temperature controls system, building automation systems and equipment.

1.3 QUALIFICATIONS OF TAB AGENCIES

- .1 Names of all personnel it is proposed to perform TAB to be submitted to and approved by Consultant within 30 days of start of work.
- .2 Provide documentation confirming qualifications, successful experience.
- .3 Only the following NEBB (National Environmental Balancing Bureau) TAB contractors may quote:
 - .1 Air Audit Inc.
110 Turnbull Court, Unit 11
Cambridge, Ontario
N1T 1K6
(519) 740-0871

-
- .2 Air Velocities Control Ltd.
100 Premium Way
Mississauga, Ontario
L5B 1A2
(905) 279-4433
 - .3 Flowset Balancing Ltd.
431 Willis Dr.
Oakville, Ontario
L6L 4V6
(416) 410-9793
 - .4 Dynamic Flow Balancing Ltd.
1200 Speers Road, Unit 36
Oakville, Ontario
L6L 4V6
(905) 338-0808
 - .5 Air Adjustments & Balancing Inc.
P.O. Box 176,
Schomberg, Ontario
L0G 1T0
(416) 254-3004
 - .6 Clark Balancing Ltd.
8094 Esquesing Line
Milton, Ontario
L9T 2X9
(905) 693-1518

1.4 PURPOSE OF TAB

- .1 Test to verify proper and safe operation, determine actual point of performance, evaluate qualitative and quantitative performance of equipment, systems and controls at design, average (95% design) and low (75% of design) loads using actual or simulated loads. TAB contractor to perform equipment evaluation upon start up and once during each season in the first year of operation.
- .2 Adjust and regulate equipment and systems so as to meet specified performance requirements and to achieve specified interaction with all other related systems under all normal and emergency loads and operating conditions. Confirm all equipment interlocks and functions of associated systems.
- .3 Balance systems and equipment to regulate flow rates to match load requirements over full operating ranges and temperatures. Refer to BAS for system operating functions.

1.5 EXCEPTIONS

- .1 TAB of systems and equipment regulated by codes, standards to be to satisfaction of authority having jurisdiction.

1.6 COORDINATION

- .1 Schedule time required for TAB (including repairs, re-testing) into project construction and completion schedule so as to ensure completion before acceptance of project.
- .2 Do TAB of each system independently and subsequently, where interlocked with other systems, in unison with those systems. Coordinate with other trades to ensure all systems are interlocked as indicated elsewhere prior to TAB.

1.7 PRE-TAB REVIEW

- .1 Review contract documents before project construction is started and confirm in writing to Consultant adequacy of provisions for TAB and all other aspects of design and installation pertinent to success of TAB.
- .2 Review specified standards and report to Consultant in writing all proposed procedures which vary from standard.
- .3 During construction, co-ordinate location and installation of all TAB devices, equipment, accessories, measurement ports and fittings.
- .4 During construction indicate all tolerances of piping, ductwork etc conforms to specifications.

1.8 START-UP

- .1 Follow start-up procedures as recommended by equipment manufacturer unless specified otherwise.
- .2 Follow special start-up procedures specified elsewhere in the Mechanical Division.

1.9 OPERATION OF SYSTEMS DURING TAB

- .1 Operate systems for length of time required for TAB and as required by Consultant for verification of TAB reports.

1.10 START OF TAB

- .1 Notify Consultant in writing 3 days prior to start of TAB.
- .2 Start TAB only when building is essentially completed, including:
- .1 Installation of ceilings, doors, windows, other construction affecting TAB.
- .2 Application of weather-stripping, sealing, caulking.
- .3 All pressure, leakage, other tests specified elsewhere in the Mechanical Division.
- .4 All provisions for TAB installed and operational.

- .5 Start-up, verification for proper, normal and safe operation of all mechanical and associated electrical and control systems affecting TAB including but not limited to:
- .1 Proper thermal overload protection in place for electrical equipment.
 - .2 Air systems:
 - .1 Filters in place, clean.
 - .2 Duct systems clean.
 - .3 Ducts, air shafts, ceiling plenums are airtight to within specified tolerances.
 - .4 Correct fan rotation.
 - .5 Fire, smoke, volume control dampers installed and open.
 - .6 Coil fins combed, clean.
 - .7 Access doors, installed, closed.
 - .8 All outlets installed, volume control dampers open.
 - .3 Liquid systems:
 - .1Flushed, filled, vented.
 - .2 Correct pump rotation.
 - .3 Strainers in place, baskets clean.
 - .4 Isolating and balancing valves installed, open.
 - .5 Calibrated balancing valves installed, at factory settings.
 - .6 Chemical treatment systems complete, operational.
 - .7 Control valves are properly piped.
 - .8 Coils and radiation are properly piped.
 - .9 BAS in operation.

1.11 APPLICATION TOLERANCES

- .1 Do TAB to following tolerances of design values:
 - .1 HVAC systems: plus 10%, minus 5%.
 - .2 Hydronic systems: plus or minus 10%.

1.12 ACCURACY TOLERANCES

- .1 Measured values to be accurate to within plus or minus 2% of actual values.

1.13 INSTRUMENTS

- .1 Prior to TAB, submit to Consultant list of instruments to be used together with serial numbers.

- .2 Calibrate in accordance with requirements of most stringent of referenced standard for either applicable system or HVAC system.
- .3 Calibrate within 3 months of TAB. Provide certificate of calibration to Consultant.

1.14 SUBMITTALS

- .1 Submit, prior to commencement of TAB:
 - .1 Proposed methodology and procedures for performing TAB if different from referenced standard.

1.15 PRELIMINARY TAB REPORT

- .1 Submit for checking and approval of Consultant, prior to submission of formal TAB report, sample of rough TAB sheets. Include:
 - .1 Details of instruments used.
 - .2 Details of TAB procedures employed.
 - .3 Calculations procedures.
 - .4 Summaries.

1.16 TAB REPORT

- .1 Format to be in accordance with NEBB, AABC, or SMACNA.
- .2 TAB report to show all results in SI or imperial units as indicated on plans and to include:
 - .1 Project record drawings.
 - .2 System schematics.
- .3 Submit copy of TAB Report to consultant for verification and approval, in English in D-ring binders, complete with index tabs.

1.17 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.
- .4 Bear costs to repeat TAB as required to satisfaction of Consultant.

1.18 SETTINGS

- .1 After TAB is completed to satisfaction of Consultant, replace drive guards, close all access doors, lock all devices in set positions, ensure sensors are at required settings. Replace all ceiling tile etc.

- .2 Permanently mark all settings to allow restoration at any time during life of facility.
Markings not to be eradicated or covered in any way.

1.19 COMPLETION OF TAB

- .1 TAB to be considered complete only when final TAB Report received and approved by Consultant.

1.20 AIR SYSTEMS

- .1 Standard: TAB to be to most stringent of TAB standards of NEBB, AABC, SMACNA, ASHRAE.
- .2 Do TAB of all systems, equipment, components, controls specified in the Mechanical Division including but not limited to following:
- .1 Air handling systems and equipment
 - .2 Duct testing to SMACNA standards.
- .3 Qualifications: personnel performing TAB to be current member in good standing of NEBB.
- .4 Quality assurance: Perform TAB under direction of qualified supervisor.
- .5 Measurements: to include, but not limited to, following as appropriate for systems, equipment, components, controls: air velocity, static pressure, flow rate, pressure drop (or loss), temperatures (dry bulb, wet bulb, dewpoint), duct cross-sectional area, RPM, electrical power, voltage, noise, vibration.
- .6 Locations of equipment measurements: To include, but not be limited to, following as appropriate:
 - .1 Inlet and outlet of each damper, filter, coil, humidifier, fan, and other equipment causing changes in conditions.
 - .2 At each controller, controlled device.
- .7 Locations of systems measurements to include, but not be limited to, following as appropriate: Each main duct, main branch, sub-branch, grille, register or diffuser.

1.21 HYDRONIC SYSTEMS

- .1 Definitions: for purposes of this section, to include low pressure hot water heating, chilled water, condenser water, glycol systems.
- .2 Standard: TAB to be the most stringent of TAB standards of NEBB, AABC, SMACNA, ASHRAE.
- .3 Do TAB of all systems, equipment, components, controls specified in Mechanical Division including but not limited to hydronic equipment testing.
- .4 Qualifications: personnel performing TAB to be current member in good standing of NEBB.

- .5 Quality assurance: perform TAB under direction of qualified supervisor.
- .6 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.
- .7 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), boiler, chiller, coil, humidifier, cooling tower, condenser, pump, PRV, control valve, other equipment causing changes in conditions.
 - .2 At each controller, controlled device.
- .8 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).

1.22 DUCT LEAKAGE TESTING

- .1 Co-ordinate leakage testing with the sheet metal contractor. TAB contractor will be responsible for all duct testing.
- .2 Duct to be tested in accordance with SMACNA HVAC Duct Leakage Test Manual and as indicated.

1.23 DOMESTIC HWC SYSTEMS

- .1 Meet all requirements as specified for hydronic systems.
- .2 Locations of equipment measurements: To include, but not be limited to, following as appropriate: Inlet and outlet of each heater, tank, pump, circulator, at each controller, controlled device.
- .3 Locations of systems measurements to include, but not be limited to, following as appropriate: main, main branch, branch, sub-branch.

1.24 OTHER SYSTEMS

- .1 Plumbing systems:
 - .1 TAB procedures:
 - .2 Pressure booster systems: test for capacity and pressures under all conditions and at all times.
- .2 Pumped sanitary and storm water systems: test for proper operation at all possible flow rates.

1.25 OTHER TAB REQUIREMENTS

- .1 General requirements applicable to all work specified this paragraph:
 - .1 Qualifications of TAB personnel: as for air systems specified this section.
- .2 Quality assurance: as for air systems specified this section.
- .3 Building pressure conditions:
 - .1 Adjust HVAC systems, equipment, controls to ensure specified pressure conditions.
 - .2 TAB procedures:

<u>Positive</u>	<u>Negative</u>
Arena Bowl	Washrooms
	Change Rooms
- .4 Zone pressure differences:
 - .1 Adjust HVAC systems, equipment, controls to establish air pressure differentials, with all systems in all possible combinations of normal operating modes.
- .5 Smoke management systems:
 - .1 Test for proper operation of all smoke and fire dampers installed as component parts of air systems specified.
- .6 Provide AHU testing as specified.
- .7 Provide plenum testing as specified.
- .8 Changing of air handling equipment sheave and belts as required for specified air flow sheaves and belts supplied by unit manufacturer. Retest equipment after sheave change.

END OF SECTION

Part 1 General

1.1 GENERAL

- .1 The Mechanical Contractor shall provide the labour and material to conduct the closeout process as outlined in this specification section.
- .2 The mechanical contractor shall perform the closeout requirements specified in conjunction with the independent commissioning consultant (CC) retained by the owner.

Part 2 Products

2.1 GENERAL

- .1 The mechanical contractor and manufacturers shall provide all instrumentation and equipment necessary to conduct the tests specified. The Mechanical Contractor shall advise the Mechanical Consultant of instrumentation to be used and the dates the instruments were calibrated.

Part 3 Execution

3.1 THE CONTRACT CLOSE OUT PROCESS

- .1 The mechanical contractor close out process shall consist of:
 - Shop Drawings and As-built Drawings
 - Installation inspection and equipment verification
 - Plumbing and drainage system testing
 - Testing of piping systems
 - Independent contractor balancing of water systems
 - Testing of air systems
 - Independent contractor balancing of air systems
 - Testing of equipment and systems
 - BAS Commissioning
 - Verification of refrigeration leak detection systems
 - Commissioning Consultant performance testing
 - Commissioning meetings
 - Operating and maintenance manuals
 - Training
 - Systems Demonstration and turnover
 - Testing forms
 - Warranties
 - Contractor to provide list of equipment maintenance including schedule of maintenance parts, quantities, and model fixtures, etc.

-
- 3.2 SHOP DRAWINGS AND AS-BUILT DRAWINGS**
- .1 Conform to General Requirements Section for shop drawings and as-built drawings requirements.
- 3.3 INSTALLATION INSPECTION AND EQUIPMENT VERIFICATION**
- .1 The Mechanical Contractor shall co-ordinate with the Consultant who will inspect the mechanical installation.
- .2 The Mechanical Contractor shall complete the equipment verification forms for each piece of equipment. The forms shall be included in the operating and maintenance manual. The equipment data shall include:
- Manufacturers name, address and telephone number
 - Distributors name, address and telephone number
 - Make, model number and serial number
 - Pumps - RPM, impeller sizes, rated flow
 - Fans - belt type and size, shive type and size
 - Electrical - volts, amps, fuse size, overload size
 - Any other special characteristics.
- 3.4 PLUMBING AND DRAINAGE SYSTEM TESTING**
- .1 The plumbing and drainage system shall be tested in accordance with the Plumbing Code under the Ontario Water Resources Act and the specification.
- .2 The Mechanical Contractor shall notify the Building Inspector when systems are available for testing. The Mechanical Contractor shall document all tests performed and shall arrange for the Building Inspector to sign for tests completed. The forms shall be forwarded to the Consultant.
- 3.5 THE CONTRACTOR'S TESTING OF PIPING SYSTEMS**
- .1 Test all piping systems in accordance with all applicable plumbing codes and General Requirements section.
- .2 All tests for the systems shall be performed in the presence of the Consultant or Commissioning Consultant. Complete the testing forms and forward to the Consultant.
- 3.6 THE INDEPENDENT CONTRACTORS TESTING AND BALANCING OF WATER SYSTEMS**
- .1 Conform with the specification section, Testing, Adjusting and Balancing.
- .2 The Independent Contractor shall be hired by The Mechanical Contractor and shall report to the Commissioning Consultant.
- 3.7 THE CONTRACTORS TESTING OF AIR SYSTEMS**
- .1 Conform with the specification section, Testing, Adjusting and Balancing.
- .2 All tests shall be performed in the presence of the Mechanical Consultant or the Commissioning Consultant. Complete the testing forms and forward to the Consultant.

3.8 THE INDEPENDENT CONTRACTORS TESTING AND BALANCING OF AIR SYSTEMS

- .1 Conform with specification section, Testing, Adjusting and Balancing.
- .2 The Independent Contractor shall be hired by The Mechanical Contractor and shall report to the Commissioning Consultant.

3.9 TESTING OF EQUIPMENT AND SYSTEMS

- .1 General:
 - .1 The Mechanical Contractor shall hire the services of the manufacturers technicians to test the equipment and associated systems. The technician shall record the results of the tests on the testing forms. The tests shall be witnessed by the Consultant or Owners representative. When the tests have been completed satisfactorily the technician and witnessing authority shall sign the forms. A copy of the forms shall be forwarded to the Consultant. The original shall be inserted into the operating and maintenance manual.
 - .2 Should equipment or systems fail a test, the test shall be repeated after repairs or adjustments have been made. The additional tests shall be witnessed.
 - .3 Tests which have not been witnessed shall not be accepted and shall be repeated.
 - .4 The equipment and systems to be tested shall include:
 - Mechanical System
 - Water Treatment Systems
- .2 BAS Testing:
 - .1 The BAS Contractor shall test the system as described in General Requirements and/or Controls Sections.
 - .2 Co-ordinate with the Consultant and submit completed test forms monthly.
 - .3 Demonstrate to the Owner and Consultant the operation of the BAS when all tests have been completed.
- .3 Verification of Refrigeration Leak Detection System Operation:
 - .1 The commissioning process shall include the verification of the refrigeration leak detection system.
 - .2 All interlocks between leak detection systems installed and system components, as well as interlocks between field installed detection systems and associated safety system components shall be tested and verified to operate as per the requirements of CSA B52. Specifically, the following shall occur for each independent system on registration of a refrigerant leak:
 - .1 Open all zone dampers in the affected system.
 - .2 Disable all electric reheat coils within the affected system.
 - .3 Activate field installed safety shut off valves within the affected refrigeration system.

- .4 Energize all fans within the affected ductwork system.
- .5 Activate all refrigerant leak system specific ventilation systems.
- .6 De-energize any other potential sources of ignition within the affected system.

3.10 CLOSEOUT SCHEDULE

- .1 The Mechanical Contractor shall include the schedule for all tests and equipment start-up tests in the construction schedule.
- .2 All testing forms and reports associated with the mechanical systems shall be directed to the Consultant with copies to the Owner and Consultant.
- .3 The forms and reports to be issued shall include:
 - Shop drawings, issued and accepted
 - Equipment verification forms
 - Testing forms
 - Reports resulting from tests
 - Testing schedule
 - Equipment Start-up Forms

3.11 OPERATION AND MAINTENANCE MANUAL

- .1 Conform to General Requirements section for the Operating and Maintenance Manual requirements.

3.12 OPERATOR TRAINING

- .1 Conform to General Requirements section for requirements for Instruction to Operating Staff.
- .2 The training shall be conducted in a classroom and at the equipment or system.
- .3 Training will begin when the operating and maintenance manuals have been delivered to The Owner and approved by the Consultant.
- .4 Each training session shall be structured to cover:
The operating and maintenance manual
 - Operating procedures
 - Maintenance procedures
 - Trouble-shooting procedures
 - Spare parts required
 - Submit a course outline to the Mechanical Consultant before training commences.
Provide course documentation for up to eight people.

- .5 The training sessions shall be scheduled and co-ordinated by the Mechanical Contractor.
- .6 Training shall be provided for the following systems:

<u>System</u>	<u>Minimum Training Times</u>
The Mechanical System	8 hours

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- .7 The training requirement for the mechanical system shall include a walk-through of the building by the Mechanical Contractor. During the walk through the Mechanical Contractor shall:
 - Identify equipment
 - Identify starters associated with equipment
 - Identify valves and balancing dampers
 - Identify access doors
 - Review general maintenance of equipment
 - Review drain points in pipework systems
 - Identify maintenance items
 - .8 When each training session has been completed The Owner shall sign the associated form to verify completion.

3.13 MECHANICAL SYSTEM DEMONSTRATION AND TURNOVER

- .1 Refer to General Requirements section, Mechanical Project Completion.
- .2 The system demonstration and turnover to The Owner shall occur when:
 - The installation is complete
 - The acceptance test conducted by the Mechanical Consultant has been completed successfully
 - The Commissioning Consultant system performance testing has been completed successfully
 - Training has been completed
 - Operating and Maintenance Manuals have been accepted
 - Shop-drawings have been updated
 - As-built drawings have been completed
- .3 The systems demonstration shall be conducted by the Mechanical Contractor and the manufacturers. The demonstration shall cover a demonstration of equipment installation and operation.

3.14 TESTING FORMS

- .1 The Mechanical Contractor and manufacturers shall provide forms for testing. The forms must be approved by the Consultant and The Owner before they are used.

3.15 WARRANTIES

- .1 Equipment and system warranties shall not begin until the system demonstration and turnover has been conducted successfully and accepted by The Owner.
- .2 The Mechanical Contractor shall fill out the warranty form listing the equipment and systems and the start and finishing dates for warranty.
- .3 Refer to the general conditions specification section for the requirements during the warranty period.

Part 1 General

1.1 RELATED SECTIONS

- .1 This section must be read in association with the following: Division 1, Mechanical and Electrical General Requirements Sections.

1.2 REFERENCES

- .1 Heating cable must conform to CSA 22.2 No.130-03 (latest edition).

1.3 PRODUCT DATA

- .1 Submit product data in accordance with General Requirements Section.

- .2 Product data to include:

- .1 Suspension of heating element.
- .2 Physical size.
- .3 Thermostat control if integral.
- .4 Finish.
- .5 kW rating, voltage, phase.
- .6 Cabinet thickness.
- .7 Cabinet surface temperature.
- .8 Mounting methods.
- .9 Auxiliary controls.
- .10 Replacement data for motor element, thermostat, and switch.

1.4 OPERATION AND MAINTENANCE DATA

- .1 Provide operation and maintenance data for all heating system components for incorporation into manual as specified in General Requirements Section.

Part 2 Products

2.1 HEAT TRACING CABLE

- .1 The equipment and all related devices specified herein shall be self-regulating SRF. All sizes, types and lengths of heat trace shall be as per the drawings. (Any alternates proposed by the Contractor must have the same operating characteristics to those of SRF self-regulating cable).

Products: XLK-PC Power connection and end seal kit
 XLK-SET Splice, End, and Tee kit
 5XL (5 watts per feet)
 8XL (8 watts per feet)

- .2 The self-regulating heat trace shall be a self-regulating polymer core with 2-16AWG nickel copper bus wires embedded in core. The polymer core will allow its resistance to vary - thus regulating its power output for temperature response. The entire heater shall be covered by a radiation cross linked modified polyolefin dielectric jacket.
- .3 Self-regulating heating cable shall be designed for a useful life of 20 years or more with "power on" continuously, based on the following useful life criteria:
 - .1 Retention of at least 75% of nominal rated power after 20 years of operation at the maximum published continuous exposure (maintain) temperature.
 - .2 Retention of at least 90% of nominal rated power after 1,000 hours of operation at the maximum published intermittent exposure temperature.
- .4 The heat trace system shall operate on a 208V system.
- .5 All power connection, end seal, splice, and tee kits shall be installed in the field with a complete inspection performed by a representative of the product company inspecting all installations prior to power up of the system. (Thus preventing any installation from being watertight). An inspection and system approval certificate shall be issued by the Contractor guaranteeing the installations.
- .6 Heat trace wire and components shall be warranted for against manufacturer defects for a period of 5 years.

2.2 MONITOR AND CONTROL PANEL

- .1 Control panel shall provide individual ground fault connection to all heat trace circuits. Provide dedicated control panel for all sprinkler and standpipe heat tracing. Panel to be powered from emergency generator and send trouble to fire alarm panel on faults. Provide panels serving other piping as noted on drawings.

The following faults shall be monitored at a minimum:

- .1 High/low temperature fault.
- .2 Ground fault alarm.
- .3 Ground fault trip.
- .4 High/low current fault.
- .5 Voltage.
- .6 Product: Raychem ACS-30 or approved equal.

2.3 GROUP HEAT-TRACE CONTROL PANELS

- .1 Distribution panels shall consist of an enclosure, including a panelboard with ground-fault protection devices.
- .2 The panels shall provide ground fault alarm capabilities.
- .3 If more than one circuit is required, a main contactor shall be used.
- .4 Panel shall be rated for amperage on electrical drawings and have 10% spare circuits for future expansion.

- .5 Panel shall operate at 208V.
- .6 The panels shall operate with ambient-sensing or proportional ambient-sensing controllers.
- .7 The panels shall be capable of remote temperature monitoring and alarming of individual heat-tracing circuits.
- .8 The panel shall be capable of providing audible and visible alarms.
- .9 The panel shall be the RAYCHEM HTPG heat-tracing panel or approved manufacturer equivalent.

2.4 APPROVED MANUFACTURERS

- .1 Approved manufacturers shall be:
 - .1 Chromalox
 - .2 Raychem
 - .3 3M
 - .4 Serge Baril
 - .5 Heron Cable Ind.
 - .6 Easy Heat (Emerson)

Part 3 Execution

3.1 INSTALLATION

- .1 All heat trace cable shall be fastened to the steel pipes with plastic cable ties or fibreglass tape.
- .2 The cable shall run the entire length of each pipe linearly.
- .3 Power connection kits shall be installed in a weatherproof surface mounted junction box (suitable to house the connection kit) in the location shown on the drawings.
- .4 A manufacturer supplied sign reading "electric traced" shall be installed on the outside of the thermal insulation at intervals of 6 m (20 ft) spacing.
- .5 Provide two runs of cable along the length of piping for all piping greater than or equal to 150mm (6" diameter). Run cable along top and bottom of entire pipe length or as per manufacturer's recommendations.
- .6 Electrical division shall provide power to junction box adjacent to heat trace circuit power connection. All other wiring shall be by this contractor to the standards of the electrical division.

3.2 TESTS

- .1 Following cable installation on pipe, heat trace shall be subject to a test using a 1000V DC MEGGAR prior to and following installation of thermal insulation. Insulation resistance should be 20-1000 MEGA OHMS regardless of length.

3.3 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Electrical General Requirements Section.
- .2 Ensure that heating cable and controls operate correctly.
- .3 On fan powered units:
 - .1 Test cut-out protection when air movement is obstructed.
 - .2 Test fan delay switch to assure dissipation of heat after element shut down.
 - .3 Test unit cut-off when fan motor overload protection has operated.
- .4 On heat tracing cable, test operation before concealing with insulation.

3.4 MONITOR AND CONTROL PANEL

- .1 Install in accordance with manufacturer's instructions.
- .2 Locate panel as indicated and mount securely. Plumb, true and square, to adjoining surfaces.
- .3 Mount panel at working height. Maintain 1m clearance in front of panel.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 All codes, standards, etc. as referenced shall be the latest edition.
- .2 Canadian General Standards Board (CGSB)
 - .1 ASTM C553, Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
 - .2 CAN/ULC-S702, Mineral Fiber Thermal Insulation for Buildings.
 - .3 ASTM C612, Mineral Fiber Block and Board Thermal Insulation.
 - .4 CGSB 51-GP-52Ma, Vapour Barrier Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
- .3 Underwriters Laboratories of Canada (ULC)
 - .1 CAN/ULC-S102, Surface Burning Characteristics of Building Materials and Assemblies.
- .4 American Society for Testing and Materials (ASTM)
 - .1 ASTM B 209M, Specification for Aluminum and Aluminum Alloy Sheet and Plate.
 - .2 ASTM C 335, Test Method for Steady State Heat Transfer Properties of Pipe Insulation.
 - .3 ASTM C 411, Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
 - .4 ASTM C 449M, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
 - .5 ASTM C 795, Specification for Thermal Insulation for Use with Austenitic Stainless Steel.
 - .6 ASTM C 921, Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
- .5 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
 - .1 ASHRAE Standard 90.1.
- .6 Manufacturer's Trade Associations
 - .1 Thermal Insulation Association of Canada (TIAC): National Insulation Standards.

1.2 PRODUCT DATA

- .1 Submit Product Data in accordance general requirements.

- 1.3 SAMPLES SUBMITTALS**
- .1 Submit samples in accordance with general requirements.
 - .2 Submit for approval: complete assembly of each type of insulation system, insulation, coating, and adhesive proposed. Mount sample on 15 mm (1/2") plywood board. Affix typewritten label beneath sample indicating service.

- 1.4 INSTALLATION INSTRUCTIONS**
- .1 Submit manufacturer's installation instructions in accordance with general requirements.
 - .2 Installation instructions to include procedures to be used, installation standards to be achieved.

- 1.5 QUALIFICATIONS**
- .1 Installer to be specialist in performing work of this section, and have at least 3 years successful experience in this size and type of project, qualified to standards of TIAC.

- 1.6 DELIVERY, STORAGE AND HANDLING**
- .1 Deliver materials to site in original factory packaging, labeled with manufacturer's name, address.
 - .2 Protect from weather and construction traffic.
 - .3 Protect against damage from any source.
 - .4 Store at temperatures and conditions required by manufacturer.

- Part 2 Products**
- 2.1 FIRE AND SMOKE RATING**
- .1 In accordance with CAN/ULC S102:
 - .1 Maximum flame spread rating: 25.
 - .2 Maximum smoke developed rating: 50.
- 2.2 INSULATION**
- .1 Mineral fibre as specified herein includes glass fibre, rock wool, slag wool.
 - .2 Thermal conductivity ("k" factor) not to exceed specified values at 24°C (75°F) mean temperature when tested in accordance with ASTM C 335.
 - .3 TIAC Code A-1: Rigid moulded mineral fibre without factory applied vapour retarder jacket.
 - .1 Mineral fibre: to ASTM C553
 - .2 Maximum "k" factor: to ASTM C553.

2.3 CEMENT

- .1 Thermal insulating and finish:
 - .1 To ASTM C553.
 - .2 Hydraulic setting or Air drying on mineral wool, to ASTM C 449.

2.4 JACKETS

- .1 Polyvinyl Chloride (PVC):
 - .1 One-piece moulded type [and sheet] to CAN/CGSB-51.53 with pre-formed shapes as required.
 - .2 Colours: white
 - .3 Minimum service temperatures: -20°C (-4°F).
 - .4 Maximum service temperature: 65°C (150°F).
 - .5 Moisture vapour transmission: 0.02 perm.
 - .6 Fastenings:
 - .1 Use solvent weld adhesive compatible with insulation to seal laps and joints.
 - .2 Tacks
 - .3 Pressure sensitive vinyl tape of matching colour.
 - .7 Covering adhesive: Compatible with insulation.

2.5 INSULATION SECUREMENTS

- .1 Tape: Self-adhesive, aluminum, [reinforced], 50 mm (2") wide minimum.
- .2 Contact adhesive: Quick setting.
- .3 Canvas adhesive: Washable.
- .4 Tie wire: 1.5 mm (16 gauge) diameter stainless steel.
- .5 Bands: Stainless steel, 20 mm (3/4") wide, 0.5 mm (26 gauge) thick.
- .6 Facing: 25 mm (1") galvanized steel hexagonal wire mesh on one face of insulation.
- .7 Fasteners: 4 mm (5/32") diameter pins with 40 mm (1½") clips. Length of pin to suit thickness of insulation.

2.6 VAPOUR RETARDER LAP ADHESIVE

- .1 Water based, fire retardant type, compatible with insulation.

2.7 INDOOR VAPOUR RETARDER FINISH

- .1 Vinyl emulsion type acrylic, compatible with insulation.

2.8 OUTDOOR VAPOUR RETARDER MASTIC

- .1 Vinyl emulsion type acrylic, compatible with insulation.
- .2 Reinforcing fabric: Fibrous glass, untreated 305 g/m² (0.062 lb/ft²).

Part 3 Execution

3.1 PRE-INSTALLATION REQUIREMENTS

- .1 Pressure testing of equipment and adjacent piping systems to be complete, witnessed and certified.
- .2 Surfaces to be clean, dry, free from foreign material.

3.2 INSTALLATION

- .1 Install in accordance with TIAC National Standards
 - .1 Hot equipment: To TIAC code 1503-H.
 - .2 Cold equipment: to TIAC code 1503-C.
- .2 Elastomeric Insulation: to remain dry at all times. Overlaps to be to manufacturer instructions. Joints to be tight and sealed properly.
- .3 Provide vapour retarder as recommended by manufacturer.
- .4 Apply materials in accordance with insulation and equipment manufacturers instructions and this specification.
- .5 Use two layers with staggered joints when required nominal wall thickness exceeds 75 mm (3").
- .6 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
 - .1 Hangers, supports to be outside vapour retarder jacket.
- .7 Supports, Hangers:
 - .1 Apply high compressive strength insulation, suitable for service, at oversized saddles and shoes where insulation saddles have not been provided.

3.3 REMOVABLE, PRE-FABRICATED, INSULATION AND ENCLOSURES

- .1 Application: At expansion joints, valves, primary flow measuring elements flanges and unions at equipment.
- .2 Installation to permit movement of expansion joint and to permit periodic removal and replacement without damage to adjacent insulation.

3.4 EQUIPMENT INSULATION SCHEDULES

- .1 Includes valves, valve bonnets, strainers, flanges & fittings unless otherwise specified.
- .2 Hot Equipment:
 - .1 TIAC code A-1 or C-1 with mechanical fastenings and bands and 15 mm ($\frac{1}{2}$ ") cement reinforced with one layer of reinforcing mesh.
 - .2 TIAC code C-2 unfaced with bands. and 15 mm (1/2") cement preceded by one layer of reinforcing mesh.
 - .3 Type and Thickness:

ITEM	THICKNESS	TYPE
Domestic hot water storage tanks	25 mm (1")	A1
Heat exchangers	50 mm (2")	A1
Buffer Tanks and Hot Glycol Storage Tank	75 mm (3")	A1
- .3 Breechings, engine exhausts and mufflers:
 - .1 TIAC code A-] with 25 mm (1") air gap, [mechanical fastenings and bands and 15 mm (1/2") cement reinforced with one layer of reinforcing mesh.
- .4 Finishes:
 - .1 Equipment elsewhere: TIAC code CEF/2 with 15mm (1/2") cement canvas jacket.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 All codes, standards, etc. as referenced shall be the latest edition.
- .2 Canadian General Standards Board (CGSB)
 - .1 ASTM C553, Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
 - .2 CGSB 51-GP-52Ma, Vapour Barrier Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
 - .3 CAN/CGSB-51.53, Poly (Vinyl Chloride) Jacketing Sheet, for Insulating Pipes, Vessels and Round Ducts.
- .3 Underwriters Laboratories of Canada (ULC)
 - .1 CAN/ULC-S102, Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
- .4 American Society for Testing and Materials (ASTM)
 - .1 ASTM C 335, Test Method for Steady State Heat Transfer Properties of Pipe Insulation.
 - .2 ASTM C 921, Practice for Determining the Properties Jacketing Materials for Thermal Insulation.
 - .3 ASTM B 209M, Specification for Aluminum and Aluminum Alloy Sheet and Plate.
- .5 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE).
 - .1 ASHRAE Standard 90.1.
- .6 Manufacturer's Trade Associations
 - .1 Thermal Insulation Association of Canada (TIAC): National Insulation Standards.

1.2 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with general requirements.
- .2 Submit for approval manufacturer's catalogue literature related to installation, fabrication for pipe, fittings, valves and jointing recommendations.

1.3 INSTALLATION INSTRUCTIONS

- .1 Submit manufacturer's installation instructions in accordance with general requirements.
- .2 Installation instructions to include procedures to be used, installation standards to be achieved.

1.4 QUALIFICATIONS

- .1 Installer to be specialist in performing work of this section, and have at least 3 years successful experience in this size and type of project, qualified to standards of TIAC.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .2 Protect from weather, construction traffic.
- .3 Protect against damage from any source.
- .4 Store at temperatures and conditions required by manufacturer.

1.6 DEFINITIONS

- .1 For purposes of this section:
- .1 "CONCEALED" - insulated mechanical services in suspended ceilings and non-accessible chases and furred-in spaces.
- .2 "EXPOSED" - will mean "not concealed" as defined herein.

Part 2 Products

2.1 FIRE AND SMOKE RATING

- .1 In accordance with CAN/ULC-S102:
- .1 Maximum flame spread rating: 25.
- .2 Maximum smoke developed rating: 50.

2.2 INSULATION

- .1 Mineral fibre as specified herein includes glass fibre, rock wool, slag wool.
- .2 Thermal conductivity ("k" factor) not to exceed specified values at 24°C (75°F) mean temperature when tested in accordance with ASTM C 335.
- .3 Type A-1: Rigid moulded mineral fibre with factory applied vapour retarder jacket.
- .1 Mineral fibre: to ASTM C553.
- .2 Jacket: to CGSB 51-GP-52 Ma.
- .3 Maximum "k" factor: to ASTM C553.
- .4 Type A-2: Mineral fibre faced with factory applied vapour retarder jacket.
- .1 Mineral fibre: to ASTM C553.
- .2 Jacket: to CGSB 51-GP-52 Ma.
- .3 Maximum "k" factor: to ASTM C553.

.5

Materials:

.1 All materials must be supplied by the same manufacturer.

.2 Acceptable Materials:
Fibreglass Canada
Knauf
Manson
Pittsburgh Corning

2.3

INSULATION SECUREMENT

- .1 Tape: Self-adhesive, aluminum, reinforced, 50 mm (2") wide minimum.
- .2 Contact adhesive: Quick setting.
- .3 Canvas adhesive: Washable.

2.4

CEMENT

- .1 Thermal insulating and finishing cement:
 - .1 To ASTM C553.
 - .2 Hydraulic setting or Air drying on mineral wool, to ASTM C 449M.

2.5

VAPOUR RETARDER LAP ADHESIVE

- .1 Water based, fire retardant type, compatible with insulation.

2.6

INDOOR VAPOUR RETARDER FINISH

- .1 Vinyl emulsion type acrylic, compatible with insulation.

2.7

JACKETS

- .1 Polyvinyl Chloride (PVC):

.1 One-piece moulded type [and sheet] to CAN/CGSB-51.53 with pre-formed shapes as required.
.2 Colours: white.
.3 Minimum service temperatures: -20°C (-4°F).
.4 Maximum service temperature: 65°C (150°F).
.5 Moisture vapour transmission: 0.02 perm.
.6 Fastenings:

- .1 Use solvent weld adhesive compatible with insulation to seal laps and joints.
- .2 Tacks.
- .3 Pressure sensitive vinyl tape of matching colour.

- .2 Caulking: Silicone clear caulking.

- | Part 3 | Execution |
|---------------|---|
| 3.1 | PRE-INSTALLATION REQUIREMENT |
| .1 | Pressure testing of piping systems and adjacent equipment to be complete, witnessed and certified. |
| .2 | Surfaces to be clean, dry, free from foreign material. |
| 3.2 | INSTALLATION |
| .1 | Install in accordance with TIAC National Standards. |
| .2 | Apply materials in accordance with manufacturers' instructions and this specification. |
| .3 | Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes. |
| .1 | Hangers, supports to be outside vapour retarder jacket. |
| .4 | Supports, Hangers: |
| .1 | Apply high compressive strength insulation, suitable for service, at oversized saddles and shoes where insulation saddles have not been provided. |
| 3.3 | REMOVABLE, PRE-FABRICATED, INSULATION AND ENCLOSURES |
| .1 | Application: At expansion joints, valves, primary flow measuring elements, flanges, and unions at equipment. |
| .2 | Design: To permit movement of expansion joint and to permit periodic removal and replacement without damage to adjacent insulation. |
| .3 | Insulation: |
| .1 | Insulation, fastenings and finishes: same as system. |
| .2 | Jacket: As per adjacent insulation. |
| 3.4 | INSTALLATION OF ELASTOMERIC INSULATION |
| .1 | Insulation to remain dry at all times. Overlaps to manufacturers instructions. Ensure tight joints. |
| .2 | Provide vapour retarder as recommended by manufacturer. |
| 3.5 | PIPING INSULATION SCHEDULES |
| .1 | Includes valves, valve bonnets, strainers, flanges and fittings unless otherwise specified. |
| .2 | Install insulator and jackets to applicable TIAC codes. |
| .3 | Insulate ends of capped piping with type and thickness indicated for capped service. |

- .4 Thickness of insulation to be as listed in following table.
- .1 Do not insulate exposed runouts to plumbing fixtures, chrome plated piping, valves, fittings.
- .2 All storm piping including all vertical and horizontal piping shall be insulated.

Application	Type	Pipe sizes through (NPS) and insulation thickness mm (")				
		to 25 (1")	32 (1¼") 40 (1½")	50 (2") 80 (3")	105 (4") 150 (6")	200 (8") & over
Domestic Water Piping	A-1	25 (1")	25 (1")	40 (1½")	40 (1½")	40 (1½")
Storm Piping	A-1	25 (1")	25 (1")	25 (1")	25 (1")	25 (1")
Cooling Coil cond. Drain	A-1	25 (1")	25(1")	25 (1")	25 (1")	25 (1")
Roof Drain sumps	A-2	25 (1")	25 (1")	25 (1")	25 (1")	25 (1")
Horizontal Cast Iron	A-1	N/A	N/A	25 (1")	25 (1")	25 (1")
Sanitary Piping						
Trap Primer Piping	A-1	15 (½")	15 (½")	25 (1")		

- .5 Finishes: Conform to the following table:

Application	Piping	Valves & Fittings
Exposed indoors	PVC	PVC
Exposed in mech. rooms	PVC	PVC
Concealed indoors	N/A	PVC

- .6 Connection: To appropriate TIAC code.
- .7 Finish attachments: SS bands, @ 150 mm (6") oc. seals: closed.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 All codes, standards, etc. as referenced shall be the latest edition.
- .2 ANSI/ASME B16.15, Cast Copper Alloy Threaded Fittings, Classes 125 and 250.
- .3 ANSI B16.18, Cast Copper Alloy Solder Joint Pressure Fittings.
- .4 ANSI/ASME B16.22, Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings.
- .5 ANSI B16.24, Cast Copper Alloy, Pipe Flanges and Flanged Fittings: Classes 150, 300, 600, 900, 1500, and 2500.
- .6 ASTM B88M, Specification for Seamless Copper Water Tube (Metric).
- .7 MSS-SP-70, Cast Iron Gate Valves, Flanged and Threaded Ends.
- .8 MSS-SP-71, Cast Iron Swing Check Valves, Flanged and Threaded Ends.
- .9 MSS-SP-80, Bronze Gate, Globe, Angle and Check Valves.
- .10 MSS-SP-67, Butterfly Valves.**

1.2 SHOP DRAWINGS

- .1 Submit shop drawing data in accordance with general requirements.

1.3 MAINTENANCE DATA

- .1 Provide maintenance data for incorporation into manual specified in general requirements.

Part 2 Products

2.1 PIPING

- .1 Domestic hot, cold and recirculation systems, within building.
 - .1 Above ground: copper tube, hard drawn, type L: to ASTM B88M.
 - .2 Buried or embedded: copper tube, soft annealed, type K: to ASTM B88M, in long lengths and with no buried joints.

2.2 FITTINGS

- .1 Bronze pipe flanges and flanged fittings, Class 150 and 300: to ANSI B16.24.
- .2 Cast bronze threaded fittings, Class 125 and 250: to ANSI/ASME B16.15.
- .3 Cast copper, solder type: to ANSI B16.18.
- .4 Wrought copper and copper alloy, solder type: to ANSI/ASME B16.22.

- .5 Tee drill NPS 25 mm (1") and larger.
 - .6 **NPS 80 mm (3") and larger: roll grooved to CSA B242.**
- 2.3 JOINTS**
- .1 Solder: 95/5.
 - .2 Teflon tape: for threaded joints.
 - .3 Dielectric connections between dissimilar metals: dielectric fitting to ASTM F1545, complete with thermoplastic liner.
 - .4 Tee drill fittings shall be brazed with silver solder, 45% Ag - 15% Cu or copper phosphorous, 95% Cu, 5% P and non-corrosive flux.
 - .5 **Rubber gaskets, 1.5 mm (16 gauge) thick: to ANSI/AWWA C111/A21.11.**
 - .6 **Bolts, nuts, hex head and washers: to ASTM A307, heavy series.**
 - .7 **Grooved couplings: designed with angle bolt pads to provide rigid joint, complete with EPDM flush seal gasket.**
- 2.4 VALVES**
- .1 All valves shall be of commercial grade and of same manufacturer, Lead-Free.
 - .2 Acceptable materials:
Milwaukee
Crane
Kitz
- 2.5 BALL VALVES**
- .1 All valves shall be of commercial grade and of same manufacturer.
 - .2 NPS 80 mm (3") and under, soldered:
 - .1 To ANSI B16.18, Class 150.
 - .2 Bronze body, full port stainless steel ball, PTFE Teflon adjustable packing, brass gland and PTFE Teflon seat, steel lever handle, with NPT to copper adaptors.
 - .3 NPS 50 mm (2") and under, soldered:
 - .1 To MSS SP-80, Class 125, 860 kPa (125 psi), bronze body, bronze swing disc, screw in cap, regrindable seat.
 - .4 NPS 50 mm (2") and under, screwed:
 - .1 To MSS SP-80, Class 125, 860 kPa (125 psi), bronze body, bronze swing disc, screw in cap, regrindable seat.
 - .5 NPS 65 mm (2 1/2") and over, flanged:
 - .1 To MSS SP-71, Class 125, 860 kPa (125 psi), cast iron body, flat flange faces, [regrind] [renewable] seat, bronze disc, bolted cap.

2.6 BUTTERFLY VALVES

- .1 Provide copper tubing grooved valves where indicated.
- .2 NPS 100 mm (4") and over:
 - .1 Bronze body per CDA-836.
 - .2 EPDM/Bronze disk and trim.
 - .3 Two position handle.
- .3 Acceptable material:
Victaulic Series 608

Part 3 Execution

3.1 INSTALLATION

- .1 Install in accordance with Provincial Plumbing Code and local authority having jurisdiction.
- .2 Cut square, ream and clean tubing and tube ends, clean recesses of fittings and assemble without binding.
- .3 Assemble all piping using fittings manufactured to ANSI standards.
- .4 Install tubing close to building structure to minimize furring, conserve headroom and space. Group exposed piping and run parallel to walls.
- .5 Install CWS piping below and away from HWS and HWC and all other hot piping so as to maintain temperature of cold water as low as possible.
- .6 Connect to fixtures and equipment in accordance with manufacturers instructions unless otherwise indicated.
- .7 Bent tubing is not acceptable.
- .8 Buried tubing:
 - .1 Lay in well compacted washed sand in accordance with AWWA Class B bedding.
 - .2 Bend tubing without crimping or constriction. Minimize use of fittings.

3.2 VALVES

- .1 Isolate equipment, fixtures and branches with ball valves.
- .2 Balance recirculation system using lockshield globe valves. Mark settings and record on record drawings on completion.

3.3 PRESSURE TESTS

- .1 Conform to requirements of general requirements.
- .2 Test pressure: greater of 1½ times maximum system operating pressure or 860 kPa (125 psi).

3.4 FLUSHING AND DISINFECTING

- .1 Maintain testable RP backflow preventor between municipal water and new plumbing system.
- .2 Ensure a minimum of 90% of plumbing fixtures are installed.
- .3 Flush water mains through available outlets with a sufficient flow of potable water to produce a velocity of 1.5 m/s, within pipe for 10 min, or until foreign materials have been removed and flushed water is clear with backflow protection.
- .4 Provide connections and pumps for flushing as required.
- .5 Open and close valves, and operate fixtures to ensure thorough flushing.
- .6 When flushing has been complete to satisfaction of Consultant introduce a strong solution of Chlorine into water system and ensure that it is distributed throughout entire system.
- .7 Rate of chlorine application to be proportional to rate of water entering pipe.
- .8 Chlorine injection to be close to point of filling water main or at building water service and to occur simultaneously.
- .9 Confirm adequate chlorine residual not less than 50 ppm has been obtained, leave system charged with chlorine solution for 24 h. After 24 h, further samples shall be taken to ensure that there is still not less than 10 ppm of chlorine residual remaining throughout system.
- .10 Upon 10 ppm confirmation and 24 hr elapsed time flush line to remove chlorine solution.
- .11 Measure chlorine residuals at extreme end of pipe-line being tested.
- .12 Perform bacteriological tests on water main, after chlorine solution has been flushed out. Take samples daily for minimum of two days. Should contamination remain or reoccur during this period, repeat disinfecting procedure. Specialist contractor shall submit certified copy of test results.
- .13 Take water samples at remote fixtures and service connections.

END OF SECTION

Part 1 General

1.1 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with general requirements.
- .2 Indicate:
 - .1 Equipment, including connections, fittings, control assemblies and ancillaries. Identify whether factory or field assembled.
 - .2 Wiring and schematic diagrams.
 - .3 Dimensions and recommended installation.
 - .4 Pump performance and efficiency curves.

1.2 CLOSEOUT SUBMITTALS

- .1 Provide maintenance data for incorporation into manual specified in Section general requirements
- .2 Data to include:
 - .1 Manufacturers name, type, model year, capacity and serial number.
 - .2 Details of operation, servicing and maintenance.
 - .3 Recommended spare parts list with names and addresses.

Part 2 Products

2.1 DOMESTIC HOT WATER CIRCULATING PUMPS

- .1 Capacity: as indicated on schedule.
- .2 Construction: closed-coupled, in-line centrifugal, all bronze construction, stainless steel shaft, stainless steel or bronze shaft sleeve, two oil lubricated bronze sleeves or ball bearings. Design for 105C continuous service.
- .3 Motor: 124 W (1/6 hp), drip-proof, with thermal overload protection.
- .4 Supports: provide as recommended by manufacturer.
- .5 Acceptable materials:
 - .1 Bell & Gossett Model
 - .2 Armstrong
 - .3 Taco

Part 3 Execution

3.1 INSTALLATION

- .1 Make piping and electrical connections to pump and motor assembly and controls as indicated.
- .2 Ensure pump and motor assembly do not support piping.
- .3 Align vertical pit mounted pump assembly after mounting and securing cover plate.
- .4 Place 150 mm (6") sand under sump pit tank.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 All codes, standards, etc. as referenced shall be the latest edition.
- .2 ASTM A126, Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings.
- .3 ASTM B62, Specification for Composition Bronze or Ounce Metal Castings.
- .4 PDI-WH201, Water Hammer Arresters.
- .5 CAN/CSA-B64 Series, Backflow Preventers and Vacuum Breakers.
- .6 **ANSI/AWWA C700, Cold Water Meters-Displacement Type, Bronze Main Case.**
- .7 **ANSI/AWWA C701, Cold Water Meters-Turbine Type, for Customer Service.**
- .8 **ANSI/AWWA C702, Cold Water Meters-Compound Type.**
- .9 **CSA-B356, Water Pressure Reducing Valves for Domestic Water Supply Systems.**

1.2 SUBMITTALS

- .1 Submit shop drawings and product data in accordance with general requirements.
- .2 For shop drawings, indicate dimensions, construction details and materials.
- .3 For product data, indicate dimensions, construction details and materials for all items specified herein.

1.3 MAINTENANCE DATA

- .1 Provide maintenance data for incorporation into manual specified in general requirements.
- .2 Data to include:
 - .1 Description of plumbing specialties and accessories, giving manufacturers name, type, model, year and capacity.
 - .2 Details of operation, servicing and maintenance.
 - .3 Recommended spare parts list.

-
- | Part 2 | Products |
|---------------|---|
| 2.1 | NON FREEZE WALL HYDRANTS (RECESSED, ENCASED) |
| .1 | Recessed, encased, all bronze construction, anti-syphon, non freeze wall hydrant with non-turning operating rod, free floating compression valve, integral vacuum breaker, self draining, replaceable seat and seat washer. Nickel bronze box and hinged cover with operating key lock. NPS 20 mm (¾") hose outlet. |
| .2 | Acceptable materials: Zurn Z-1300
Mifab MHY-20
Ancon HY-725
Contour C7100 |
| 2.2 | INTERIOR HOSE BIBB |
| .1 | 20 mm (3/4") diameter brass construction, 200 psi, 180°F pressure and temperature limits, complete with hose connection, and wheel handle straight/angle pattern to suit. |
| .2 | Provide vacuum breaker complete with hose connection. |
| .3 | Acceptable manufacturers:
Exposed on wall; Watts BD series
Surface mounted (piping in wall); Watts SC-3 series
Delta
Waltec
Wilkins
Emco |
| 2.3 | WATER HAMMER ARRESTORS |
| .1 | Copper construction, bellows type: to PDI-WH 201. |
| .2 | Acceptable material:
Zurn Z-1700
Mifab MWH-100
Ancon No. 15 |
| 2.4 | BACK FLOW PREVENTORS |
| .1 | The backflow preventor shall prevent backflow by either backpressure or backsiphonage from a cross-connection between potable water lines and substances that are objectionable. |
| .2 | To CAN/CSA-B64. |
| .3 | Application: as indicated. |

- .4 Reduced pressure principle type up to 50 mm (2") (RP):
Rated to 180°F and supplied with full port ball valves. The main body and access covers shall be bronze (ASTM B584), the seat ring and all internal polymers shall be NSF® Listed Noryl™ and the seat disc elastomers shall be SILICONE. The first and second check shall be orientated at a 45° angle up-wards and accessible for maintenance without removing the relief valve. Supplied with an air gap adapter.
- .1 Acceptable materials:
Watts 009 ½" - 2"
Wilkins 975 XL ½" - 2"
Conbraco 40-200 Series
- .5 Reduced pressure principle type from 65 mm (2½") to 250 mm (10") (RP):
The reduced pressure principle backflow preventer shall be ASSE 1013 approved, and supplied with full port gate valves. The main body and access covers shall be epoxy coated cast iron (ASTM A126 Class B), the seat ring and check valve shall be cast bronze (ASTM B584), the stem shall be stainless steel (ASTM A276) and the seat disc elastomers shall be EPDM. The first and second checks shall be accessible for maintenance without removing the relief valve or the entire device from the line.
If installed indoors, the installation shall be supplied with an air gap adapter, strainer, and integral monitor switch.
- .1 Acceptable materials:
Watts 909 2½" - 10"
Wilkins 975 2½"- 10" or 375 4"- 6"
Conbraco 40-200 Series
- .6 Double check valve assembly (DCVA):
The double check type backflow preventer shall be ASSE 1015 approved, and supplied with full port ball valves. The main body and access covers shall be bronze (ASTM B584), the seat rings and all internal polymers shall be NSF® Listed Noryl™ and the seat disc elastomers shall be silicone. The first and second checks shall be accessible for maintenance without removing the device from the line.
- .1 Acceptable materials:
Watts 007 ½"- 2"
Wilkins 950XL ¾ "- 2"
Conbraco 40-100 Series

- .7 Double check valve assembly (DCVA)
The double check backflow preventer shall be ASSE 1015 approved, and supplied with full port gate valves. The main body and access covers shall be epoxy coated cast iron (ASTM A126 Class B), the seat ring and check valve shall be cast bronze (ASTM B584), the stem shall be stainless steel (ASTM A276) and the seat disc elastomers shall be EPDM. The checks shall be accessible for maintenance without removing the device from the line.

- .1 Acceptable materials:
Watts 709 2½" - 10"
Wilkins 950 2" - 10", 350 4" - 6"
Conbraco 40-100 Series

- .8 Back flow preventor with intermediate atmospheric vent:

- .1 Acceptable material:
Watts Series 9D
Wilkins 750
Conbraco 40-4A Series

2.5 VACUUM BREAKERS

- .1 To CAN/CSA-B64 Series.
.2 Atmospheric vacuum breaker (A-VB):
.1 Acceptable materials:
Watts 288A
Conbraco 38-103 Series
Wilkins 35
.3 Hose connection vacuum breaker (HCVB):
.1 Acceptable materials:
Watts Series 8
Conbraco 38-304-AS
Wilkins BFP-8
.4 Laboratory faucet intermediate vacuum breaker (LFVB):
.1 Acceptable materials:
Watts N-LF9
Conbraco 38-502-01

2.6 PRESSURE REGULATORS

- .1 Capacity: as indicated.
.1 Inlet pressure: 1034 kPa (150 psi).
.2 Outlet pressure: 41 kPa (5.9 psi).

- .2 Up to NPS 40 mm (1 1/2") bronze bodies, screwed: to ASTM B62.
 - .1 Acceptable material:
Watts Series 25AUB (1/2" - 2")
- .3 NPS 50 mm (2") and over, semi-steel bodies, Class 125, flanged: to ASTM A126, Class [B].
 - .1 Acceptable materials:
Watts PV-10
Conbraco 36 Series
- .4 Semi-steel spring chambers with bronze trim.
 - .1 Acceptable materials:
Watts PV-10
Conbraco 36 Series

2.7 HOSE BIBBS AND SEDIMENT FAUCETS

- .1 Bronze construction complete with integral back flow preventer, hose thread spout, replaceable composition disc, and chrome plated in finished areas.
 - .1 Acceptable materials:
Watts BD series
Emco
Chicago
Zurn

2.8 WATER MAKE-UP ASSEMBLY

- .1 Complete with backflow preventor, pressure gauge on inlet and outlet, pressure reducing valve to CSA B356, pressure relief valve on low pressure side and gate valves on inlet and outlet.
 - .1 Acceptable materials:
Watts
Conbraco

2.9 STRAINERS

- .1 860 kPa (125 psi), Y type with 20 mm (3/4") mesh, bronze or stainless steel removable screen.
- .2 NPS 50 mm (2") and under, bronze body, screwed ends, with brass cap.
 - .1 Acceptable materials:
Watts Series 777SI
Crane/Powers
Colton 125 YTB
Wilkins S Series

.3 NPS 65 mm (2½") and over, cast iron body, flanged ends, with bolted cap.

- .1 Acceptable materials:
Watts 77F-D (77F-D-FDA for water service)
Crane/Powers
Colton 125 YTB
Wilkins FS Series

2.10 WATER FILTERS

- .1 Five (5) micron filter assembly for taste/odour and dirt/rust.
.2 The unit shall be constructed of molded transparent plastic housing and a bottom pressure relief for cartridge change.
.3 Install as per manufacturer's recommendations
.4 Supply a spare set of cartridges.
.5 Acceptable material:
Aqua Puro AP11B

2.11 SOLENOID VALVES

- .1 Two (2) way normally closed all bronze construction.
.2 Voltage shall be suitable for controlling function.
.3 Acceptable material:
Asco

2.12 MECHANICAL FLOAT VALVE

- .1 Heavy duty mechanical float valve all bronze construction, serrated arm for easy adjustment, lever action, replaceable seals.
.2 Heavy duty, corrosion resistant, plastic float suitable for up to 140°F.
.3 Provide all necessary accessories for complete installation.
.4 Acceptable manufacturers:
Watts Series 500 (1/2"), 750 (3/4") and PX float.
Wilkins
Conbraco

2.13 OWNER SUPPLIED EQUIPMENT

- .1 The mechanical contractor shall supply and install all water, gas, condensate and sanitary piping to the owner supplied equipment. Connection to equipment shall be by this contractor.
.2 Provide flexible riser stops to all sinks and ball valves to all other equipment.
.3 Provide backflow preventors on equipment required by the local plumbing inspector.
.4 Provide flexible gas piping to all gas equipment.

- .5 All equipment in store equipment schedule will be supplied and set in place by Mechanical Contractor unless otherwise noted.
- .6 Coordinate all rough-ins and connection with the supplier on site.
- .7 Owner supplied equipment includes existing relocated equipment.

Part 3	Execution
3.1	INSTALLATION
.1	Install in accordance with provincial codes, and local authority having jurisdiction.
.2	Install in accordance with manufacturer's instructions and as specified.
3.2	NON FREEZE WALL HYDRANTS
.1	Install 600 mm (24") above finished grade unless otherwise indicated.
3.3	NON-FREEZE GROUND HYDRANT
.1	Install with top of box flush with ground and with drainage connection to discharge as indicated.
3.4	WATER HAMMER ARRESTORS
.1	Install on branch supplies to each fixture or group of fixtures and where indicated. (Install at least 4 through the building).
3.5	BACK FLOW PREVENTORS
.1	Install in accordance with CAN/CSA-B64 Series, where indicated and elsewhere as required by code.
.2	Pipe discharge to terminate over nearest drain and or service sink.
.3	Provide test results in manual and leave tag with test results on device.
3.6	HOSE BIBBS AND SEDIMENT FAUCETS
.1	Install at bottom of all risers, at low points to drain systems, and as indicated.
3.7	STRAINERS
.1	Install with sufficient room to remove basket.
.2	Strainer size to match pipe size.
3.8	WATER METERS
.1	Install water meter provided by local water authority coordinated by this contractor .
.2	Install water meter as indicated.

.3 Install remote readout to acceptance of local water authority and as indicated.

.4 Install check meter(s) as indicated.

3.9 WATER MAKE-UP ASSEMBLY

.1 Install with valved bypass.

.2 Pipe discharge from relief valve to nearest floor drain.

3.10 COMMISSIONING

.1 In context of this paragraph, "verify" to include "demonstrate" to Consultant.

.2 Timing: commission only after start-up deficiencies rectified.

.3 Access doors: verify size and location relative to items to be services.

.4 Adjust to suit site conditions, including, but not necessarily limited to, following:

.1 Non-freeze wall, ground hydrants:

.1 Verify complete drainage.

.2 Verify operation of vacuum breaker.

.2 Water hammer arrestors:

.1 Verify accessibility.

.3 Backflow preventors, vacuum breakers:

.1 Verify installation of correct type to suit application.

.2 Adjust as necessary to ensure proper operation.

.3 Verify visibility of discharge.

.4 Pressure regulators:

.1 Adjust settings to suit installed locations, required flow rates.

.5 Hose bibbs, sediment faucets:

.1 Verify operation.

.6 Water make-up assembly:

.1 Verify operation.

.7 Water meters:

.1 Verify operation.

.8 Pipeline strainers:

.1 Verify accessibility of basket.

.2 Clean out during commissioning until system clean.

.5 Commissioning reports:

.1 Record all results on approved report forms.

.2 Include signature of tester and supervisor.

.3 To be countersigned by Consultant.

- .6 Verification:
 - .1 Notify Consultant 48 h before commencing tests.
 - .2 All tests and procedures to be witnessed by Consultant.
 - .3 All reported results subject to verification by consultant.
- .7 Training:
 - .1 Train O&M personnel in start-up, operation, monitoring, servicing, maintenance and shut-down procedures.
- .8 Demonstrations:
 - .1 Demonstrate full compliance with Design Criteria.
 - .2 Demonstrations also to show completeness of O&M personnel training.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 All codes, standards, etc. as referenced shall be the latest edition.
- .2 ASTM A126, Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings.
- .3 ASTM B62, Specification for Composition Bronze or Ounce Metal Castings.
- .4 CAN/CSA-B79, Commercial and Residential Drains and Cleanouts.

1.2 SUBMITTALS

- .1 Submit shop drawings and product data in accordance with general requirements.
- .2 For shop drawings, indicate dimensions, construction details and materials.
- .3 For product data, indicate dimensions, construction details and materials for all items specified herein.

1.3 MAINTENANCE DATA

- .1 Provide maintenance data for incorporation into manual specified in general requirements.
- .2 Data to include:
 - .1 Description of plumbing specialties and accessories, giving manufacturers name, type, model, year and capacity.
 - .2 Details of operation, servicing and maintenance.
 - .3 Recommended spare parts list.

Part 2 Products

2.1 FLOOR DRAINS

- .1 Floor drains and trench drains: to CAN/CSA-B79.

2.2 CLEANOUTS

- .1 Cleanout plugs: heavy cast iron male ferrule with brass screws and threaded brass or bronze plug. Sealing-caulked lead seat or neoprene gasket.
- .2 Wall access: face or wall type, stainless steel round cover with flush head securing screws, bevelled edge frame complete with anchoring lugs.
 - .1 Acceptable material:
 - Zurn ZSS-1469
 - Mifab C1400-RD
 - Ancon CO-480-RD-3
 - Contour C3700RAC

- .3 Floor access: rectangular only to be used, cast iron body and frame with adjustable secured 15 mm ($\frac{1}{2}$ ") thick flush mounted heavy duty nickel bronze top and:
Plugs: bolted bronze with neoprene gasket.
- .1 Cover for unfinished concrete floors: nickel bronze square, gasket, vandal-proof screws.
- .1 Acceptable material:
Zurn ZN-1400 – HD or Zurn ZXN-1612
Mifab C1100-XR-6
Ancon CO-200-RX-1-6
Contour C3000RXNB
- .2 Cover for terrazzo finish: square polished nickel bronze with recessed cover for filling with terrazzo, vandal-proof locking screws.
- .1 Acceptable materials:
Zurn ZN-1400-Z
Mifab C1100-UR-6
Ancon CO-200-U-1-6
Contour C3000RZNB
- .3 Cover for VCT tile and linoleum floors: square polished nickel bronze with 15 mm (1/2") thick flush mounted heavy duty nickel bronze cover, complete with vandal-proof locking screws.
- .1 Acceptable materials:
Zurn ZN-1400-T – HD
Mifab C1100-TS-6
Ancon CO-200-TS-1-6
Contour C3000SYNB
- .4 Cover for ceramic tile floors: 15 mm ($\frac{1}{2}$) thick heavy duty nickel bronze square, cover complete with gasket, vandal-proof screws, for flush finish.
- .1 Acceptable material:
Zurn ZN-1400 – T-HD or Zurn ZXN-1612
Mifab C1100-S-6
Ancon CO-200-S-1-6
Contour C3000SNB
- .5 Cover for carpeted floors: square polished nickel bronze with flush cover, complete with stainless steel carpet marker, vandal-proof locking screws.
- .1 Acceptable materials:
Zurn ZN-1400-HD-CM or ZN-1612-CM
Mifab C1100C-S-1-6
Ancon CO-200-RC-1-6
Smith
Contour C3000RMNB

2.3 BACKWATER VALVES

- .1 Coated extra heavy cast iron body with bronze seat, revolving bronze flapper and threaded cover.
 - .1 Acceptable materials:
 - Zurn Z-1090
 - Mifab BV1200-R
 - Ancon BV200
 - Smith
- .2 Access: Surface access.
 - Access pipe with cover: maximum 300 mm (12") depth.
 - Steel housing with gasketed steel cover.
 - Concrete access pit with cover, as indicated.
 - .1 Acceptable material:
 - Ancon BV-230-R

2.4 TRAP SEAL PRIMERS

- .1 All brass, with integral vacuum breaker, NPS 15 mm (1/2") solder ends, NPS 15 mm (1/2") drip line connection.
- .2 Acceptable materials:
 - Zurn Z-1022
 - Mifab
 - Ancon MS-810
 - Smith

2.5 TRAP SEAL PRIMER STATIONS

- .1 Provide trap primer stations where indicated complete with solenoid valve, backflow preventor, vacuum breaker, NPS 15 mm (1/2") solder ends, NPS 15 mm (1/2") drip line connections.
- .2 Solenoid valve electric characteristics shall be suitable for controlling function.
- .3 Coordinate location and number of trap primer stations with Building Automation System (BAS) contractor.

2.6 SOLENOID VALVES (HEADER TRAP SEAL PRIMER)

- .1 Two (2) way normal closed all bronze construction.
- .2 With integral adjustable cycle time clock control. Timer control to have two dial functions, time between cycles and time held in "open position".
- .3 Suitable for 120V.
- .4 Acceptable material:
 - Asco

- Part 3 Execution**
- 3.1 INSTALLATION**
- .1 All cleanouts and floor drain covers in tiled areas to be square.
 - .2 Install in accordance with provincial codes, and local authority having jurisdiction.
 - .3 Install in accordance with manufacturer's instructions and as specified.
- 3.2 CLEANOUTS**
- .1 In addition to those required by code, and as indicated, install at base of all soil and waste stacks.
 - .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 100 mm (4").
- 3.3 BACKWATER VALVES**
- .1 Install where indicated.
- 3.4 TRAP SEAL PRIMERS**
- .1 Install for all floor, hub and trench drains and elsewhere, as indicated.
 - .2 Install on cold water supply to nearest frequently used plumbing fixture, in concealed space, to approval of Consultant.
 - .3 Install soft copper tubing to floor drains above grade and polyethylene piping to floor drains below grade.
- 3.5 TRAP SEAL PRIMER STATIONS**
- .1 Provide primer stations where indicated.
 - .2 Install for all floor drains and elsewhere, as indicated.
 - .3 Install copper piping to floor drains above grade. Install polypropylene piping to floor drains on grade.
- 3.6 COMMISSIONING**
- .1 In context of this paragraph, "verify" to include "demonstrate" to Consultant.
 - .2 Timing: commission only after start-up deficiencies rectified.
 - .3 Access doors: verify size and location relative to items to be services.
 - .4 Adjust to suit site conditions, including, but not necessarily limited to, following:
 - .1 Floor, hub and trench drains:
 - .1 Verify proper operation of trap primer, flushing features.
 - .2 Verify security and removability of strainers.

- .2 Cleanouts:
 - .1 Verify covers are gastight, secure and easily removable.
 - .2 Verify that cleanout rods can probe as far as next cleanout.
- .3 Backwater valves:
 - .1 Verify accessibility of cover, valve.
- .4 Trap seal primers:
 - .1 Verify operation.
 - .2 Adjust flow rate to suit site conditions.
- .5 Acid dilution devices:
 - .1 Verify operation.
- .5 Commissioning reports:
 - .1 Record all results on approved report forms.
 - .2 Include signature of tester and supervisor.
 - .3 To be countersigned by Consultant.
- .6 Verification:
 - .1 Notify Consultant 48 h before commencing tests.
 - .2 All tests and procedures to be witnessed by Consultant.
 - .3 All reported results subject to verification by consultant.
- .7 Training:
 - .1 Train O&M personnel in start-up, operation, monitoring, servicing, maintenance and shut-down procedures.
- .8 Demonstrations:
 - .1 Demonstrate full compliance with Design Criteria.
 - .2 Demonstrations also to show completeness of O&M personnel training.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 All codes, standards, etc. as referenced shall be the latest edition.
- .2 ASTM B32, Specification for Solder Metal.
- .3 ASTM B306, Specification for Copper Drainage Tube (DWV).
- .4 ASTM C564, Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
- .5 CAN/CSA-B70, Cast Iron Soil Pipe, Fittings and Means of Joining.
- .6 CAN/CSA-B125.3, Plumbing Fittings.

Part 2 Products

2.1 COPPER TUBE AND FITTINGS

- .1 Above ground sanitary, and vent, maximum 65 mm (2½") Type DWV copper to: ASTM B306.
 - .1 Fittings.
 - .1 Cast brass: to CAN/CSA B125.3.
 - .2 Wrought copper: to CAN/CSA B125.3.
 - .2 Solder: tin-lead, 50:50, to ASTM B32, type 50A.

2.2 CAST IRON PIPING AND FITTINGS

- .1 Above ground sanitary, and vent, minimum NPS 80 mm (3"), cast iron to: CAN/CSA-B70.
 - .1 Mechanical joints (vents)
 - .1 Neoprene or butyl rubber compression gaskets: to ASTM C564 or CAN/CSA-B70.
 - .2 Stainless steel clamps (2 band).
 - .2 Mechanical joints (sanitary)
 - .1 Heavy duty neoprene or butyl rubber compression gaskets to: ASTM C1540.
 - .2 Stainless steel clamps (4 band min).

2.3 VENT FLASHINGS

- .1 Thaler or equal spun aluminum complete with insulation, cap, and rubber gasket.

2.4 FORCED MAINS

- .1 Above and below ground sewage pump discharge, size as indicated, type 'L' copper to ASTMB88M.
- .2 Cast copper, solder fitting to ANSI B16.18.
- .3 Cast bronze threaded fittings, class 125 to ANSI/ASME B16.15.

Part 3 Execution

3.1 INSTALLATION

- .1 Install in accordance with Provincial Plumbing Code and local authority having jurisdiction.
- .2 Install above ground piping parallel and close to walls and ceilings to conserve headroom and space, and to grade as indicated.
- .3 Place Cleanouts
 - .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 (50') of horizontal run.
 - .4 Extend clean out to accessible surface. Do not place cleanouts in carpeted floors. In such locations, use wall type cleanouts.
- .4 Each fixture and appliance discharging water into sanitary sewer or building sewer lines shall have a seal trap in connection with a complete venting system so gases pass freely to atmosphere with no pressure or siphon condition on water seal.
- .5 Vent entire waste system to atmosphere.
 - .1 Discharge 500 mm (20") above roof. Join lines together in fewest practicable number before projecting above roof.
 - .2 Set back vent lines so they will not pierce roof near an edge or valley.
 - .3 Do not terminate vents within 3600 mm of any building intake and/or exhaust opening.
 - .4 Provide copper vent piping through roof as per detail.
- .6 Use torque wrench to obtain proper tension in cinch bands when using hubless cast iron pipe. Butt ends of pipe against centering flange of coupling.
- .7 Flash pipes passing through roof with 453 g (16 oz) sheet copper flashing fitted snugly around pipes and caulk between flashing and pipe with flexible waterproof compound.
 - .1 Flashing base shall be at least 600 mm (24") square.
 - .2 Flashing may be a 24 kg/m² (5 lb/ft²) lead flashing fitted around pipes and turned down into pipe 15 mm (½") with turned edge hammered against pipe wall.

- .8 Before piping is covered, conduct tests in presence of Consultant and correct leaks or defective work. Conduct test prior to placing floor slab but after backfill is placed.
 - .1 Do not caulk threaded work.
 - .2 Fill waste and vent system to roof level [a minimum of 3,100 mm - (10')] with water and show no leaks for 2 hours.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 All codes, standards, etc. as referenced shall be the latest edition.
- .2 CSA B51, Boiler, Pressure Vessel, and Pressure Piping Code.

1.2 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with general requirements.
- .2 Indicate:
 - .1 Equipment, including connections, fittings, control assemblies and ancillaries, identifying factory and field assembled.
 - .2 Wiring and schematic diagrams.
 - .3 Dimensions and recommended installation.
 - .4 Pump performance and efficiency curves.

1.3 CLOSEOUT SUBMITTALS

- .1 Provide maintenance and engineering data for incorporation into manual specified in general requirements
- .2 Data to include:
 - .1 Manufacturer's name, type, model year, capacity, and serial number.
 - .2 Details of operation, servicing, and maintenance.
 - .3 Recommended spare parts list with names and addresses.

1.4 MANIFOLD SYSTEM WARRANTY

- .1 Fibreglass mineral tanks 10 years
- .2 Brine Salt Storage tanks 5 years
- .3 Exchange resin 5 years
- .4 Control Valves and Electronics 5 years
- .5 All other Components 5 years

Part 2 Products

2.1 WATER SOFTENER

- .1 To include softener tank, brine tank, brine distribution system, regenerating manifold and control system, ready for piping and wiring connections as indicated. Suitable for 120V/1/60.
- .2 Capacity: 297 kilograins @ 10lb/cf, 55 – 99 gpm @ max. of 25 PSI drop

- .3 Mineral tank: reinforced fibreglass tested to 1 ½ times working pressure or minimum 860 kPa.
- .4 Salt storage tank: moulded plastic, complete with lid.
- .5 Control:
 - .1 Fully automatic: electronic control with backlit display, meter initiated regeneration, and 20 mm MNPT connections.
 - .2 Cycle Controller: NXT 3214
- .6 Acceptable materials:
Canature WaterGroup CW-FAF 330 - 2" T800 Triplex, 3214 NXT
Myers
USF Watergroup

Part 3 Execution

3.1 WATER SOFTENER

- .1 Install in accordance with manufacturer's recommendations and as indicated.
- .2 Provide initial charge of salt, minimum of 80 kg (160 lb).

3.2 START-UP AND TRAINING

- .1 Equipment supplier shall provide raw water testing, programming, and individual start up for each softener column, setting up system operation.
- .2 Equipment supplier shall provide 2 hours of training on equipment to owner's maintenance personnel.

3.3 FIELD QUALITY CONTROL

- .1 Check power supply.
- .2 Check starter protective devices.
- .3 Start up, check for proper and safe operation.
- .4 Demonstrate equipment operation as directed by consultant.
- .5 Demonstrate water softener regeneration controls.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 All codes, standards, etc. as referenced shall be the latest edition.
- .2 ANSI Z21.10.1/CSA 4.1, Gas Water Heaters Volume I, Storage Water Heaters with Inputs Ratings of 75,000 Btuh, or less.
- .3 ANSI Z21.10.3/CSA 4.3, Gas Water Heaters Volume III; Storage Water Heaters with Input Ratings above 75,000 Btuh, circulating and Instantaneous.
- .4 CSA-B149.1, Natural Gas and Propane Installation Code.
- .5 CSA B51, Boiler, Pressure Vessel, and Pressure Piping Code.
- .6 CAN/CSA-B139, Installation Code for Oil Burning Equipment.
- .7 CAN/CSA-B140.0, Oil Burning Equipment: General Requirements.
- .8 CSA B140.12, Oil Burning Equipment: Service Water Heaters for Domestic Hot Water, Space Heating, and Swimming Pools.
- .9 CAN/CSA-C309, Performance Requirements for Glass-Lined Storage Tanks for Household Hot Water Service.

1.2 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with general requirements.
- .2 Indicate:
 - .1 Equipment, including connections, fittings, control assemblies and ancillaries, identifying factory and field assembled.
 - .2 Wiring and schematic diagrams.
 - .3 Dimensions and recommended installation.
 - .4 Pump performance and efficiency curves.

1.3 CLOSEOUT SUBMITTALS

- .1 Provide maintenance and engineering data for incorporation into manual specified in general requirements
- .2 Data to include:
 - .1 Manufacturer's name, type, model year, capacity, and serial number.
 - .2 Details of operation, servicing, and maintenance.
 - .3 Recommended spare parts list with names and addresses.

Part 2 Products

2.1 GAS FIRED HIGH EFFICIENCY WATER HEATER

- .1 To ANSI Z21.10.3/CSA 4.3. Refer to schedule for capacity. Efficiency of 94%.
- .2 Tank: 378 l (100 gal), glass, lined steel, 692 mm (27½") dia x 1739 mm (69½") high fibreglass insulation, enameled steel jacket.
- .3 Gas burner: complete with high limit control, gas valve, gas pressure regulator, 100% safety shut-off, firepower gas burner with air distribution ring, 120V /1/60.
- .4 3 year warranty certificate.
- .5 Vent kit complete with wall vent and vent pipe.
- .6 Provide ULC S636 approved CPVC piping and fittings for combustion and exhaust. Install as per manufacturers recommendations. Support piping at 1.5 m maximum.
- .7 Provide neutralizing cartridge for each hot water tank as supplied by equipment manufacturer.
- .8 Acceptable materials:
A. O. Smith Cyclone
Ruud
Bradford White

2.2 WATER HEATER TRIM AND INSTRUMENTATION

- .1 Drain valve: NPS 25 mm (1") with hose end.
- .2 Thermometer: 100 mm (4") dial type with red pointer and thermowell filled with conductive paste.
- .3 Thermowell filled with conductive paste for control valve temperature sensor.
- .4 ASME rated temperature and pressure relief valve sized for full capacity of heater, having discharge terminating over floor drain and visible to operators.
- .5 Magnesium anodes adequate for 20 years of operation and located for easy replacement.

Part 3 Execution

3.1 WATER HEATER

- .1 Install in accordance with manufacturer's recommendations and authority having jurisdiction.
- .2 Provide structural steel for horizontal (vertical) mounted tanks.
- .3 Provide insulation between tank and supports.
- .4 Provide neutralizing cartridge on each vent drain.

-
- .5 Install oil burning domestic water heaters in accordance with CAN/CSA B139.
 - .6 Install natural gas or propane gas fired domestic water heaters in accordance with CSA-B149.1-00.

3.2 FIELD QUALITY CONTROL

- .1 Manufacturer's factory trained, certified Engineer to start up and commission DHW heaters.
- .2 Check power supply.
- .3 Check starter protective devices.
- .4 Start up, check for proper and safe operation.
- .5 Check settings and operation of all hand-off-auto selector switch, operating, safety and limit controls, audible and visual alarms, over-temperature and other protective devices.
- .6 Demonstrate equipment operation as directed by consultant.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 All codes, standards, etc. as referenced shall be the latest edition.
- .2 CSA B51, Boiler, Pressure Vessel, and Pressure Piping Code.

1.2 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with general requirements.
- .2 Indicate:
 - .1 Equipment, including connections, fittings, control assemblies and ancillaries, identifying factory and field assembled.
 - .2 Wiring and schematic diagrams.
 - .3 Dimensions and recommended installation.
 - .4 Pump performance and efficiency curves.

1.3 CLOSEOUT SUBMITTALS

- .1 Provide maintenance and engineering data for incorporation into manual specified in general requirements
- .2 Data to include:
 - .1 Manufacturer's name, type, model year, capacity, and serial number.
 - .2 Details of operation, servicing, and maintenance.
- .3 Recommended spare parts list with names and addresses.

Part 2 Products

2.1 DOMESTIC HOT WATER EXPANSION TANK

- .1 Pre-charged 6.4 gal (3.2 gal accept volume) hydropneumatic steel expansion tank complete with internal butyl diaphragm.
- .2 Tank construction shall be in accordance with Section VIII of the ASME Boiler and Pressure Vessel Code, with all welds conforming to ASME Section IX. The tank must be stamped with a maximum working pressure of 150 psi and a maximum working temperature of 250°F.
- .3 Tank volume: 24 l (4.5 gallons) with 0.73 acceptance factor.
- .4 Acceptable material:
 - Amtrol ST-12C
 - Well-X-Trol

- 2.2 THERMOSTATIC WATER CONTROLLER (3 Port)**
- .1 1½" inlets 2" outlets thermostatic controller with swivel action check stops, removable cartridge with strainer, stainless steel piston and liquid fill thermal motor with bellows mounted out of water. Volume control shut off valve, bimetal dial thermometer (3" face, range 20° – 240°F), brass pipe, fittings and unions. Standard valve and piping finish is rough bronze.
 - .2 Acceptable materials:
Symmons 7-1000A-ASB-W
Powers
- 2.3 ANCHOR BOLTS AND TEMPLATES**
- .1 Supply for installation by other Divisions.
- 2.4 FLAMMABLE STORAGE CABINET**
- .1 For storage of flammable liquids.
 - .2 Non-vented ULC and FM approved.
 - .3 Capacity: 1150 mm high x 1120 mm wide x 480 mm deep.
 - .4 Install where indicated on drawings.
 - .5 Non-vented storage cabinets shall conform to the Fire Code 4.2.10.6 (1)(A).
 - .6 Acceptable material:
Metric Storage Systems Model 30FM

- Part 3 Execution**
- 3.1 RECIRCULATING PUMP**
- .1 Make piping and electrical connections to pump and motor assembly and controls as indicated.
 - .2 Ensure pump and motor assembly do not support piping.
- 3.2 DOMESTIC HOT WATER EXPANSION TANK**
- .1 Adjust expansion tank pressure to suit system pressure.
 - .2 Provide an expansion tank on the cold water feed to each water heater complete with lockshield type shutoff valve at inlet to tank.
 - .3 Provide an expansion tank at the water entrance.
- 3.3 FIELD QUALITY CONTROL**
- .1 Manufacturer's factory trained, certified Engineer to start up and commission DHW heaters.
 - .2 Check power supply.

-
- .3 Check starter protective devices.
 - .4 Start up, check for proper and safe operation.
 - .5 Check settings and operation of all hand-off-auto selector switch, operating, safety and limit controls, audible and visual alarms, over-temperature and other protective devices.
 - .6 Adjust flow from water-cooled bearings.
 - .7 Adjust impeller shaft stuffing boxes, packing glands.
 - .8 Demonstrate equipment operation as directed by consultant.
 - .9 Demonstrate water softener regeneration controls.

END OF SECTION

Part 1 General

1.1 GENERAL REQUIREMENTS

.1 Conform to Sections of Division 1 and to General Mechanical Requirements Section.

1.2 REFERENCES

.1 All codes, standards, etc. as referenced shall be the latest edition.

.2 Perform work in accordance with the recommendations of and the requirements of:

.1 Local and district bylaws and regulations.

.2 N.F.P.A.14 "Installation of Standpipe and Hose Systems".

.3 The Ontario Building Code.

.4 U.L.C. or Factory Mutual approval for hose, valve and extinguisher requirements.

.5 N.F.P.A.10 "Standard for Portable Fire Extinguishers".

.6 The Ontario Fire Code.

1.3 SUBMITTALS

.1 Submit shop drawings and maintenance data in accordance with general requirements.

1.4 COORDINATION

.1 Confirm fire extinguisher cabinet locations and quantities from both architectural and mechanical drawings and report any discrepancies to consultant prior to bid close.

.2 Coordinate location of cabinet with other trades and provide protection against damage during construction.

Part 2 Products

2.1 MULTI-PURPOSE DRY CHEMICAL EXTINGUISHERS (CLASS ABC)

.1 Stored pressure rechargeable type with hose and shut off nozzle, ULC labelled for A, B and C class protection as indicated. Size of extinguishers shall be as follows:

.1 Kitchen Type 'K' 10 lb 20BC rating

.2 Servery Areas Type 'K' 10 lb 20 BC rating

.3 Mechanical Rooms 10 lb ABC rating

.4 Storage Rooms 10 lb ABC rating

.5 Corridor/Gym/Finished Areas 5 lb ABC rating complete with cabinet

.6 Acceptable materials:

.1 Wilson & Cousins

.2 National

2.2 CABINETS

- .1 Recessed mounted type of a size sufficient to contain all necessary components. Tub to be constructed of 1.5 mm (16 gauge) steel and finished with Wilco "Pro-Tech" Premier white painted finish. Adjustable frame comprising of 180° opening door and trim to be separate assembly adaptable to any type of finished wall. Trim to have 6 mm (1/4") return on outer edges with full length semi-concealed piano hinge, and Corbin style latching device.
- .2 Doors and trim to be 1.5 mm (16 gauge) white painted finish. Door glass to be 6 mm (1/4") Duo Lite Safety Glass.
- .3 Cabinet to maintain fire resistive rating of construction in which they occur.
- .4 Do not provide cabinets for mechanical room and service area fire extinguishers unless indicated.
- .5 Acceptable material:
 - .1 Wilson & Cousins Model IE - 105R (5 and 10 lb. Class)
 - .2 National

2.3 IDENTIFICATION

- .1 Identify extinguishers in accordance with recommendations of NFPA 10.
- .2 Attach tag or label to extinguishers indicating month and year of installation and provide space for the addition of recording service dates.

Part 3 Execution

3.1 INSTALLATION

- .1 Provide portable fire extinguisher cabinets and mount in wall during construction. Cabinet to be surface or recessed mounted as indicated on the drawings. Install cabinets so that the door will not obstruct normal traffic when open.
- .2 Hang extinguishers in cabinets with wall mounting bracket.
- .3 Prior to installing the extinguisher cabinets, confirm the mounting height and exact location with the Consultant. Mount extinguisher so top of unit is not more than 1.5 m (5').
- .4 Install wall mounted fire extinguishers complete with wall mounting bracket where indicated and/or directed on site by consultant.
- .5 Caulk perimeter of fire extinguisher cabinets after acceptance.

3.2 TESTS

- .1 Fire protection equipment shall be tested to the requirements of NFPA10, NFPA13, NFPA14 and comply with the requirements of the authorities having jurisdiction.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 All codes, standards, etc. as referenced shall be the latest edition.
- .2 CAN/CSA B45S1, Supplement #1 to CAN/CSA B-45 Series Plumbing Fixtures.
- .3 CAN/CSA-B45 Series, CSA Standards on Plumbing Fixtures.
- .4 CAN/CSA-B125.3, Plumbing Fittings.
- .5 CAN/CSA-B651, Accessible Design for the Built Environment.

1.2 SHOP DRAWINGS

- .1 Submit shop drawings and product data in accordance with general requirements.
- .2 Indicate, for all fixtures and trim:
 - .1 Dimensions, construction details, roughing-in dimensions.
 - .2 Factory-set water consumption per flush at recommended pressure.
 - .3 For water closets, urinals: minimum pressure required for flushing.

1.3 CLOSEOUT SUBMITTALS

- .1 Provide maintenance data including monitoring requirements for incorporation into manual specified in general requirements.
- .2 Include:
 - .1 Description of fixtures and trim, giving manufacturer's name, type, model, year, capacity.
 - .2 Details of operation, servicing, maintenance.
 - .3 List of recommended spare parts.

1.4 PRODUCTS INSTALLED BUT NOT SUPPLIED UNDER THIS SECTION

- .1 Install rough-in for equipment supplied by others, complete with valves on hot and cold water supplies, waste and vent.
- .2 Equipment installed by others.
 - .1 Connect with unions.
- .3 Equipment not installed.
 - .1 Capped with valves for future connection by others.

Part 2	Products
2.1	MANUFACTURED UNITS
.1	Fixtures: manufacture in accordance with CAN/CSA-B45 series.
.2	Trim, fittings: manufacture in accordance with CAN/CSA-B125.3.
.3	Exposed plumbing brass to be chrome plated.
.4	Number, locations: Architectural drawings to govern.
.5	Fixtures in any one location to be product of one manufacturer and of same type.
.6	Trim in any one location to be product of one manufacturer and of same type.
2.2	Fixture Carriers
.1	Provide factory manufactured floor-mounted carrier systems for all wall-mounted fixtures.
.2	Acceptable materials:
.1	Zurn
.2	Smith
.3	Ancon
2.3	PLUMBING FIXTURES
.1	Refer to plumbing fixture schedule on the drawings for fixture type, manufacturer, trim, drainage supply, and accessories.
2.4	Fixture Piping
.1	Hot and cold water supplies to each fixture/faucet: Chrome plated flexible supply pipes each with screwdriver stop, reducers, escutcheon and chrome plated nipple.
.1	Acceptable materials: .1 Delta 47T900 Series .2 McGuire
.2	Waste: Open grid strainer, or pop up as indicated, offset open grid strainer on Barrier-Free fixtures, cast brass fittings with tubular piping, chrome plated, rubber gasket compression fitting, and overflow flange.
.1	Acceptable materials: .1 Delta 33T200 Series .2 McGuire

.3 'P' Traps:

Cast brass P trap with cleanout on each fixture not having integral trap.

Chrome plated in all exposed places.

.1 Acceptable materials:

.1 Delta 33T300 Series

.2 McQuire

Part 3 Execution

3.1 INSTALLATION

.1 Mounting heights:

.1 Standard: to comply with manufacturer's recommendations unless otherwise indicated or specified. Confirm mounting height(s) with consultant prior to rough-in.

.2 Wall-hung fixtures: measured from finished floor.

.3 Physically Barrier-Free: to comply with most stringent of either NBCC or CAN/CSA B651.

.2 Drinking fountains:

.1 In accordance with CAN/CSA B45S1.

3.2 ADJUSTING

.1 Conform to water conservation requirements specified this section.

.2 Adjustments.

.1 Adjust water flow rate to design flow rates.

.2 Adjust pressure to fixtures to ensure no splashing at maximum pressures.

.3 Adjust flush valves to suit actual site conditions.

.4 Adjust urinal flush timing mechanisms.

.5 Adjust water cooler, drinking fountain flow stream to ensure no spillage.

.6 Automatic flush valves for water closets and urinals: set controls to prevent unnecessary flush cycles during silent hours.

.3 Checks.

.1 Water closets, urinals: flushing action.

.2 Aerators: operation, cleanliness.

.3 Vacuum breakers, backflow preventors: operation under all conditions.

.4 Wash fountains: operation of flow-actuating devices.

.5 Refrigerated water coolers: operation, temperature settings.

- .4 Thermostatic controls.
 - .1 Verify temperature settings, operation of control, limit and safety controls.
- .5 Floor and wall mounted fixtures: caulk to floor or wall using silicone caulking to make water tight, colour to match fixture.
- .6 Counter mounted fixtures: lay fixtures into bead of caulking to ensure excess moisture does not reach the cut edge of the countertop. Clean excess caulking off outside the sink.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 This section must be read in association with the following: Division 1, Mechanical and Electrical General Requirements Sections.

1.2 REFERENCES

- .1 Heaters must conform to CSA 22.2 No.46 (latest edition).

1.3 PRODUCT DATA

- .1 Submit product data in accordance with General Requirements Section.

- .2 Product data to include:

- .1 Suspension of heating element.
- .2 Physical size.
- .3 Thermostat control if integral.
- .4 Finish.
- .5 kW rating, voltage, phase.
- .6 Cabinet thickness.
- .7 Cabinet surface temperature.
- .8 Mounting methods.
- .9 Auxiliary controls.
- .10 Replacement data for motor element, thermostat, and switch.

1.4 OPERATION AND MAINTENANCE DATA

- .1 Provide operation and maintenance data for all heating system components for incorporation into manual as specified in General Requirements Section.

Part 2 Products

2.1 HEAT TRACING CABLE

- .1 The equipment and all related devices specified herein shall be manufactured by Raychem and the product shall be XL-TRACE. All sizes, types and lengths of heat trace shall be as per the drawings. (Any alternates proposed by the Contractor must have the same operating characteristics to those of XL-TRACE).

Products:	5XL-2	Heat Trace
	8XL-2	Heat Trace
	XLK-PC	Power connection and end seal kit
	XLK-SET	Splice, End and Tee Kit

- .2 The self-regulating heat trace shall be a self-regulating polymer core with 2-14AWG tinned copper bus wires embedded in core. The polymer core will allow its resistance to vary - thus regulating its power output for temperature response. The entire heater shall be covered by a radiation cross linked modified polyolefin dielectric jacket.
- .3 The heat trace system shall operate on a 120V system.
- .4 All power connection, end seal, splice, and tee kits shall be installed in the field with a complete inspection performed by a representative of the product company inspecting all installations prior to power up of the system. (Thus preventing any installation from being watertight). An inspection and system approval certificate shall be issued by the Contractor guaranteeing the installations.

2.1 APPROVED MANUFACTURERS

- .1 Approved manufacturers shall be:
 - .1 Chromalox
 - .2 Raychem
 - .3 3M
 - .4 Serge Baril
 - .5 Heron Cable Ind.
 - .6 Easy Heat (Emerson)

Part 3 Execution

3.1 INSTALLATION

- .1 All heat trace cable shall be fastened to the steel pipes with plastic cable ties or fibreglass tape.
- .2 The cable shall run the entire length of each pipe linearly.
- .3 Power connection kits shall be installed in a weatherproof surface mounted junction box (suitable to house the connection kit) in the location shown on the drawings.
- .4 A manufacturer supplied sign reading "electric traced" shall be installed on the outside of the thermal insulation at intervals of 6 m (20 ft) spacing.
- .5 Provide power to the point indicated on the electrical drawing. Where electrical drawings do not indicate connection points, provide a dedicated power panel(s) wired from the main switchboard to all the heaters. All wiring shall be by this contractor to the standards of Electrical Division.

3.2 TESTS

- .1 Following cable installation on pipe, heat trace shall be subject to a test using a 1000V DC MEGGAR prior to and following installation of thermal insulation. Insulation resistance should be 20-1000 MEGA OHMS regardless of length.

3.3 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Electrical General Requirements Section.
- .2 Ensure that heaters and controls operate correctly.
- .3 On fan powered units:
 - .1 Test cut-out protection when air movement is obstructed.
 - .2 Test fan delay switch to assure dissipation of heat after element shut down.
 - .3 Test unit cut-off when fan motor overload protection has operated.
- .4 On heat tracing cable, test operation before concealing with insulation.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 All codes, standards, etc. as referenced shall be the latest edition.
- .2 Canadian General Standards Board (CGSB)
 - .1 ASTM C553, Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
 - .2 CAN/ULC-S702, Mineral Fiber Thermal Insulation for Buildings.
 - .3 ASTM C612, Mineral Fiber Block and Board Thermal Insulation.
 - .4 CGSB 51-GP-52Ma-[89], Vapour Barrier Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
- .3 Underwriters Laboratories of Canada (ULC).
 - .1 CAN/ULC-S102, Surface Burning Characteristics of Building Materials and Assemblies.
- .4 American Society for Testing and Materials (ASTM).
 - .1 ASTM C 335, Test Method for Steady State Heat Transfer Properties of Pipe Insulation.
 - .2 ASTM C 449M, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
 - .3 ASTM B 209M, Specification for Aluminum and Aluminum Alloy Sheet and Plate.
- .5 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE).
 - .1 ASHRAE Standard 90.1.
- .6 Manufacturer's Trade Associations.
 - .1 Thermal Insulation Association of Canada (TIAC): National Insulation Standards.

1.2 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with general requirements.
- .2 Submit for approval manufacturer's catalogue literature related to installation, fabrication for duct jointing recommendations.

1.3 INSTALLATION INSTRUCTIONS

- .1 Submit manufacturer's installation instructions in accordance with general requirements.
- .2 Installation instructions to include procedures to be used, installation standards to be achieved.

1.4 QUALIFICATIONS

- .1 Installer to be specialist in performing work of this section, and have at least 3 years successful experience in this size and type of project, qualified to standards of TIAC.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver materials to site in original factory packaging, labeled with manufacturer's name, address.
- .2 Protect from weather and construction traffic.
- .3 Protect against damage from any source.
- .4 Store at temperatures and conditions required by manufacturer.

1.6 DEFINITIONS

- .1 For purposes of this section:
 - .1 "CONCEALED" - insulated mechanical services and equipment in suspended ceilings and non-accessible chases and furred-in spaces.
 - .2 "EXPOSED" - will mean "not concealed" as defined herein.
- .2 Insulation systems - insulation material, fasteners, jackets, and other accessories.

Part 2 Products

2.1 FIRE AND SMOKE RATING

- .1 In accordance with CAN/ULC S102:
 - .1 Maximum flame spread rating: 25.
 - .2 Maximum smoke developed rating: 50.

2.2 INSULATION

- .1 Mineral fibre as specified herein includes glass fibre, rock wool, slag wool.
- .2 Thermal conductivity ("k" factor) not to exceed specified values at 24°C (75°F) mean temperature when tested in accordance with ASTM C 335.
- .3 Type C-1: Rigid mineral fibre board to ASTM C612, with factory applied vapour retarder jacket to CGSB 51-GP-52Ma:
 - .1 Mineral fibre: to ASTM C553.
 - .2 Jacket: to CGSB 51-GP-52 Ma.
 - .3 Maximum "k" factor: to ASTM C553.
- .4 Type C-2: Mineral fibre blanket to ASTM C553 faced with factory applied vapour retarder jacket to CGSB 51-GP-52Ma:
 - .1 Mineral fibre: to ASTM C553.
 - .2 Jacket: to CGSB 51-GP-52 Ma.
 - .3 Maximum "k" factor: to ASTM C553.

.5 Manufacturers:

.1 All materials must be supplied by the same manufacturer.

.2 Acceptable Materials:

.1 Johns Manville

.2 Fibreglass Canada

.3 Knauf

.4 Manson

.5 Roxul

2.3 JACKETS

.1 Canvas:

.1 220 g/m² (0.0451 lb/ft²) cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C 921.

.2 Lagging adhesive: Compatible with insulation.

.2 Aluminum:

.1 To ASTM B 209 with moisture barrier as scheduled in PART 3 of this section.

.2 Thickness: 0.5 mm (26 gauge) sheet.

.3 Finish: Smooth.

.4 Jacket banding and mechanical seals: 15 mm (1/2") wide, 0.5 mm (26 gauge) thick stainless steel.

.5 Provide exterior silicone sealant on all joints.

.6 **Self-adhesive aluminum jackets are not permitted.**

2.4 ACCESSORIES

.1 Vapour retarder lap adhesive:

.1 Water based, fire retardant type, compatible with insulation.

.2 Indoor Vapour Retarder Finish:

.1 Vinyl emulsion type acrylic, compatible with insulation.

.3 Insulating Cement: hydraulic setting on mineral wool, to ASTM C 449.

.4 ULC Listed Canvas Jacket:

.1 220 g/m² (0.0451 lb/ft²) cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C 921.

.5 Tape: self-adhesive, aluminum, reinforced, 75 mm (3") wide minimum.

.6 Contact adhesive: quick-setting Duro Dyne 1A-22 or equal.

.7 Canvas adhesive: washable.

.8 Tie wire: 1.5 mm (16 gauge) stainless steel.

.9 Facing: 25 mm (1") stainless steel hexagonal wire mesh stitched on one face of insulation

- .10 Fasteners: weld pins, length to suit insulation, with 40 mm (1½") diameter clips.
- .11 **Outdoor Vapour Retarder Mastic:**
 - .1 Vinyl emulsion type acrylic, compatible with insulation.
 - .2 Reinforcing fabric: Fibrous glass, untreated 305 g/m² (0.062 lb/ft²).
- .12 **Banding: 15 mm (1/2") wide, 0.5 mm (26 gauge) thick stainless steel.**

Part 3 Execution

3.1 PRE-INSTALLATION REQUIREMENTS

- .1 Pressure testing of ductwork systems to be complete, witnessed and certified.
- .2 Surfaces to be clean, dry, free from foreign material.

3.2 INSTALLATION

- .1 Install in accordance with TIAC National Standards.
- .2 Apply materials in accordance with manufacturers instructions and this specification.
- .3 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
 - .1 Hangers, supports to be outside vapour retarder jacket.
- .4 Supports, Hangers in accordance with general requirements.
 - .1 Apply high compressive strength insulation where insulation may be compressed by weight of ductwork.
- .5 Fasteners: At 300 mm (12") oc. in horizontal and vertical directions, minimum two rows each side.
- .6 Provide rigid insulation for exposed ductwork.
- .7 **Use two layers with staggered joints when required nominal thickness exceeds 75 mm (3").**

3.3 DUCTWORK INSULATION SCHEDULE

- .1 Insulation types and thickness' conform to following table:

Application	Type	Thickness
Rectangular supply air ducts	C-1	25 mm (1")
Round supply air ducts	C-2	25 mm (1")
Supply, return and exhaust ducts exposed (visible) in space being served	none	
Outdoor air ducts (exterior ductwork)	C-1	80 mm (3")
Outdoor air intake ductwork and plenums	C-1	50 mm (2")
Exhaust plenums dampers and louvres	C-1	25 mm (1")
Interior acoustically lined ducts	none	
Last 1.5m of Exhaust duct	C-1	25 mm (1")
Exterior ductwork	C-1	80 mm (3")

.2 Exposed round ducts 600 mm (24") and larger, smaller sizes where subject to abuse:

.1 Use TIAC code C-1 insulation, scored to suit diameter of duct.

.3 Finishes: Conform to following table:

Application	Rectangular	Round
Indoor, concealed	none	none
Indoor, exposed	Canvas	Canvas
Outdoor, exposed to Precipitation	Aluminum	Aluminum

END OF SECTION

General

1.1 REFERENCES

- .1 All codes, standards, etc. as referenced shall be the latest edition.
- .2 Canadian General Standards Board (CGSB)
 - .1 ASTM C553, Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
 - .2 CAN/ULC-S702, Mineral Fiber Thermal Insulation for Buildings.
 - .3 ASTM C612, Mineral Fiber Block and Board Thermal Insulation.
 - .4 CGSB 51-GP-52Ma, Vapour Barrier Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
- .3 Underwriters Laboratories of Canada (ULC)
 - .1 CAN/ULC-S102, Surface Burning Characteristics of Building Materials and Assemblies.
- .4 American Society for Testing and Materials (ASTM)
 - .1 ASTM B 209M, Specification for Aluminum and Aluminum Alloy Sheet and Plate.
 - .2 ASTM C 335, Test Method for Steady State Heat Transfer Properties of Pipe Insulation.
 - .3 ASTM C 411, Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
 - .4 ASTM C 449M, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
 - .5 ASTM C 795, Specification for Thermal Insulation for Use with Austenitic Stainless Steel.
 - .6 ASTM C 921, Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
- .5 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
 - .1 ASHRAE Standard 90.1.
- .6 Manufacturer's Trade Associations
 - .1 Thermal Insulation Association of Canada (TIAC): National Insulation Standards.

1.2 PRODUCT DATA

- .1 Submit Product Data in accordance general requirements.

- 1.3 SAMPLES SUBMITTALS**
- .1 Submit samples in accordance with general requirements.
 - .2 Submit for approval: complete assembly of each type of insulation system, insulation, coating, and adhesive proposed. Mount sample on 15 mm (1/2") plywood board. Affix typewritten label beneath sample indicating service.

- 1.4 INSTALLATION INSTRUCTIONS**
- .1 Submit manufacturer's installation instructions in accordance with general requirements.
 - .2 Installation instructions to include procedures to be used, installation standards to be achieved.

- 1.5 QUALIFICATIONS**
- .1 Installer to be specialist in performing work of this section, and have at least 3 years successful experience in this size and type of project, qualified to standards of TIAC.

- 1.6 DELIVERY, STORAGE AND HANDLING**
- .1 Deliver materials to site in original factory packaging, labeled with manufacturer's name, address.
 - .2 Protect from weather and construction traffic.
 - .3 Protect against damage from any source.
 - .4 Store at temperatures and conditions required by manufacturer.

Part 2 Products

- 2.1 FIRE AND SMOKE RATING**
- .1 In accordance with CAN/ULC S102:
 - .1 Maximum flame spread rating: 25.
 - .2 Maximum smoke developed rating: 50.
- 2.2 INSULATION**
- .1 Mineral fibre as specified herein includes glass fibre, rock wool, slag wool.
 - .2 Thermal conductivity ("k" factor) not to exceed specified values at 24°C (75°F) mean temperature when tested in accordance with ASTM C 335.
 - .3 TIAC Code A-1: Rigid moulded mineral fibre without factory applied vapour retarder jacket.
 - .1 Mineral fibre: to ASTM C553
 - .2 Maximum "k" factor: to ASTM C553.

- .4 TIAC Code A.2: Rigid moulded calcium silicate in sections and blocks, and with special shapes to suit project requirements.
- .1 Insulation: to ASTM C553.
- .2 Maximum "k" factor: to ASTM C553.
- .3 Design to permit periodic removal and re-installation.

2.3 CEMENT

- .1 Thermal insulating and finish:
- .1 To ASTM C553.
- .2 Hydraulic setting or Air drying on mineral wool, to ASTM C 449.

2.4 JACKETS

- .1 Polyvinyl Chloride (PVC):
- .1 One-piece moulded type [and sheet] to CAN/CGSB-51.53 with pre-formed shapes as required.
- .2 Colours: white
- .3 Minimum service temperatures: -20°C (-4°F).
- .4 Maximum service temperature: 65°C (150°F).
- .5 Moisture vapour transmission: 0.02 perm.
- .6 Fastenings:
- .1 Use solvent weld adhesive compatible with insulation to seal laps and joints.
- .2 Tacks
- .3 Pressure sensitive vinyl tape of matching colour.
- .7 Covering adhesive: Compatible with insulation.

2.5 INSULATION SECUREMENTS

- .1 Tape: Self-adhesive, aluminum, [reinforced], 50 mm (2") wide minimum.
- .2 Contact adhesive: Quick setting.
- .3 Canvas adhesive: Washable.
- .4 Tie wire: 1.5 mm (16 gauge) diameter stainless steel.
- .5 Bands: Stainless steel, 20 mm (3/4") wide, 0.5 mm (26 gauge) thick.
- .6 Facing: 25 mm (1") galvanized steel hexagonal wire mesh on one face of insulation.
- .7 Fasteners: 4 mm (5/32") diameter pins with 40 mm (1½") clips. Length of pin to suit thickness of insulation.

2.6 VAPOUR RETARDER LAP ADHESIVE

- .1 Water based, fire retardant type, compatible with insulation.

2.7 INDOOR VAPOUR RETARDER FINISH

- .1 Vinyl emulsion type acrylic, compatible with insulation.

2.8 OUTDOOR VAPOUR RETARDER MASTIC

- .1 Vinyl emulsion type acrylic, compatible with insulation.
.2 Reinforcing fabric: Fibrous glass, untreated 305 g/m^2 (0.062 lb/ft^2).

Part 3 Execution

3.1 PRE-INSTALLATION REQUIREMENTS

- .1 Pressure testing of equipment and adjacent piping systems to be complete, witnessed and certified.
.2 Surfaces to be clean, dry, free from foreign material.

3.2 INSTALLATION

- .1 Install in accordance with TIAC National Standards
.1 Hot equipment: To TIAC code 1503-H.
.2 Elastomeric Insulation: to remain dry at all times. Overlaps to be to manufacturer instructions. Joints to be tight and sealed properly.
.3 Provide vapour retarder as recommended by manufacturer.
.4 Apply materials in accordance with insulation and equipment manufacturers instructions and this specification.
.5 Use two layers with staggered joints when required nominal wall thickness exceeds 75 mm (3").
.6 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
.1 Hangers, supports to be outside vapour retarder jacket.
.7 Supports, Hangers:
.1 Apply high compressive strength insulation, suitable for service, at oversized saddles and shoes where insulation saddles have not been provided.

3.3 REMOVABLE, PRE-FABRICATED, INSULATION AND ENCLOSURES

- .1 Application: At expansion joints, valves, primary flow measuring elements flanges and unions at equipment.
.2 Installation to permit movement of expansion joint and to permit periodic removal and replacement without damage to adjacent insulation.

3.4 EQUIPMENT INSULATION SCHEDULES

- .1 Includes valves, valve bonnets, strainers, flanges & fittings unless otherwise specified.
- .2 Hot Equipment:
 - .1 TIAC code A-1 or C-1 with mechanical fastenings and bands and 15 mm ($\frac{1}{2}$ ") cement reinforced with one layer of reinforcing mesh.
 - .2 TIAC code C-2 unfaced with bands. and 15 mm (1/2") cement preceded by one layer of reinforcing mesh.
 - .3 Type and Thickness:

ITEM	THICKNESS	TYPE
Hot water heating tanks	25 mm (1")	A1
Heat exchangers	50 mm (2")	A1
Buffer Tanks and Hot Water Glycol Tank	75 mm (3")	A1
- .3 Finishes:
 - .1 Equipment in mechanical rooms: TIAC code CEF/1 with canvas jacket.
 - .2 Equipment elsewhere: TIAC code CEF/2 with canvas jackets.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 All codes, standards, etc. as referenced shall be the latest edition.
- .2 Canadian General Standards Board (CGSB)
 - .1 ASTM C553, Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
 - .2 CGSB 51-GP-52Ma, Vapour Barrier Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
 - .3 CAN/CGSB-51.53, Poly (Vinyl Chloride) Jacketing Sheet, for Insulating Pipes, Vessels and Round Ducts.
- .3 Underwriters Laboratories of Canada (ULC)
 - .1 CAN/ULC-S102, Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
- .4 American Society for Testing and Materials (ASTM)
 - .1 ASTM C 335, Test Method for Steady State Heat Transfer Properties of Pipe Insulation.
 - .2 ASTM C 921, Practice for Determining the Properties Jacketing Materials for Thermal Insulation.
 - .3 ASTM B 209M, Specification for Aluminum and Aluminum Alloy Sheet and Plate.
- .5 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE).
 - .1 ASHRAE Standard 90.1.
- .6 Manufacturer's Trade Associations
 - .1 Thermal Insulation Association of Canada (TIAC): National Insulation Standards.

1.2 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with general requirements.
- .2 Submit for approval manufacturer's catalogue literature related to installation, fabrication for pipe, fittings, valves and jointing recommendations.

1.3 INSTALLATION INSTRUCTIONS

- .1 Submit manufacturer's installation instructions in accordance with general requirements.
- .2 Installation instructions to include procedures to be used, installation standards to be achieved.

1.4 QUALIFICATIONS

- .1 Installer to be specialist in performing work of this section, and have at least 3 years successful experience in this size and type of project, qualified to standards of TIAC.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .2 Protect from weather, construction traffic.
- .3 Protect against damage from any source.
- .4 Store at temperatures and conditions required by manufacturer.

1.6 DEFINITIONS

- .1 For purposes of this section:
- .1 "CONCEALED" - insulated mechanical services in suspended ceilings and non-accessible chases and furred-in spaces.
- .2 "EXPOSED" - will mean "not concealed" as defined herein.

Part 2 Products

2.1 FIRE AND SMOKE RATING

- .1 In accordance with CAN/ULC-S102:
- .1 Maximum flame spread rating: 25.
- .2 Maximum smoke developed rating: 50.

2.2 INSULATION

- .1 Mineral fibre as specified herein includes glass fibre, rock wool, slag wool.
- .2 Thermal conductivity ("k" factor) not to exceed specified values at 24°C (75°F) mean temperature when tested in accordance with ASTM C 335.
- .3 Type A-1: Rigid moulded mineral fibre with factory applied vapour retarder jacket.
- .1 Mineral fibre: to ASTM C553.
- .2 Jacket: to CGSB 51-GP-52 Ma.
- .3 Maximum "k" factor: to ASTM C553.
- .4 Type A-3: Flexible unicellular tubular elastomer.
- .1 Insulation to ASTM C553 with vapour retarder jacket.
- .2 Jacket: to CGSB 51-GP-52 Ma.
- .3 Maximum "k" factor: to ASTM C553.
- .4 To be certified by manufacturer to be free of potential stress corrosion cracking corrodants.

.5 Materials:

- .1 All materials must be supplied by the same manufacturer.
- .2 Acceptable Materials:
 - Fibreglass Canada
 - Knauf
 - Manson
 - Pittsburg Corning

2.3 INSULATION SECUREMENT

- .1 Tape: Self-adhesive, aluminum, reinforced, 50 mm (2") wide minimum.
- .2 Contact adhesive: Quick setting.
- .3 Canvas adhesive: Washable.
- .4 **Tie wire: 1.5mm (16 gauge) diameter stainless steel.**
- .5 **Bands: Stainless steel, 20 mm (3/4") wide, 0.5 mm (26 gauge) thick.**

2.4 CEMENT

- .1 Thermal insulating and finishing cement:
 - .1 To ASTM C553.
 - .2 Hydraulic setting or Air drying on mineral wool, to ASTM C 449M.

2.5 VAPOUR RETARDER LAP ADHESIVE

- .1 Water based, fire retardant type, compatible with insulation.

2.6 INDOOR VAPOUR RETARDER FINISH

- .1 Vinyl emulsion type acrylic, compatible with insulation.

2.7 OUTDOOR VAPOUR RETARDER FINISH

- .1 Vinyl emulsion type acrylic, compatible with insulation.
- .2 Reinforcing fabric: Fibrous glass, untreated 305 g/m² (0.062 lb/ft²).

2.8 JACKETS

- .1 Polyvinyl Chloride (PVC):

- .1 One-piece moulded type [and sheet] to CAN/CGSB-51.53 with pre-formed shapes as required.
- .2 Colours: white.
- .3 Minimum service temperatures: -20°C (-4°F).
- .4 Maximum service temperature: 65°C (150°F).
- .5 Moisture vapour transmission: 0.02 perm.

- .6 Fastenings:
 - .1 Use solvent weld adhesive compatible with insulation to seal laps and joints.
 - .2 Tacks.
 - .3 Pressure sensitive vinyl tape of matching colour.
- .2 Stainless steel:
 - .1 Type: [316].
 - .2 Thickness: 0.25 mm (32 gauge).
 - .3 Finish: Smooth
 - .4 Joining: Longitudinal and circumferential slip joints with 50 mm (2") laps.
 - .5 Fittings: 0.50 mm (26 gauge) thick die-shaped fitting covers with factory-attached protective liner.
 - .6 Metal jacket banding and mechanical seals: stainless steel, 20 mm (3/4") wide, 0.50 mm (26 gauge) thick at 300 mm (12") spacing.

2.9 CAULKING FOR JACKETS

- .1 Caulking: Silicone clear caulking.

Part 3 Execution

3.1 PRE-INSTALLATION REQUIREMENT

- .1 Pressure testing of piping systems and adjacent equipment to be complete, witnessed and certified.
- .2 Surfaces to be clean, dry, free from foreign material.

3.2 INSTALLATION

- .1 Install in accordance with TIAC National Standards.
- .2 Apply materials in accordance with manufacturers' instructions and this specification.
- .3 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
 - .1 Hangers, supports to be outside vapour retarder jacket.
- .4 Supports, Hangers:
 - .1 Apply high compressive strength insulation, suitable for service, at oversized saddles and shoes where insulation saddles have not been provided.
- .5 **Use two layers with staggered joints when required nominal wall thickness exceeds 75 mm (3").**

3.3 REMOVABLE, PRE-FABRICATED, INSULATION AND ENCLOSURES

- .1 Application: At expansion joints, valves, primary flow measuring elements, flanges, and unions at equipment.
- .2 Design: To permit movement of expansion joint and to permit periodic removal and replacement without damage to adjacent insulation.
- .3 Insulation:
 - .1 Insulation, fastenings and finishes: same as system.
 - .2 Jacket: As per adjacent insulation.

3.4 PIPING INSULATION SCHEDULES

- .1 Includes valves, valve bonnets, strainers, flanges and fittings unless otherwise specified.
- .2 Install insulator and jackets to applicable TIAC codes.
- .3 Insulate ends of capped piping with type and thickness indicated for capped service.
- .4 Thickness of insulation to be as listed in following table.
 - .1 Do not insulate exposed runouts to plumbing fixtures, chrome plated piping, valves, fittings.

Application	Type	Pipe sizes through (NPS) and insulation thickness mm ("")				
		to 25 (1")	32 (1¼") 40 (1½")	50 (2") 80 (3")	105 (4") 150 (6")	200 (8") & over
Geothermal Heat Pump Loop (inside south Mech Room)	A-3	25 (1")	25 (1")	25 (1")	25 (1")	25 (1")
Condensate	A-1	40 (1½")	40 (1½")	50 (2")	50 (2")	50 (2")
Hot Water Heating	A-1	40 (1½")	50 (2")	50 (2")	50 (2")	50 (2")
Glycol Heating (including heating from ice plant heat rejection tank)	A-1	40 (1½")	50 (2")	50 (2")	50 (2")	50 (2")
Refrigerant piping	A-3	25 (1")	25 (1")	25 (1")	25 (1")	25 (1")
Cooling Coil cond. Drain	A-1	25 (1")	25(1")	25 (1")	25 (1")	25 (1")

- .5 Finishes: Conform to the following table:

Application	Piping	Valves & Fittings
Exposed indoors	PVC	PVC
Exposed in mech. rooms	PVC	PVC
Concealed indoors	N/A	PVC
Exterior piping	Stainless Steel	Stainless Steel

- .6 Connection: To appropriate TIAC code.
- .7 Finish attachments: SS bands, @ 150 mm (6") oc. seals: closed.

Part 1 General

1.1 REFERENCES

- .1 All codes, standards, etc. as referenced shall be the latest edition.
- .2 Canadian Standards Association (CSA).
 - .1 CSA B51, Boiler, Pressure Vessel, and Pressure Piping Code.
- .3 American Society for Testing and Materials (ASTM).
 - .1 ASTM A47/A47M, Specification for Ferritic Malleable Iron Castings.
 - .2 ASTM A278/A278M, Specification for Gray Iron Castings for Pressure-Containing Parts for Temperatures up to 650°F (350°C).
 - .3 ASTM A516/A516M, Specification for Pressure Vessel Plates, Carbon Steel, for Moderate - and Lower - Temperature Service.
 - .4 ASTM A536, Specification for Ductile Iron Castings.
 - .5 ASTM B62, Specification for Composition Bronze or Ounce Metal Castings.
- .4 American Society of Mechanical Engineers (ASME).
 - .1 ANSI/ASME, Boiler and Pressure Vessels Code (BPVC).

1.2 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with general requirements.
- .2 Indicate on product data expansion tanks, air vents, separators, valves, strainers.

1.3 CLOSEOUT SUBMITTALS

- .1 Submit maintenance data in accordance with general requirements.

Part 2 Products

2.1 CLOSED EXPANSION TANK

- .1 Horizontal expansion tank with threaded pipe connections.
- .2 Size: 600 mm x 1300 mm (24" x 52")
- .3 Construction:
 - .1 ASME code rated welded tank to 860 kPa (125 psi) test pressure of ASTM A516/A516M, pressure vessel carbon steel plate with dished heads galvanized after manufacture.
 - .2 Conform to: ANSI/ASME BPVC, Section VIII and CSA B51, and provincial regulations.
 - .3 Submit certificate of registration as required by [provincial authorities].

- .4 Accessories:
- .1 Expansion pipe connection at bottom.
 - .2 NPS 25 mm (1") drain connection at bottom with drain valve.
 - .3 Vent connection, NPS 25 mm (1"), at top.
 - .4 Relief valve and connection at top, to manufacturer's recommendations.
 - .5 15 mm (1/2") sight glass connections at 1/8 and 7/8 points of height, complete with sight glass, shut-off valves with blowdown and protective guards.
 - .6 Two - 65 mm (2 1/2") inspection tappings on centre line of sides, one near each end.

- .5 Acceptable Manufacturers:

- .1 Bell and Gossett
- .2 Armstrong
- .3 Clemmer

2.2 BLADDER TYPE EXPANSION TANK

- .1 Vertical galvanized steel pressurized bladder type expansion tank.
- .2 Model: 300 L.
- .3 Size: 1330 (52 $\frac{3}{8}$ ") x 600 (24") diameter.
- .4 Working pressure: 860 kPa (125 psi) with ASME stamp and certification.
- .5 Air precharged to 84 kPa (12 psi) (initial fill pressure of system).
- .6 Base mount for vertical installation.

.7 Suitable for glycol services when specified.

- .8 Acceptable materials:

- .1 Amtrol
- .2 Armstrong
- .3 Bell & Gossett

2.3 AIR SEPARATOR BOILER MOUNTED

- .1 Complete with dip tube.
- .2 Working pressure: 860 kPa (125 psi).

2.4 AIR SEPARATOR EXPANSION TANK FITTING

- .1 Complete with adjustable vent tube and built-in manual vent valve.
- .2 Working pressure: 860 kPa (125 psi).

2.5 AIR SEPARATOR IN-LINE

- .1 Size: line size as indicated.

2.6 COMBINATION SEPARATORS STRAINERS

- .1 Steel, tested and stamped in accordance with ANSI/ASME BPVC, for 860 kPa (125 psi) operating pressure, with galvanized steel integral strainer with 5 mm (3/16") perforations, tangential inlet and outlet connections, and internal stainless steel air collector tube.
- .2 Size: to match piping.
- .3 Acceptable material:

To be of the same manufacturer of base mounted pumps.

2.7 COMBINATION LOW PRESSURE RELIEF AND REDUCING VALVE

- .1 Adjustable pressure setting: 206 kPa (30 psi) relief, 55 to 172 kPa (8.0 to 25 psi) reducing.
- .2 Low inlet pressure check valve.
- .3 Removable strainer.

2.8 PIPE LINE STRAINER

- .1 NPS 15 mm to 50 mm (1/2" to 2"): bronze body to ASTM B62, screwed connections.
- .2 NPS 65 mm to 300 mm (2 1/2" to 12"): cast steel body to ASTM A278M, Class 30, flanged connections.
- .3 NPS 50 mm to 300 mm (2" to 12"): T type with malleable iron body to ASTM A47M, grooved ends.
- .4 Blowdown connection: NPS 25 mm (1").
- .5 Screen: stainless steel with 1.19 mm (50 mil) perforations.
- .6 Working pressure: 860 kPa (125 psi).

2.9 SUCTION DIFFUSER

- .1 Body: cast iron with flanged connections.
- .2 Strainer: with built-in, disposable 1.19 mm (50 mil) mesh, low pressure drop screen and NPS 25 mm (1") blowdown connection.
- .3 Permanent magnet particle trap.
- .4 Full length straightening vanes.
- .5 Pressure gauge tappings.
- .6 Adjustable support leg.
- .7 Acceptable manufacturer: To be same as manufacturer of base mounted pumps.

Part 3	Execution
3.1	GENERAL
.1	Install as indicated and to manufacturer's recommendations.
.2	Run drain lines (and blow off connections) to terminate above nearest drain.
.3	Maintain proper clearance to permit service and maintenance.
.4	Should deviations beyond allowable clearances arise, request and follow Consultant's directive.
.5	Check shop drawings for conformance of all tappings for ancillaries and for equipment operating weights.
3.2	STRAINERS
.1	Install in horizontal or down flow lines.
.2	Ensure clearance for removal of basket.
.3	Install ahead of each pump.
.4	Install ahead of each automatic control valve and as indicated.
.5	Strainer size to match pipe size.
3.3	EXPANSION TANKS
.1	Adjust expansion tank pressure to suit design criteria.
.2	Install isolation ball valve and union at inlet to tank.
3.4	PRESSURE SAFETY RELIEF VALVES
.1	Run discharge pipe to terminate above nearest drain.
3.5	SUCTION DIFFUSERS
.1	Install on inlet to pumps.
3.6	AIR SEPARATOR
.1	Provide independent support from structure.
.2	Provide high capacity air vent as indicated.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 HVAC Water Treatment Section.

1.2 REFERENCES

- .1 All codes, standards, etc. as referenced shall be the latest edition.
- .2 Canadian Standards Association (CSA).
- .1 CSA W47.1, Certification of Companies for Fusion Welding of Steel.
- .3 American National Standards Institute (ANSI).
- .1 ANSI/ASME B16.1, Gray Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250 and 800.
- .2 ANSI/ASME B16.3, Malleable-Iron Threaded Fittings, Classes 150 and 300.
- .4 American Society for Testing and Materials (ASTM).
- .1 ASTM A47/A47M, Specification for Ferritic Malleable Iron Castings.
- .2 ASTM A53/A53M, Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded and Seamless.
- .3 ASTM A536, Specification for Ductile Iron Castings.
- .4 ASTM B61, Specification for Steam or Valve Bronze Castings.
- .5 ASTM B62, Specification for Composition Bronze or Ounce Metal Castings.
- .5 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS).
- .1 MSS-SP-67, Butterfly Valves.
- .2 MSS-SP-70, Cast Iron Gate Valves, Flanged and Threaded Ends.
- .3 MSS-SP-71, Cast Iron Swing Check Valves, Flanged and Threaded Ends.
- .4 MSS-SP-80, Bronze Gate, Globe, Angle and Check Valves.
- .5 MSS-SP-85, Cast Iron Globe and Angle Valves, Flanged and Threaded Ends.

1.3 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with general requirements.
- .2 Indicate on manufacturers catalogue literature the following:
- .1 Piping
- .2 Valves
- .3 Accessories

1.4 CLOSEOUT SUBMITTALS

- .1 Provide maintenance data for incorporation into manual specified in general requirements.

Part 2	Products
2.1	PIPE
.1	Steel pipe: to ASTM A53/A53M, Grade B, as follows: .1 NPS 150 mm (6") and smaller: Schedule 40.
.2	Final connection to copper heating elements. .1 Type "L" copper with 95/5 solder joints and dielectric couplings. Maximum length 600 mm (24").
2.2	PIPE JOINTS
.1	NPS 50 mm (2") and under: screwed fittings with pulverized lead paste.
.2	NPS 65 mm (2½") and over: welding fittings and flanges to CSA W47.1.
.3	Flanges: plain or raised face, slip-on.
.4	Flange gaskets: suitable for hydronic heating up to 110°C (220°F).
.5	Pipe thread: taper.
.6	Bolts and nuts: to ANSI B18.2.1 and ANSI/ASME B18.2.2.
2.3	FITTINGS
.1	Screwed fittings: malleable iron, to ANSI/ASME B16.3, Class 150.
.2	Pipe flanges and flanged fittings: .1 Cast iron: to ANSI/ASME B16.1, Class 125. .2 Steel: to ANSI/ASME B16.5.
.3	Butt-welding fittings: steel, to ANSI/ASME B16.9.
.4	Unions: malleable iron, to ASTM A47/A47M and ANSI/ASME B16.3.
2.4	VALVES MANUFACTURERS
.1	All valves shall be of commercial grade and of same manufacturer.
.2	Acceptable Manufacturers: .1 Newman Hattersley Canada Ltd. .2 Jenkins/Crane .3 Milwaukee .4 Toyo .5 Kitz

2.5 VALVES

- .1 Connections:
 - .1 NPS 50 mm (2") and smaller: screwed ends.
 - .2 NPS 65 mm (2 ½") and larger: flanged ends.
- .2 Butterfly valves: Application: Isolating each cell or section of multiple component equipment and where indicated.
 - .1 NPS 65 mm (2 1/2") and over: Flanged ends. Jenkins FIG 2232 ELJ.
- .3 Drain valves: Gate, Class 125, non-rising stem, solid wedge disc, with chain and cap.
- .4 Swing check valves:
 - .1 NPS 50 mm (2") and under:
 - .1 Class 150, swing, with PTFE disc, as specified. Bronze. Jenkins 4475TJ.
 - .2 NPS 65 mm (2 1/2") and over:
 - .1 Flanged or Grooved ends, Bronze trim, Cast Iron: Gate, Globe, Check. Jenkins 587J.
- .5 Ball valves:
 - .1 NPS 80 mm (3") and under:
 - .1 Body and cap: cast high tensile bronze to ASTM B62.
 - .2 Pressure rating: Class 125, 860 kPa (125 psi) steam, WP = 1.4 MPa (203 psi) WOG.
 - .3 Connections:
 - .1 NPS 50 mm (2") and under screwed ends to ANSI B1.20.1 and with hex. shoulders.
 - .2 NPS 65 mm (2 ½") and over flanged ends.
 - .4 Stem: stainless steel tamperproof ball drive.
 - .5 Ball and seat: replaceable stainless steel solid ball and teflon seats.
 - .6 Operator: removable lever handle.
 - .7 Extended handles on chilled water valves.
 - .8 Full port.
 - .9 Jenkins 201SJ.

2.6 BALANCING VALVES

- .1 Size 15 mm (1/2") to 50mm (2"): Bronze body, brass ball, NPT connections and variable orifice.
- .2 Size 65 mm (2 1/2") to larger: Cast iron body, raised flange connections, glove style with brass plug.
- .3 Differential pressure readout ports with internal EPT inserts and check valves, 6 mm (1/4")NPT tapped drain/purge ports, memory stop and calibrated nameplate.

- .4 Acceptable materials:
- .1 Bell & Gossett Circuit Setters
 - .2 Armstrong
 - .3 Taco
 - .4 Tour & Anderson
 - .5 Oventrop
- 2.7 TRIPLE DUTY VALVE**
- .1 Straight pattern, combination check, throttling shut off and calibrated balancing valve, heavy duty cast iron construction with standard 125 psig ANSI flanged connections rated for maximum working pressure of 175 psig at 250°F.
 - .2 Valve shall be fitted with a replaceable bronze disk with EPDM seat insert, stainless steel stem and chatter preventing spring. Valve design shall permit replacing under full system pressure.
 - .3 Valve shall be equipped with brass readout valves (with integral check valves).
 - .1 Acceptable material
 - Bell & Gossett
 - Armstrong
- 2.8 AUTOMATIC AIR VENT**
- .1 Industrial float vent: cast iron body and NPS 15 mm (1/2") connection and rated at 860 kpa (125 psi) working pressure.
 - .2 Float: solid material suitable for 115°C (240°F) working temperature.
 - .3 Plastic vents are not acceptable.
 - .4 Acceptable materials:
 - .1 Maid-O-Mist No. 67
 - .2 Spirax Sarco
- 2.9 PRE-ASSEMBLED COIL KITS**
- .1 Ball valve,strainer/drain assembly: cast brass blowout proof stem, Teflon packing, plated ball, strainer-blowdown. Strainer has 20 mesh stainless steel screen, removable. Assembly has temp/pressure port and extra port/plugged) on top. Rated up to 400 psi (2760 kPa) and 110°C (230°F).
 - .2 Coil hoses: Stainless steel braided exterior, synthetic polymer core hose and stainless ferrules. Rated to 110°C (230°F).
 - .3 Union/Port fitting: Cast brass with EPDM O-ring, complete with side temp/pressure port, manual air vent on top and union fitting. Rated for 400 psi (2760 kPa) and 110°C (230°F).
 - .4 ATC: temperature control valve supplied by BAS contractor and turned over to manufacturer for assembly into coil kit. 2-way or 3-way as indicated.

- .5 Balancing valve: A metal copper alloy body bonnet, stem and restriction cone. EPDM O-ring union seal and seat seal, with plastic handwheel.
Two pressure measuring ports for accurate setting. Handwheel range from 4 turns to 22 turns with locking tamperproof setting. Rated from -20°C to 180°C (-4 to 250°F).
- .6 Bypass (for TCV & coil bypass): Provide additional, 3rd hose and ball valve/union assembly.
- .7 Components to be factory assembled and tested.
- .8 Strainer/ball valve/drain on coil inlet.
Union/Port fitting, ATC, balancing valve on coil outlet.
- .9 Acceptable manufacturer:
 - .1 Victaulic Koil Kit
 - .2 Nexus

Part 3 Execution

3.1 PIPING INSTALLATION

- .1 Installation shall be by a licensed pipe fitter.
- .2 Connect to equipment in accordance with manufacturer's instruction unless otherwise indicated.
- .3 Install concealed pipes close to building structure to keep furring space to minimum. Install to conserve headroom and space. Run exposed piping parallel to walls. Group piping wherever practical.
- .4 Slope piping in direction of drainage and for positive venting.
- .5 Use eccentric reducers at pipe size change installed to provide positive drainage or positive venting.
- .6 Provide clearance for installation of insulation and access for maintenance of equipment, valves and fittings.
- .7 Ream pipes, clean scale and dirt, inside and outside, before and after assembly.
- .8 Assemble piping using fittings manufactured to ANSI standards.
- .9 Saddle type branch fittings may be used on mains if branch line is no larger than half the size of main. Hole saw or drill and ream main to maintain full inside diameter of branch line prior to welding saddle.

3.2 VALVE INSTALLATION

- .1 Install rising stem valves in upright position with stem above horizontal.
- .2 Install butterfly valves on chilled water and condenser water lines only.
- .3 Install gate or ball valves at branch take-offs and to isolate each piece of equipment, and as indicated.

- .4 Install globe valves for balancing and in by-pass around control valves as indicated.
- .5 Provide silent check valves on discharge of pumps and in vertical pipes with downward flow and as indicated.
- .6 Provide swing check valves in horizontal lines as indicated.
- .7 Install chain operators on valves NPS 65 mm (2 1/2") and over where installed more than 2400 mm (96") above floor in Boiler Rooms and Mechanical Equipment Rooms.
- .8 **Provide ball valves for glycol service.**

3.3 AIR VENTS

- .1 Install at high points of systems.
- .2 Install ball valve on automatic air vent inlet.
- .3 Extend vent lines in Mechanical Room with screwdriver stop at 1.8 m AFF.

3.4 CIRCUIT BALANCING VALVES

- .1 Install flow measuring stations and flow balancing valves as indicated and as follows:
 - .1 On return side of all heating devices (convectors, panels, force flows, radiation, coils, etc).
 - .2 On return side of all water or glycol cooling coils.
 - .3 On return side of all reverse return piping loops and/or branch circuits.
- .2 Install to manufacturers requirements.
- .3 Valve size shall be one trade size smaller than piping.
- .4 Refer to Testing Adjusting and Balancing Section for applicable procedures.

3.5 FILLING OF SYSTEM

- .1 Refill system with clean water adding water treatment as specified.
- .2 Co-ordinate filling of system with HVAC water treatment contractor.
- .3 Drain and vent all new and existing piping, radiation, etc for a complete operable system.
- .4 **Refill glycol heating system with 40% propylene glycol solution as specified.**

3.6 TESTING

- .1 Test system in accordance with Mechanical General Requirements Section.
- .2 For glycol systems, retest with propylene glycol to ASTM E202, inhibited, for use in building system after cleaning. Repair any leaking joints, fittings or valves.

3.7 GLYCOL CHARGING

- .1 **Provide mixing tank and positive displacement pump for glycol charging.**
- .2 **Retest for concentration to ASTM E202 after cleaning.**

- .3 Provide report to Consultant.
- .4 Maintain glycol level in storage tank until system is fully charged and has equalized throughout the entire system. Monitor system on bi-weekly basis until system is completely filled. Provide glycol solution as required.

3.8 FLUSHING AND CLEANING

- .1 Procedure:
 - .1 Flushing and cleaning should only take place after successful piping pressure testing.
 - .2 Terminal device (reheat coils, heat pumps, perimeter radiation, etc.), air handling unit coils and their associated control and balancing valves should be bypassed during the preliminary flushing and cleaning process.
 - .3 Instruments such as flow meters, flow metering valves and orifice plates should only be installed after flushing and cleaning.
- .2 Timing:
 - .1 The overall construction schedule identifies piping flushing and cleaning with realistic time allotments.
 - .2 The mechanical contractor is required to provide a detailed report outlining the processes and procedures for flushing and cleaning per piping system at least 4 to 6 weeks in advance of work.
 - .3 As a minimum, at least one piping flushing and cleaning procedure shall be witnessed, by the consultant and/or commissioning agent.
- .3 The mechanical contractor shall utilize a qualified water treatment specialist to supervise the flushing and cleaning process and provide the certified water analysis report certifying that the piping systems are clean.
- .4 Coordinate flushing and cleaning of mechanical systems with HVAC water treatment contractor and HVAC systems commissioning contractor.
- .5 Flush and clean new piping system in presence of Consultant.
- .6 Flush after pressure test for a minimum of 4 hrs.
- .7 Fill system with solution of water and non-foaming, phosphate-free detergent 3% solution by weight. Circulate for minimum of 8 hrs.
- .8 Thoroughly flush all new mechanical systems and equipment with approved cleaning chemicals designed to remove deposition from construction such as pipe dope, oils, loose mill scale and other extraneous materials. Chemicals to inhibit corrosion of various system materials and be safe to handle and use.
- .9 During circulation of cleaning solution, periodically examine and clean filters and screens and monitor changes in pressure drop across equipment.
- .10 Refill system with clean water. Circulate for at least 2 hours. Clean out strainer screens/baskets regularly. Then drain.
- .11 Drainage to include drain valves, dirt pockets, strainers, every low point in system.

- .12 Drain and flush systems until alkalinity of rinse water is equal to make-up water. Refill with clean water treated to prevent scale and corrosion during system operation.
- .13 Re-install strainer screens/baskets only after obtaining Consultant's approval and approval from HVAC water treatment contractor.
- .14 Repeat system drain and flush as often as necessary to have a clean system.
- .15 Disposal of cleaning solutions to be approved by authority having jurisdiction.
- .16 Isolate new piping system from existing system as required for system cleaning.
- .17 After hydronic system is cleaned, refill with clean water and chemical as per chemical supplier treatment.
- .18 After glycol piping system is cleaned, refill with 40% glycol solution.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 All codes, standards, etc. as referenced shall be the latest edition.
- .2 American National Standards Institute (ANSI).
 - .1 ANSI/ASME B16.1, Gray Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250 and 800.
 - .2 ANSI/ASME B16.3, Malleable-Iron Threaded Fittings, Classes 150 and 300.
 - .3 ANSI B18.2.1, Square, Hex, Heavy Hex, and Askew Head Bolts and Hex, Heavy Hex, Hex Flange, Lobed Head, and Lag Screws (Inch Series).
 - .4 ANSI/ASME B18.2.2, Nuts for General Applications: Machine Screw Nuts, Hex, Square, Hex Flange, and Coupling Nuts (Inch Series).
 - .5 ANSI/AWWA C111/A21.11, Rubber Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
- .3 American Society for Testing and Materials (ASTM).
 - .1 ASTM A47/A47M, Specification for Ferritic Malleable Iron Castings.
 - .2 ASTM A53/A53M, Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded and Seamless.
 - .3 ASTM A536, Specification for Ductile Iron Castings.
 - .4 ASTM B61, Specification for Steam or Valve Bronze Castings.
 - .5 ASTM B62, Specification for Composition Bronze or Ounce Metal Castings.
 - .6 ASTM F-1476, Standard Specification for Performance of Gasketed Mechanical Couplings for Use in Piping Applications.
- .4 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS).
 - .1 MSS-SP-67, Butterfly Valves.
 - .2 MSS-SP-70, Cast Iron Gate Valves, Flanged and Threaded Ends.
 - .3 MSS-SP-71, Cast Iron Swing Check Valves, Flanged and Threaded Ends.
 - .4 MSS-SP-80, Bronze Gate, Globe, Angle and Check Valves.
 - .5 MSS-SP-85, Cast Iron Globe and Angle Valves, Flanged and Threaded Ends.

1.2 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with general requirements.
- .2 Indicate on manufacturers' catalogue literature the following:
 - .1 Piping
 - .2 Valves
 - .3 Accessories
 - .4 Grooved joint products shall be shown on drawings and product submittals and shall be specifically identified with the applicable Victaulic style or series number.

1.3 CLOSEOUT SUBMITTALS

- .1 Provide maintenance data for incorporation into manual specified in general requirements.

1.4 APPLICATION

- .1 Hydronic heating over 43°C (110°F).

Part 2 Products

2.1 APPLICATION

- .1 Inside Mechanical Rooms only.

2.2 ACCEPTABLE MATERIALS

- .1 Victaulic.
- .2 No alternates.

2.3 PIPE

- .1 Steel pipe: to ASTM A53/A53M, Grade B, as follows:
 - .1 NPS 150 mm (6") and smaller: Schedule 40.
 - .2 Final connection to copper heating elements.
 - .1 Type "L" copper with 95/5 solder joints and dielectric couplings. Maximum length 600 mm (24").

2.4 PIPE JOINTS

- .1 NPS 50 mm (2") and under: screwed fittings with pulverized lead paste.
- .2 Rolled grooved with Grade E (EPDM) gaskets.

2.5

FITTINGS

- .1 Grooved fittings: ASTM A536, Grade 65-45-12, ductile iron; ASTM A234, Grade WPB, wrought steel; or factory-fabricated from ASTM A53 steel pipe.
- .2 Grooved joint couplings shall consist of two ductile iron housing segments, pressure responsive elastomer gasket, and ASTM A449 zinc-electroplated steel bolts and nuts. Couplings shall comply with ASTM F-1476, Standard Specification for Performance of Gasketed Mechanical Couplings for Use in Piping Applications.
 - .1 Rigid: Couplings shall be Victaulic Style 107N Installation-Ready with angled bolt pad design to provide system rigidity and support and hanging in accordance with ANSI B31.1 and B31.9. Couplings must be installed with Grade EHP (EPDM-HP) gaskets, rated for water service to 120°C (250°F).
 - .2 Flexible: Use in locations where vibration attenuation and stress relief are required. Flexible couplings may be used in lieu of flexible connectors at equipment connections. Three couplings, for each connector, shall be placed in close proximity to the vibration source. Basis of Design: Victaulic Style 177 Installation-Ready, and Style 77.
 - .3 AGS series two-segment couplings with lead-in chamfer on housing key and wide-width FlushSeal gasket. Basis of Design: Victaulic Style W07 (rigid) and Style W77 (flexible).
- .3 Flanges: Victaulic Style 741 / W741.
- .4 Hole Cut Products and Branch Connections:
 - Victaulic Style 920 / 920N Mech. Tee
 - Victaulic Style 923 Vic-Let Outlet
 - Victaulic Style 924 Vic-O-Well Thermometer Outlet

2.6

VALVES

- .1 Connections:
 - .1 NPS 50 mm (2") and smaller: screwed ends.
 - .2 NPS 65 mm (2 ½") and larger: rolled grooved ends.
- .2 Butterfly valves: Application: Isolating each cell or section of multiple component equipment and where indicated. Valve seat shall be pressure responsive in sizes through NPS 300 mm (12"). The stem shall be offset from the disc centerline to provide complete 360-degree circumferential seating.
 - .1 NPS 50 mm (2") to 300 mm (12"): Victaulic Vic 300 MasterSeal
 - .2 NPS 350 mm (14") and over: Victaulic AGS-Vic300
- .3 Drain valves: Gate, Class 125, non-rising stem, solid wedge disc, with chain and cap.

.4 Check valves:

- .1 NPS 50 mm (2") and under:
 - .1 Class 150, swing, with PFTE disc, as specified.
Bronze. Jenkins 4475TJ.
- .2 NPS 65 mm (2 1/2") and over: Victaulic Style 716 Vic – check and AGS W715 for NPS 350 mm (14") and over.

.5 Ball valves:

- .1 NPS 50 mm (2") and under:
 - .1 Body and cap: cast high tensile bronze to ASTM B62.
 - .2 Pressure rating: Class 125, 860 kPa (125 psi) steam, WP = 1.4 MPa (203 psi) WOG.
 - .3 Connections: Screwed ends to ANSI B1.20.1 and with hex. shoulders.
 - .4 Stem: stainless steel tamperproof ball drive.
 - .5 Stem packing nut: external to body.
 - .6 Ball and seat: replaceable stainless steel solid ball and teflon seats.
 - .7 Stem seal: TFE with external packing nut.
 - .8 Operator: removable lever handle.
 - .9 Extended handles on chilled water valves.
 - .10 Full port.
 - .11 Jenkins 201SJ.

.6 Strainers:

- .1 Tee strainers: NPS 40 mm (1½") and over: Victaulic 730/W730 Tee Type Vic-Strainer.
- .2 Wye Strainer: NPS 50 mm (2") and over: Victaulic 732/W732 Wye Type Vic-Strainer.

2.7 PUMP ACCESSORIES

.1 Series 380 Discharge Vibration Pump Drop

Factory assembled grooved end vibration pump discharge drop for pipe sizes 3" through 12" (DN80 though DN300). Orange enamel coated assembly, consisting of a Class 150 flange for pump connection, [base elbow for horizontal pump connection] [straight line with concentric reducer for vertical pump connections], tri-service valve assembly consisting of a spring-actuated check [Venturi-Check] valve and butterfly valve with offset stem for 360-degree circumferential seating, and pipe spool with thermometer and pressure ports. Assembly is installation-ready, with flexible couplings to accommodate vibration attenuation and stress relief. Assembly rated for working pressure to 300-psig (2068-kPa). Standard of Acceptance: Victaulic Series 380.

.2 **Series 381 Suction Vibration Isolation Pump Drop**

Factory assembled grooved end vibration pump suction drop for pipe sizes 3" through 12" (DN80 though DN300). Orange enamel coated assembly, consisting of a suction diffuser with stainless steel basket and diffuser and Class 150 flange for pump connection, butterfly valve with offset stem for 360-degree circumferential seating, and pipe spool with thermometer and/or pressure ports. Assembly is installation-ready, with flexible couplings to accommodate vibration attenuation and stress relief. Assembly rated for working pressure to 300-psig (2068-kPa). Standard of Acceptance: Victaulic Series 381.

.3 **Series 382 Strainer Vibration Isolation Pump Drop**

Factory assembled grooved end vibration pump suction drop for pipe sizes 3" through 12" (DN80 though DN300). Orange enamel coated assembly, consisting of a 90-degree base elbow with Class 150 flange for pump connection, Wye pattern strainer with stainless steel perforated metal basket, butterfly valve with offset stem for 360-degree circumferential seating, and pipe spool(s) with thermometer and/or pressure ports. Assembly is installation-ready, with flexible couplings to accommodate vibration attenuation and stress relief. Assembly rated for working pressure to 300-psig (2068-kPa). Standard of Acceptance: Victaulic Series 382.

2.8 BALANCING VALVES

- .1 Size 15 mm (1/2") to 50mm (2"): DZR Brass (Ametal®) globe type or bronze body, brass ball, NPT connections and variable orifice. Victaulic Series 786 / 787.
- .1 Victaulic Koil-Kits Series 799, 79V, 79A, and 79B may be used at coil connections. The kit shall include a Series 786/787/78K circuit balancing valve or series 76 (where automatic balancing valves are required), Series 78Y Strainer-Ball or Series 78T Union-Ball valve combination, Series 78U Union-Port fitting, and required coil hoses. A Style 793 and/or 794 and/or Pilot R differential pressure controller shall be provided as required. A meter shall be provided by the valve manufacturer that shall remain with the building owner after commissioning.
- .2 Combination balancing and control valve: at mechanical contractor and control contractor agreement, combination balancing/control valves will be accepted: ½" – 2" Victaulic TC on/off, Victaulic Series TM Modulating. For sizes 2-1/2" – 6" Fusion C
- .3 Pressure Independent balancing and control valve (PIBCV) to be provided where required: Victaulic Series TCP/7CP/Fusion P
- .2 Size 65 mm (2 1/2") to larger: Victaulic Tour Anderson Series 788/789.
- .3 Differential pressure readout ports with internal EPT inserts and check valves, 6 mm (¼")NPT tapped drain/purge ports, memory stop and calibrated nameplate.

- .4 Acceptable materials:
 .1 Tour & Anderson
 .2 No alternates.

2.9 AUTOMATIC AIR VENT

- .1 Industrial float vent: cast iron body and NPS 15 mm (1/2") connection and rated at 860 kPa (125 psi) working pressure.
.2 Float: solid material suitable for 115°C (240°F) working temperature.
.3 Plastic vents are not acceptable.
.4 Acceptable materials:
 .1 Maid-O-Mist No. 67
 .2 Spirax Sarco

2.10 SUCTION DIFFUSERS AND TRIPLE DUTY VALVES

- .1 Suction Diffuser: Victaulic Style 731 and W731.
.2 Triple Duty Valve: Victaulic Triple Service Combination.

2.11 EXPANSION JOINTS AND FLEXIBLE CONNECTIONS

- .1 Application: to suit motion.
.2 Minimum length in accordance with manufacturers recommendations to suit offset.
.3 Victaulic Style 150 Mover slip-type expansion joint or Style 155 Expansion Compensators. The expansion joint shall be installed with Style 07 Zero-Flex couplings.

Part 3 Execution

3.1 PIPING INSTALLATION

- .1 Installation shall be by a licensed pipe fitter.
.2 Connect to equipment in accordance with manufacturer's instruction unless otherwise indicated.
.3 Install concealed pipes close to building structure to keep furring space to minimum. Install to conserve headroom and space. Run exposed piping parallel to walls. Group piping wherever practical.
.4 Slope piping in direction of drainage and for positive venting.
.5 Use eccentric reducers at pipe size change installed to provide positive drainage or positive venting.
.6 Provide clearance for installation of insulation and access for maintenance of equipment, valves and fittings.
.7 Ream pipes, clean scale and dirt, inside and outside, before and after assembly.
.8 Assemble piping using fittings manufactured to ANSI standards.

- .9 Saddle type branch fittings may be used on mains if branch line is no larger than half the size of main. Hole saw or drill and ream main to maintain full inside diameter of branch line prior to welding saddle.
- .10 Grooved Joints: Install in accordance with the manufacturer's latest published installation instructions.
 - .1 Pipe ends shall be clean and free from indentations, projections and roll marks in the area from pipe end to (and including) groove.
 - .2 Gasket shall be manufactured by the coupling manufacturer and verified as suitable for the intended service.
 - .3 A manufacturer's factory trained representative shall periodically visit the job site and review the installation for best practices. This shall be at the expense of the installing contractor. The installing Contractor shall correct any identified deficiencies.
 - .4 Victaulic product that has been examined and has not met the visual inspection criteria for proper installation must be corrected and re-examined by Inspection Services prior to the completion of the project. Any Victaulic product that has not been corrected or was not examined will not be considered as part of the successful completion of Inspection Services.
 - .5 Upon completion of the manufacturer's inspection of the installation and any identified corrections, the manufacturer will provide the owner or purchaser with a limited warranty on manufacturer's products.

3.2 PIPE END PREPARATION

- .1 Refer to the latest Victaulic installation instructions.
- .2 Outside diameter of grooved pipe shall not vary more than the tolerance approved. Any internal or external weld bead or seams in the groove area must be ground smooth and flush. The end of the pipe internally must be cleaned of any material that might interfere with or damage the internal roll.
- .3 Pipe surface shall be free from indentations and projections from the end of the pipe to the groove, to provide a leak tight seat for the gasket. All loose paint, scale, dirt, chips, grease and rust must be removed. It is the recommendations of Victaulic that the pipe be square cut.
- .4 Bottom of the groove must be free of loose dirt, chips, rust and scale that may interfere with proper coupling assembly.
- .5 Groove dimensions shall conform to standard roll groove specifications as published by Victaulic.
- .6 Pipe shall be grooved using Victaulic roll grooving system with track enhanced grooving rolls.

3.3 "ZERO-FLEX" COUPLING INSTALLATION

- .1 Refer to the latest Victaulic installation instructions.
- .2 Pipe must be free from indentation, projections, or roll marks on exterior from the end to the groove, to assure a leak tight seat for the gasket.

- .3 Gasket supplied must be checked to be certain it is suited for intended service. Colour code identifies gasket grade. Apply a thin coat of Victaulic Lubricant to gasket lips and outside of gasket.
- .4 Place gasket over pipe end, being sure lip does not overhang pipe end.
- .5 Align and bring two pipe ends together and slide gasket into position centered between the grooves on each pipe. No portion of the gasket shall extend into the groove on either pipe.
- .6 Loosely assemble all segments leaving one nut and bolt off to allow for "swing-over" feature.
- .7 With one nut and one bolt removed, use "swing-over" feature to position housings over gasket and into position into the grooves on both pipes.
- .8 Remaining bolt shall be inserted. Bolt track head must engage into housing recess.
- .9 Nuts shall be tightened alternately and equally and must maintain metal-to-metal contact at the angle bolt-pads. Tighten securely to assure a rigid joint.

3.4 "REDUCING" COUPLING INSTALLATION

- .1 Refer to the latest Victaulic installation instructions.
- .2 Pipe must be free from indentation, projections, or roll marks on exterior from the end to the groove, to assure a leak tight seat for the gasket.
- .3 Gasket supplied must be checked to be certain it is suited for intended service. Colour code identifies gasket grade. Gasket must be thoroughly lubricated.
- .4 Place large opening of the gasket over the larger pipe ends until the Assembly Washer touches the pipe end.
- .5 Align the pipe centerlines and insert the smaller pipe end in the gasket. Assembly washer provided by Victaulic shall be used.
- .6 Coupling housings shall be positioned over the gasket into the groove on each pipe.
- .7 Insert bolts and apply nuts.
- .8 Nuts must be tightened alternately and equal until housing bolt pads are firmly together – metal-to-metal.

3.5 "OUTLET" COUPLING INSTALLATION

- .1 Refer to the latest Victaulic installation instructions.
- .2 Pipe must be free from indentation, projections, or roll marks on exterior from the end to the groove, to assure a leak tight seat for the gasket.
- .3 Gasket supplied must be checked to be certain it is suited for intended service. Colour code identifies gasket grade. Gasket must be thoroughly lubricated.
- .4 Gasket shall be placed on one pipe end so the lips on one side cover the area between the pipe end and the groove. The gasket must not overlap the groove. The pipe ends shall be d to touch the reinforcement ribs inside the gasket.

- .5 Bring mating pipe or fitting into position and insert into gasket. The gasket shall not overlap the groove, but fully cover the pipe end.
- .6 Housings shall be placed over the gasket and the housing keys must engage into the grooves. Ample lubricant shall be applied to the gasket outlet neck and the upper housing interior.
- .7 Insert bolts and apply nuts.
- .8 Nuts must be tightened alternately and equally until housing bolt pads are firmly together – metal-to-metal.

3.6 VICTAULIC "FLANGE ADAPTOR" INSTALLATION

- .1 Refer to the latest Victaulic installation instructions.
- .2 Pipe must be free from indentation, projections, or roll marks on exterior from the end to the groove, to assure a leak tight seat for the gasket.
- .3 Gasket supplied must be checked to be certain it is suited for intended service. Colour code identifies gasket grade.
- .4 Victaulic Flange adaptor shall be opened fully and hinged flange shall be placed around the grooved pipe end with the circular key section locating into the groove.
- .5 Standard bolt shall inserted through the mating holes of the Vic-Flange adaptor to secure firmly in the groove.
- .6 Gasket shall be fully lubricated and pressed into the cavity between the pipe O.D. and flange recess.
- .7 Standard flange bolt shall be place in the hinge hole (opposite the lock bolt) and the bolt assembly shall be directed to mate with the adjoining flange. Remaining flange bolts shall be added and tightened evenly until faces contact firmly.
- .8 Where Vic-Flange adaptors do not mate to a hard smooth surface, Victaulic Flange Washers must be used.

3.7 MECHANICAL-T OUTLET INSTALLATION

- .1 Refer to the latest Victaulic installation instructions.
- .2 Holes must be drilled.
- .3 Gasket supplied must be checked to be certain it is suited for intended service. Colour code identifies gasket grade.
- .4 In preparation for assembly, one nut and bolt shall be removed from the housing. The other nut and bolt shall be loosened until it is flush with the nut and bolt. Remove the tape and lift the gasket from the mechanical-T outlet.
- .5 Victaulic lubricant shall be applied to all surfaces of the gasket and the gasket shall be properly repositioned into the housing using alignment tabs.
- .6 When assembling the coupling, the lower housing shall be rotated 90 degrees away from the upper housing. Place the upper, or outlet section on to the face of the pipe in line with the outlet hole. The lower section shall then be rotated around the pipe to close the two halves. The locating collar must be in the outlet hole.

- .7 Insert bolt and apply nut. Oval neck must engage in recess of the housing.
- .8 Nuts shall be tightened alternately and equally until the housing is in complete surface contact in the gasket pocket area and the assembly is rigid.
- .9 Where mechanical-T are used as transition pieces between two runs, they must be assembled onto the runs before the branch connections are made.

3.8 VIC-LET STRAPLESS OUTLET & VIC-O-WELL STRAPLESS THERMOMETER & PRESSURE GAUGE INSTALLATION

- .1 Refer to the latest Victaulic installation instructions.
- .2 Holes must be drilled.
- .3 Do not use for branch piping connections where size may not be available. Use first available size and reducer.
- .4 Gasket supplied must be checked to be certain it is suited for intended service. Colour code identifies gasket grade. Victaulic lubricant shall be applied to exposed gasket sealing lip.
- .5 Vic-Let outlet toe shall align with pipe. Tilt toe into the hole and drop into the pipe. The Vic-Let outlet must be positioned with the heel inside the pipe.
- .6 Collar shall be held in position while nut is being hand tightened. Nut shall then be wrench tightened until collar deforms to contact pipe all around. Maintain collar/gasket alignment to prevent gasket pinching. Do not exceed 200 ft.lbs. Vic-Let outlet shall not be reused after initial installation.

3.9 ROUST-A-BOUT PLAIN END PIPE COUPLING INSTALLATION

- .1 Refer to the latest Victaulic installation instructions.
- .2 Pipe shall be marked as required.
- .3 Gasket supplied must be checked to be certain it is suited for intended service. Colour code identifies gasket grade. Apply a thin coat of Victaulic Lubricant to gasket lips and outside of gasket.
- .4 Place gasket over pipe end, being sure lip does not overhang pipe end.
- .5 The pipe shall be butt and held in position while slide the gasket back into position. The gasket must be centered between the marks.
- .6 Housings shall be placed over the gasket.
- .7 Insert bolts and apply nuts.
- .8 Nuts must be tightened alternately and equally to standard torque specifications as published by Victaulic. Segments must be assembled with equal gaps between the bolt pads.

3.10 VALVE INSTALLATION

- .1 Install valves in upright position with stem above horizontal.
- .2 Install butterfly valves on chilled water and condenser water lines only.
- .3 Install butterfly or ball valves at branch take-offs and to isolate each piece of equipment, and as indicated.

- .4 Install globe valves for balancing and in by-pass around control valves as indicated.
- .5 Provide silent check valves on discharge of pumps and in vertical pipes with downward flow and as indicated.
- .6 Provide swing check valves in horizontal lines as indicated.
- .7 Install chain operators on valves NPS 65 mm (2 1/2") and over where installed more than 2400 mm (96") above floor in Boiler Rooms and Mechanical Equipment Rooms.
- .8 Provide ball valves for glycol service.

3.11 AIR VENTS

- .1 Install at high points of systems.
- .2 Install isolating ball valve on automatic air vent inlet.

3.12 CIRCUIT BALANCING VALVES

- .1 Install flow measuring stations and flow balancing valves as indicated.
 - .1 On return side of all heating devices (convectors, panels, force flows, radiation, coils, etc).
 - .2 On return side of all water or glycol cooling coils.
 - .3 On return side of all reverse return piping loops and/or branch circuits.
- .2 Install to manufacturers requirements.
- .3 Tape joints in prefabricated insulation on valves installed in chilled water mains.
- .4 Refer to Testing Adjusting and Balancing Section for applicable procedures.

3.13 FLUSHING AND CLEANING

- .1 Coordinate flushing and cleaning of mechanical systems with HVAC water treatment contractor **and HVAC systems commissioning contractor**.
- .2 Flush and clean **new** piping system in presence of Consultant.
- .3 Flush after pressure test for a minimum of 4 hrs.
- .4 Fill system with solution of water and non-foaming, phosphate-free detergent 3% solution by weight. Circulate for minimum of 8 hrs.
- .5 Thoroughly flush all new mechanical systems and equipment with approved cleaning chemicals designed to remove deposition from construction such as pipe dope, oils, loose mill scale and other extraneous materials. Chemicals to inhibit corrosion of various system materials and be safe to handle and use.
- .6 During circulation of cleaning solution, periodically examine and clean filters and screens and monitor changes in pressure drop across equipment.
- .7 Refill system with clean water. Circulate for at least 2 hours. Clean out strainer screens/baskets regularly. Then drain.
- .8 Drainage to include drain valves, dirt pockets, strainers, every low point in system.

- .9 Drain and flush systems until alkalinity of rinse water is equal to make-up water.
Refill with clean water treated to prevent scale and corrosion during system operation.
- .10 Re-install strainer screens/baskets only after obtaining Consultant's approval and approval from HVAC water treatment contractor.
- .11 Repeat system drain and flush as often as necessary to have a clean system.
- .12 Disposal of cleaning solutions to be approved by authority having jurisdiction.
- .13 Isolate new piping system from existing system as required for system cleaning.

3.14 FILLING OF SYSTEM

- .1 Fill glycol system with 40% propylene glycol as specified elsewhere.

3.15 TESTING

- .1 Test system in accordance with Mechanical General Requirements Section.
- .2 For glycol systems, retest with propylene glycol to ASTM E202, inhibited, for use in building system after cleaning. Repair any leaking joints, fittings or valves.

3.16 GLYCOL CHARGING

- .1 Provide mixing tank and positive displacement pump for glycol charging.
- .2 Retest for concentration to ASTM E202 after cleaning.
- .3 Provide report to Consultant.
- .4 Maintain glycol level in storage tank until system is fully charged and has equalized throughout the entire system. Monitor system on bi-weekly basis until system is completely filled.

END OF SECTION

Part 1 General

1.1 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with General Requirements.
- .2 Submit manufacturer's detailed composite wiring diagrams for control systems showing factory installed wiring and equipment on packaged equipment or required for controlling devices or ancillaries, accessories and controllers.
- .3 Submit product data of pump curves for review showing point of operation.
- .4 Indicate piping, valves and fittings shipped loose by packaged equipment supplier, showing their final location in field assembly.

1.2 MAINTENANCE DATA

- .1 Provide maintenance data for incorporation into manual specified in general requirements.

Part 2 Products

2.1 VERTICAL IN-LINE CIRCULATORS

- .1 Volute: cast iron radially split, with tapped openings for venting, draining and gauge connections, with screwed or flanged suction and discharge connections.
- .2 Impeller: brass or bronze.
- .3 Shaft: stainless steel with bronze sleeve bearing, integral thrust collar.
- .4 Seal assembly: mechanical for service to 135°C (275°F).
- .5 Coupling: flexible self-aligning.
- .6 Motor: resilient mounted, drip proof, sleeve bearing, as indicated
- .7 Capacity: as indicated.
- .8 Design pressure: 1200 kPa (175 psi).
- .9 Acceptable material:
 - .1 Bell & Gossett Model
 - .2 Armstrong
 - .3 Darling

2.2 SINGLE SUCTION CENTRIFUGAL PUMP

- .1 General: bronze fitted all iron pump complete with motor.
- .2 Base: common fabricated steel with drip rim and tapping for drain connection.
- .3 Volute: cast iron radially split, end suction, flanged suction and discharge, with drain plug and vent cock, suction and discharge pressure gauge tappings.

- .4 Impeller: bronze type, keyed drive with locking nut or screw.
- .5 Shaft: stainless steel with two point support,
- .6 Seal assembly: mechanical seal, oil lubricated.
- .7 Coupling: flexible self-aligning complete with guard.
- .8 Motor: EEMAC Class B, squirrel cage induction, continuous duty, drip proof, ball bearing, TEFC, maximum temperature rise 50°C (90°F) as indicated.
- .9 Inlet suction guide with strainers and triple duty valve.
- .10 Capacity: as indicated.
- .11 Design pressure: 1200 kPa (175 psi).
- .12 Acceptable material:
 - .1 Bell & Gossett
 - .2 Armstrong

2.3 TRIPLE DUTY VALVES

- .1 Body: Cast iron with flanged connections. Straight pattern combination shut off, non slam check and calibrated balance valve.
- .2 Brass seat, bronze disk with EPDM seat insert.
- .3 Brass stem, stainless steel spring, teflon-graphite packing.
- .4 Brass readout valve.
- .5 Acceptable material:
 - .1 To match pump supplier.

2.4 SUCTION DIFFUSER

- .1 Body: cast iron with flanged connections.
- .2 Strainer: with built-in, disposable 1.19 mm (3/64") mesh, low pressure drop screen and NPS 25 mm (1") blowdown connection.
- .3 Permanent magnet particle trap.
- .4 Full length straightening vanes.
- .5 Pressure gauge tappings.
- .6 Adjustable support leg.
- .7 Acceptable Material:
 - .1 To match pump supplier.

2.5 VERTICAL DUAL ARM IN-LINE CIRCULATORS

- .1 Volute: cast iron radially split, with tapped openings for venting, draining and gauge connections, with screwed or flanged suction and discharge connections.
- .2 Impeller: brass or bronze.

- .3 Shaft: stainless steel with bronze sleeve bearing, integral thrust collar.
- .4 Seal assembly: mechanical for service to 135°C (275°F).
- .5 Coupling: flexible self-aligning.
- .6 Motor: two motors, resilient mounted, drip proof, sleeve bearing, as indicated
- .7 Capacity: as indicated.
- .8 Design pressure: 1200 kPa (175 psi).
- .9 Provide flush line, flow gauge and filter.
- .10 Acceptable material:
 - .1 Armstrong
 - .2 Bell & Gossett Model

Part 3 Execution

3.1 INSTALLATION

- .1 In line circulators: install as indicated by flow arrows. Support at inlet and outlet flanges or unions. Install with bearing lubrication points accessible suction discharge in vertical alignment.
- .2 Base mounted type: supply templates for anchor bolt placement. Furnish anchor bolts with sleeves. Place level, shim unit and grout. Align coupling in accordance with manufacturer's recommended tolerance. Check oil level and lubricate. After run-in, tighten glands.
- .3 Ensure that pump body does not support piping or equipment. Provide stanchions or hangers for this purpose. Refer to manufacturer's installation instructions for details.
- .4 Pipe drain tapping to floor drain complete with isolating valve.
- .5 Install volute venting pet cock in accessible location.
- .6 Check rotation prior to start-up.
- .7 Install pressure gauge with plug cocks on inlet and outlet on pump.

3.2 TRIPLE DUTY VALVES

- .1 Valves shall be straight pattern.
- .2 Provide 4x pipe diameter spool piece between pump discharge and triple duty valve.
- .3 Leave valves open for T.A.B to set.

3.3 SUCTION DIFFUSER

- .1 Body: cast iron with flanged connections.
- .2 Strainer: with built-in, disposable 1.19 mm (3/64") mesh, low pressure drop screen and NPS 25 mm (1") blowdown connection complete with valve and hose end.
- .3 Permanent magnet particle trap.

- .4 Full length straightening vanes.
- .5 Pressure gauge tappings.
- .6 Adjustable support leg.
- .7 Remove construction screen from inlet suction guide after system cleaned and before balancing.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Plumbing Specialties and Accessories.
- .2 Hydronic Systems – Steel.

1.2 REFERENCES

- .1 All codes, standards, etc. as referenced shall be the latest edition.
- .2 American Society of Mechanical Engineers (ASME).
- .3 ANSI/ASME Boiler and Pressure Vessel Code, Section VI.

1.3 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with general requirements.

1.4 CLOSEOUT SUBMITTALS

- .1 Submit operation and maintenance data for incorporation into manual specified in general requirements
- .2 Include following:
 - .1 Log sheets as recommended by manufacturer.
 - .2 Test reports.

Part 2 Products

2.1 MANUFACTURER

- .1 Equipment, chemicals, service by one supplier.
- .2 Acceptable manufacturer:
 - .1 Chem Aqua
 - .2 D.H. Jutzi Limited
 - .3 Magnus Chmeicals

2.2 POT FEEDER

- .1 Welded steel, pressure rating 1200 kPa (175 psi). Temperature rating: 90°C (194°F).

2.3 CHEMICAL FEED PIPING

- .1 Resistant to chemicals employed. Pressure rating: 1200 kPa (175 psi).

-
- 2.4 SHIPPING/ FEEDING CHEMICAL CONTAINERS**
 - .1 High density moulded polyethylene, with liquid level graduations, cover.
 - .2 Agitators: as required by manufacturer.
 - 2.5 WATER TREATMENT FOR HYDRONIC HEATING SYSTEMS**
 - .1 Hot water heating system: Pot feeder, 25 l (6.6 gal) or 19 l (5 gal).
 - .2 Micron filter for each pot feeder:
 - .1 Capacity 2% of pump recirculating rate at operating pressure.
 - .2 Six (6) sets of filter cartridges for each type, size of micron filter.
 - .3 Balancing valve set for 2% pump capacity.
 - 2.6 CHEMICALS**
 - .1 Provide 1 year's supply.
 - 2.7 TEST EQUIPMENT**
 - .1 Provide one set of test equipment for each system to verify performance.
 - .2 Complete with carrying case, reagents for chemicals, all specialized or supplementary equipment.
 - 2.8 CLEANING CHEMICALS**
 - .1 Provide as required to make system clean.
 - .2 Cleaner chemical: compatible and of the same manufacturer of the water treatment supplier.
 - 2.9 RECORD MANAGEMENT**
 - .1 Provide cards and card holder mounted on wall adjacent to each pot feeder.
 - Part 3 Execution**
 - 3.1 INSTALLATION**
 - .1 Install HVAC water treatment systems in accordance with ASME Boiler Code Section VII, and requirements and standards of authorities having jurisdiction, except where specified otherwise.
 - .2 Ensure adequate clearances to permit performance of servicing and maintenance of equipment.
 - 3.2 CHEMICAL FEED PIPING**
 - .1 Install crosses at all changes in direction. Install plugs in all unused connections.

3.3 WATER TREATMENT SERVICES

- .1 After system is cleaned as specified elsewhere, provide monthly water treatment monitoring and consulting services for period of one year after system start-up. Service to include:
 - .1 Initial water analysis and treatment recommendations.
 - .2 System start-up assistance.
 - .3 On site system testing and recording of treated hydronic system.
 - .4 Operating staff training.
 - .5 Visit plant every 7 days during period of operation and as required until system stabilizes, and advise on treatment system performance.
 - .6 Provide monthly visits with reports after system has stabilized to the satisfaction of the owner.
 - .7 Provide necessary recording charts and log sheets for one year operation.
 - .8 Provide necessary laboratory and technical assistance.
 - .9 Instructions and advice to operating staff to be clear, concise and in writing.

3.4 START-UP

- .1 Start up water treatment systems in accordance with manufacturer's instructions.

3.5 SYSTEM COMMISSIONING AND TRAINING

- .1 Commissioning and training shall be provided by installing water treatment sub-contractor and water treatment supplier.
- .2 Timing:
 - .1 After start-up deficiencies rectified.
 - .2 After start-up and before TAB of connected systems.
- .3 Pre-commissioning Inspections:
 - .1 Verify:
 - .1 Presence of test equipment, reagents, chemicals, details of specific tests to be performed, operating instructions.
 - .2 Suitability of log book.
 - .3 Currency and accuracy of initial water analysis.
 - .4 Required quality of treated water.
- .4 Commissioning procedures - applicable to all Water Treatment Systems:
 - .1 Establish, adjust as necessary and record all automatic controls and chemical feed rates.
 - .2 Monitor performance continuously during commissioning of all connected systems and until acceptance of project.
 - .3 Establish test intervals, regeneration intervals.

- .4 Record on approved report forms all commissioning procedures, test procedures, dates, times, quantities of chemicals added, raw water analysis, treated water analysis, test results, instrument readings, adjustments made, results obtained.
 - .5 Establish, monitor and adjust automatic controls and chemical feed rates as necessary.
 - .6 Visit project at monthly intervals after commissioning is satisfactorily completed to verify that performance remains as set during commissioning (more often as required until system stabilizes at required level of performance).
 - .1 Advise Engineer in writing on all matters regarding installed water treatment systems.
 - .2 Commissioning procedures - Closed Circuit Hydronic Systems:
 - .1 Analyse water in system.
 - .2 Based upon an assumed rate of loss approved by Engineer, establish rate of chemical feed.
 - .3 Record types, quantities of chemicals applied.
 - .4 Provide written verification of glycol solution concentration.
 - .3 Training:
 - .1 Commission systems, perform tests in presence of, and using assistance of, assigned O&M personnel.
 - .2 Train O&M personnel in softener regeneration procedures.
 - .4 Certificates:
 - .1 Upon completion, furnish certificates confirming satisfactory installation and performance.
 - .5 Commissioning Reports:
 - .1 To include system schematics, test results, test certificates, raw and treated water analyses, design criteria, all other data required by Consultant.
 - .6 Commissioning activities during Warranty Period:
 - .1 Check out water treatment systems on regular basis and submit written report to Consultant.
- 3.6 CLEANING OF MECHANICAL SYSTEM**
- .1 Coordinate cleaning of mechanical systems with mechanical contractor.
 - .2 Provide copy of recommended cleaning procedures and chemicals for approval by Consultant.

END OF SECTION

Part 1 General**1.1 REFERENCES**

- .1 All codes, standards, etc. as referenced shall be the latest edition.
- .2 SMACNA HVAC Duct Construction Standards, Metal and Flexible.
- .3 SMACNA HVAC Duct Leakage Test Manual.
- .4 ASTM A480/A480M, Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet and Strip.
- .5 ASTM A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process. (Metric).
- .6 ANSI/NFPA 90A, Installation of Air Conditioning and Ventilating Systems.
- .7 ANSI/NFPA 90B, Installation of Warm Air Heating and Air Conditioning Systems.
- .8 **ANSI/NFPA 96, Ventilation Control and Fire Protection of Commercial Cooking Operations.**
- .9 **CSA B228.1, Pipe Ducts and Fittings for Residential Type Air Conditioning Systems.**

1.2 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Section general requirements.
- .2 Indicate following:
 - .1 Sealants
 - .2 Tape
 - .3 Proprietary Joints
 - .4 Fittings

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 DUCTWORK****.1 Galvanized Steel:**

.1 Galvanized steel with Z90 designation zinc coating lock forming quality: to ASTM A653/A653M.

.2 Thickness:

Size Type	Class A Gauge	Class B Gauge	Class C Gauge
Square and Rectangular			
Up to 600 mm (24")	22	24	24
625 mm to 1000 mm (25" to 40")	20	22	24
1025 mm to 1800 mm (41" to 72")	18	20	22
1825 mm to 2400 mm (73" to 96")	16	18	20
2450 mm and over (97")	16	16	16
Round and Oval			
Up to 300 mm (12")	24	24	24
325 mm to 600 mm (13" to 24")	22	24	24
625 mm to 900 mm (25" to 36")	20	22	24
925 mm to 1200 mm (37" to 48")	18	20	22
1225 mm (49") and over	18	18	20

.3 All ductwork between HVAC unit connections and 3.0 m (10'-0") downstream or to silencers shall be 1.4 mm (18 gauge).

.2 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:

.1 Ductmate Canada Ltd.

.4 Foil tape all transverse and longitudinal joints.

2.2 DUCT CONSTRUCTION**.1 Round and oval:**

.1 Ducts: factory fabricated, spiral wound, with matching fittings and specials to SMACNA.

.2 Transverse joints up to 900 mm (36"): slip type with tape and sealants.

.3 Transverse joints over 900 mm (36"): Ductmate or Exanno Nexus Duct System.

- .2 Square and rectangular:
- .1 Ducts: to SMACNA.
- .2 Transverse joints, longest side:
up to and including 750 mm (30"): SMACNA proprietary duct joints.
- .3 Ducts with sides over 750 mm (30") to 1200 mm (48"), transverse duct joint system by Ductmate/25, Nexus, or WDCI (Lite) (SMACNA "E" or "G" Type connection). Weld all corners.
- .1 Acceptable materials:
- .1 Ductmate Canada Ltd.
- .2 Nexus, Exanno Corp.
- .3 WDCI
- .4 Ducts 1200 mm (48") and larger, Ductmate/35, Nexus, or WDCI (heavy) (SMACNA "J" Type connection). Weld all corners.
- .1 Acceptable materials:
- .1 Ductmate Canada Ltd.
- .2 Nexus, Exanno Corp.
- .3 WDCII.

2.3 FITTINGS

- .1 Fabrication: to SMACNA.
- .2 Radiused elbows:
- .1 Rectangular: standard radius and or short radius with single thickness turning vanes
Centreline radius: 1.5 times width of duct.
- .2 Round:
.1 In exposed areas one-piece smooth radius, 1.5 times diameter.
.2 In concealed areas 3-piece adjustable, 1.5 times diameter.
- .3 Mitred elbows, rectangular:
.1 To 400 mm (16"): with double thickness turning vanes.
.2 Over 400 mm (16"): with double thickness turning vanes.
- .4 Branches:
.1 Rectangular main and branch: with 45° entry on branch.
.2 Round main and branch: enter main duct at 45° with conical connection.
.3 Provide volume control damper in branch duct near connection to main duct.
.4 Main duct branches: with splitter damper.
- .5 Diffuser connection to main:
.1 90° round spin in collars with balancing damper and locking quadrant.

- .6 Transitions:
 - .1 Diverging: 20° maximum included angle.
 - .2 Converging: 30° maximum included angle.
- .7 Offsets:
 - .1 Full short radiused elbows.
- .8 Obstruction deflectors: maintain full cross-sectional area.

2.4 SEAL CLASSIFICATION

- .1 Classification as follows:

Maximum Pressure Pa (" w.c.)	SMACNA Seal Class
2500 (10")	A
1500 (6")	A
1000 (4")	A
750 (3")	A
500 (2")	B
250 (1")	B
125 (0.5")	C

- .2 Seal classification:

- .1 Class A: longitudinal seams, transverse joints, duct wall penetrations and connections made airtight with sealant and tape.
- .2 Class B: longitudinal seams, transverse joints and connections made airtight with sealant.
- .3 Class C: transverse joints and connections made air tight with gaskets, or sealant or combination thereof. Longitudinal seams sealed with foil tape or sealant.

2.5 SEALANT

- .1 Sealant: oil resistant, polymer type flame resistant duct sealant. Temperature range of -30°C (-22°F) to plus 93°C (199°F).

- .1 Acceptable materials:
 - .1 Duro Dyne S-2
 - .2 Foster

2.6 TAPE

- .1 Tape: polyvinyl treated, open weave fiberglass tape, 50 mm (2") wide.
 - .1 Acceptable material:
 - .1 Duro Dyne FT-2

2.7 DUCT LEAKAGE

- .1 In accordance with SMACNA HVAC Duct Leakage Test Manual.

2.8 FIRESTOPPING

- .1 40 mm x 40 mm x 3 mm (1½" x 1½" x 16ga) retaining angles all around duct, on both sides of fire separation.
- .2 Firestopping material and installation must not distort duct.
- .3 All ductwork passing through partition walls shall be firestopped.

2.9 WATERTIGHT DUCT

- .1 Provide watertight duct for:
 - .1 Fresh air intake.
 - .2 Minimum 3000 mm (120") from duct mounted humidifier in all directions.
 - .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.

2.10 HANGERS AND SUPPORTS

- .1 Band hangers: use on round and oval ducts only up to 500 mm (20") diameter, of same material as duct but next sheet metal thickness heavier than duct.
- .2 Trapeze hangers: ducts over 500 mm (20") diameter or longest side, to ASHRAE and SMACNA.
- .3 Hangers: galvanized steel angle with black steel rods to ASHRAE and SMACNA following table:

Duct Size mm ("")	Angle Size mm ("")	Rod Size mm ("")
up to 750 (30)	25 x 25 x 3 (1 x 1 x 1/8)	6 (1/4)
>750 to 1050 (>30 to 42)	40 x 40 x 3 (1½ x 1½ x 1/8)	6 (1/4)
>1050 to 1500 (>42 to 60)	40 x 40 x 3 (1½ x 1½ x 1/8)	10 (3/8)
>1500 to 2100 (>60 x 84)	50 x 50 x 3 (2 x 2 x 1/8)	10 (3/8)
>2100 to 2400 (>84 x 96)	50 x 50 x 5 (2 x 2 x 1/8)	10 (3/8)
>2400 (96) and over	50 x 50 x 6 (2 x 2 x ¼)	10 (3/8)

- .4 Upper hanger attachments:
 - .1 For concrete: manufactured concrete inserts.
 - .1 Acceptable material:
 - .1 Myatt fig. 485
 - .2 For steel joist: manufactured joist clamp or steel plate washer.
 - .1 Acceptable material:
 - .1 Grinnell fig. 61 or 60
 - .3 For steel beams: manufactured beam clamps:
 - .1 Acceptable material:
 - .1 Grinnell Fig. 60

Part 3 Execution**3.1 GENERAL**

- .1 The following systems shall conform to these requirements:

System	Class	Material
VAV Supply	A	Galvanized steel
HVAC Supply and Return	B	Galvanized steel
General Exhaust	B	Galvanized steel
Shower Exhaust	B	Aluminum
Ventilation Plenum	B	Galvanized steel
Exhaust Plenum	B	Galvanized steel
Individual Exhaust	C	Galvanized steel

- .2 Do work in accordance with ASHRAE and SMACNA.
- .3 Do not break continuity of insulation vapour barrier with hangers or rods.
- .4 Support risers in accordance with ASHRAE and SMACNA.
- .5 Install breakaway joints in ductwork on each side of fire separation.
- .6 Install proprietary manufactured flanged duct joints in accordance with manufacturer's instructions.
- .7 Manufacture duct in lengths to accommodate installation of acoustic duct lining.

3.2 HANGERS

- .1 Strap hangers: install in accordance with SMACNA.
- .2 Angle hangers: complete with locking nuts and washers.
- .3 Hanger spacing: in accordance with ASHRAE, SMACNA and as follows:

Duct Size mm ("")	Spacing mm ("")
to 1500 (60")	3000 (120")
over 1500 (60")	2500 (100")

- .4 Do not support ductwork over 250 mm x 250 mm (10" x 10") from roof deck.

3.3 WATERTIGHT DUCT

- .1 Slope horizontal branch ductwork down towards hoods served. Slope header ducts down toward risers.
- .2 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.

3.4 SEALING

- .1 Apply sealant to outside of joint to manufacturer's recommendations.
- .2 Bed tape in sealant and recoat with minimum of 1 coat of sealant to manufacturers recommendations.

3.5 LEAKAGE TESTS

- .1 Co-ordinate leakage testing with TAB contractor **and commissioning agent**. TAB contractor will be responsible for all duct testing.
- .2 Duct to be tested in accordance with SMACNA HVAC Duct Leakage Test Manual.
- .3 Leakage tests to be done in sections.
- .4 Trial leakage tests to be performed as instructed to demonstrate workmanship.
- .5 Install no additional ductwork until trial test has been passed.
- .6 Test section to be minimum of 15 m (50'-0") long with not less than 3 branch takeoffs and two 90° elbows. Maximum test length and area to be determined by BAS testing equipment. Allow for twelve (12) tests.
- .7 Complete test before insulation or concealment.
- .8 Provide all necessary end caps and fittings as required for the TAB contractor. Remove same after successful completion of duct test.
- .9 Pressure test ductwork to 1½ times operating pressure (minimum pressure 500 Pa (2" wc) all systems).

3.6 CLEANING

- .1 Keep ducts clear from dust and debris
- .2 Keep duct liner clean from dust, debris, and moisture.
- .3 At completion of project vacuum ducts if dirt or dust is present.
- .4 Where new systems connect into existing systems the existing systems shall be cleaned and vacuumed prior to reconnection.
- .5 Ensure all systems are clean prior to start up.

3.7 ROOF MOUNTED DUCT SUPPORT

- .1 Provide zero penetration duct support on roof where indicated.
- .2 Base shall be made of high density polypropylene with UV protection.
- .3 Frames shall be galvanized. All fastenings, rods, nuts, washers, etc. shall be stainless steel.

.4 Provide shop drawings as specified. Install to manufacturers recommendations.

.5 Acceptable materials:

.1 Portable pipe hanger

.2 Bigfoot systems

.3 Trikon Systems

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 All codes, standards, etc. as referenced shall be the latest edition.
- .2 SMACNA HVAC Duct Construction Standards, Metal and Flexible.
- .3 ANSI/NFPA 90B, Installation of Warm Air Heating and Air Conditioning Systems.
- .4 ANSI/NFPA 96, Ventilation Control and Fire Protection of Commercial Cooking Operations.
- .5 CSA B228.1, Pipes, Ducts and Fittings for Residential Type Air Conditioning.

1.2 PRODUCT DATA

- .1 Submit product data in accordance with general requirements.
- .2 Indicate the following:
 - .1 Flexible connections.
 - .2 Duct access doors.
 - .3 Turning vanes.
 - .4 Instrument test ports.

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 GENERAL

- .1 Manufacture in accordance with CSA B228.1.

2.2 FLEXIBLE CONNECTIONS

- .1 Frame: galvanized sheet metal frame with fabric clenched by means of double locked seams.
- .2 Material:
 - .1 Fire resistant, self extinguishing, neoprene coated glass fabric, temperature rated at - 40°C (-40°F) to plus 90°C (194°F), density of 1.3 kg/m.

2.3 ACCESS DOORS IN DUCTS

- .1 Non-insulated ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm (25 gauge) thick complete with sheet metal angle frame.
- .2 Insulated ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm (24 gauge) thick complete with sheet metal angle frame and 25 mm (1") thick rigid glass fibre insulation.
- .3 Gaskets: neoprene
- .4 Hardware:
 - .1 Up to 300 mm (12"): 2 sash locks
 - .2 301 mm to 450 mm (13" to 18"): 4 sash locks Complete with safety chain.
 - .3 451 mm to 1000 mm (19" to 40"): piano hinge and minimum 2 sash locks.
 - .4 Doors over 1000 mm (40"): piano hinge and 2 handles operable from both sides.
 - .5 Hold open devices.
- .6 **300 mm x 300 mm (12" x 12") glass viewing panels.**

- .5 Acceptable materials:
 - Nailor
 - E. H. Price
 - Titus

2.4 TURNING VANES

- .1 Factory or shop fabricated double thickness, to recommendations of SMACNA and as indicated.
- .2 Acceptable materials:
 - Duro Dyne
 - Ductmate

2.5 INSTRUMENT TEST PORTS

- .1 1.6 mm (16 gauge) thick steel zinc plated after manufacture.
- .2 Cam lock handles with neoprene expansion plug and handle chain.
- .3 28 mm (1 1/8") minimum inside diameter. Length to suit insulation thickness.
- .4 Neoprene mounting gasket.
- .5 Acceptable material:
 - Duro Dyne IP1 or IP2
 - Duct mate

2.6 PREFABRICATED ROOF CURB

- .1 Construction: welded with exposed joints ground flush and smooth.
- .2 Material: 1.3 mm (18 gauge) galvanized steel with raised cant and wood nailer.

.3 25 mm (1") insulation 3 lb density.

.4 Acceptable materials:
Greenheck GPR – 600 mm (24") high
Penn

2.7 SPIN-IN COLLAR

.1 Construction: galvanized straight or conical spin-in collar complete with spin-in bead and crimped collar connection.

.2 Provide balancing damper where indicated.

.3 Acceptable materials:

.1 Ecco Manufacturing

.2 Flex Master

Part 3 Execution

3.1 INSTALLATION

.1 Flexible connections:

.1 Install in following locations:

.1 Inlets and outlets to supply air units and fans. (Unless internally isolated)

.2 Inlets and outlets of exhaust and return air fans.

.3 As indicated.

.2 Length of connection: 100 mm (4").

.3 Minimum distance between metal parts when system in operation: 75 mm (3").

.4 Install in accordance with recommendations of SMACNA.

.5 When fan is running:

.1 Ducting on each side of flexible connection to be in alignment.

.2 Ensure slack material in flexible connection.

.2 Access doors and viewing panels:

.1 Size:

.1 600 mm x 600 mm (24" x 24") for person size entry.

.2 600 mm x 1000 mm (24" x 40") for servicing entry.

.3 300 mm x 300 mm (12" x 12") for viewing.

.4 As indicated.

.2 Location:

.1 At fire and smoke dampers.

.2 At control dampers.

.3 At devices requiring maintenance.

.4 At locations required by code.

- .5 At inlet and outlet of reheat coils.
 - .6 Elsewhere as indicated.
 - .7 Inlet and outlet of duct mounted coils.
- .3 Instrument test ports.
- .1 General:
 - .1 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.
 - .2 Locate to permit easy manipulation of instruments
 - .3 Install insulation port extensions as required.
 - .4 Locations.
 - .1 For traverse readings:
 - .1 At ducted inlets to roof and wall exhausters.
 - .2 At inlets and outlets of other fan systems.
 - .3 At main and sub-main ducts.
 - .4 And as indicated.
 - .2 For temperature readings:
 - .1 At outside air intakes.
 - .2 In mixed air applications in locations as approved by Consultant.
 - .3 At inlet and outlet of coils.
 - .4 Downstream of junctions of two converging air streams of different temperatures.
 - .5 And as indicated.
- .4 Turning vanes:
- .1 Install in accordance with recommendations of SMACNA and as indicated.
 - .2 Install on supply ducts only.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 All codes, standards, etc. as referenced shall be the latest edition.
- .2 SMACNA HVAC Duct Construction Standards, Metal and Flexible.

1.2 PRODUCT DATA

- .1 Submit product data in accordance with general requirements
- .2 Indicate the following: performance data.

Part 2 Products

2.1 GENERAL

- .1 Manufacture to SMACNA standards.

2.2 SINGLE BLADE DAMPERS

- .1 Of same material as duct, but one sheet metal thickness heavier. V-groove stiffened, minimum 1.6 mm (16 gauge).
- .2 Size and configuration to recommendations of SMACNA, except maximum height 100 mm (4").
- .3 Shaft extension to accommodate insulation thickness and locking quadrant.
- .4 Inside and outside nylon end bearings.
- .5 Channel frame of same material as adjacent duct, complete with angle stop.

2.3 MULTI-BLADED DAMPERS

- .1 Factory manufactured of material compatible with duct.
- .2 Opposed blade: configuration, metal thickness and construction to recommendations of SMACNA.
- .3 Maximum blade height:
 - .1 50 mm (2") up to 375 mm (15") high duct.
 - .2 100 mm (4") max 400 mm (16") high duct and over.
- .4 Bearings: self-lubricating nylon.
- .5 Linkage: shaft extension with locking quadrant.
- .6 Channel frame of same material as adjacent duct, complete with angle stop.
- .7 Shaft extension to accommodate insulation thickness and locking quadrants.

- .8 Acceptable materials:
- .1 Duro Dyne
 - .2 National Controlled Air (NCA)
 - .3 Nailor
 - .4 T.A. Morrison
 - .5 Tamco
 - .6 Ruskin
 - .7 Ventex/Alumavent
 - .8 United Enertech

2.4 LOCKING QUADRANTS

- .1 6 mm (1/4") dial regulator with square bearing shaft.
 - .1 18 gauge oval frame, cadmium plated, clearly shows damper position.
 - .2 18 gauge formed handle for easy adjustment.
 - .3 Bolt and wing nut lock damper securely.
 - .4 Offset mounting holes avoid interference with damper movement and mechanical fastening to duct.
- .2 9 mm (3/8") and larger: clamp quadrant with square bearing shaft.
 - .1 Accommodates and securely locks square rod, bearing fitting and adaptor pins.
 - .2 Heavily ribbed 16 gauge steel frame, 3 mm (1/8") thick formed steel handle, cadmium-plated.
 - .3 By tightening nut, bearing is securely locked in handle, preventing slippage and rattle.
 - .4 Neoprene and steel washer assembly seals bearing opening to eliminate air-leakage.
 - .5 Screw holes for mechanically fastening to ductwork.
- .3 High pressure system locking quadrant:
 - .1 Airtight, rattle-proof regulator, designed for ZERO leakage at high pressure. Use for applications up to 500°F constant temperature.
 - .2 Handle design for easy recognition of damper position.
 - .3 Heavy-gauge, zinc-plated steel, 2 high temperature rubber seals and washers, end bearing support, and 2 end bearings. Pressure loss and damper rattle in ductwork has been a constant annoyance for as long as HVAC ductwork has been installed. Now, a truly air-tight, rattle-proof regulator is available. The SPEC-SEAL regulator utilizes a special high-temperature rubber seal to eliminate leakage and rattle even at many times the pressure found in high pressure.
 - .4 Soft, comfortable grip handle with a highly-visible, plastic cover which indicates the damper position.
 - .5 Handle to accommodate 9 mm (3/8") or 12 mm (1/2") to match damper shaft size, square and round bearing shafts.

- .4 Acceptable manufacturers:
Duro Dyne
Ductmate

Part 3 Execution

3.1 INSTALLATION

- .1 Install where indicated.
- .2 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.
- .3 For supply, return and exhaust systems, locate balancing dampers in each branch duct.
 - .1 Single blade dampers up to 200 mm (8").
 - .2 Multi-blade dampers over 200 mm (8").
- .4 Runouts to registers and diffusers: install single blade damper located as close as possible to main ducts.
- .5 All dampers to be vibration free.
- .6 Leave all dampers in open position for T.A.B.
- .7 Fasten locking quadrants to ductwork and shaft.
- .8 Place locking quadrants on standoffs where ductwork insulated.
- .9 Lock down quadrant arm in the open position.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 All codes, standards, etc. as referenced shall be the latest edition.
- .2 ANSI/NFPA 90A, Installation of Air Conditioning and Ventilating Systems.
- .3 CAN/ULC-S112, Standard Method of Fire Test of Fire Damper Assemblies.
- .4 CAN/ULC-S112.1, Standard Method of Fire Test of Ceiling Firestop Flap Assemblies.
- .5 ULC-S505, Fusible Links for Fire Protection Service.

1.2 PRODUCT DATA

- .1 Submit product data in accordance with general requirements.
- .2 Indicate the following:
 - .1 Fire dampers.
 - .2 Operators.
 - .3 Firestop flaps.
 - .4 Fusible links.

1.3 MAINTENANCE DATA

- .1 Provide maintenance data for incorporation into manual specified in general requirements.

1.4 MAINTENANCE MATERIALS

- .1 Provide following:
 - .1 6 fusible links of each type.

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 (DYNAMIC)

- .1 Multi blade or roll type, fire damper suitable for HVAC system velocities up to 2000 fpm (610 m/mm), dual direction air flow, max 4" wg pressure.
- .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; guillotine type; sized to maintain full duct cross section.

- .4 Stainless closure spring to positively close damper upon fusible link release, for horizontal or vertical orientations.
- .5 Linkage concealed in frame.
- .6 40 mm x 40 mm x 3 mm (1½" x 1½" x 16ga) retaining angle iron frame, on full perimeter of fire damper, on both sides of fire separation being pierced.
- .7 Fire damper assemblies and type to meet requirements of provincial fire authority and authority having jurisdiction.
- .8 Acceptable materials:
 - .1 Ruskin
 - .2 Nailor
 - .3 National Controlled Air (NCA)
 - .4 T.A. Morrison
 - .5 Tamco
 - .6 Greenheck
 - .7 Ventex/Alumavent

Part 3 Execution

3.1 INSTALLATION

- .1 Provide where indicated and at all fire rated partitions indicated, on architectural drawing.
- .2 Install in accordance with ANSI/NFPA 90A and in accordance with conditions of ULC listing.
- .3 Maintain integrity of fire separation.
- .4 After completion and prior to concealment obtain approvals of complete installation from authority having jurisdiction.
- .5 Install access door adjacent to each damper.
- .6 Coordinate with installer of firestopping.
- .7 Static fire dampers: Only on transfer air ducts where ductwork is not connected to a fan/blower.
- .8 Dynamic fire dampers: In all duct work where air is moved by a fan/blower.

END OF SECTION

Part 1 General

1.1 CODES AND STANDARDS

- .1 All codes, standards, etc. as referenced shall be the latest edition.
- .2 ANSI/NFPA 90A, Installation of Air Conditioning and Ventilating Systems.
- .3 CAN/ULC-S112, Standard Method of Fire Test of Fire Damper Assemblies.
- .4 CAN/ULC-S112.1, Standard Method of Fire Test of Ceiling Firestop Flap Assemblies.
- .5 ULC-S505, Fusible Links for Fire Protection Service.
- .6 CAN/ULC-S524, Installation of Fire Alarm Systems
- .7 CAN/ULC-S1001.11, Integrated Systems Testing of Fire Protection and Life Safety Systems.

1.2 PRODUCT DATA

- .1 Submit product data in accordance with general requirements indicating the following:
 - .1 Damper type
 - .2 Operators
 - .3 Fusible links
 - .4 Smoke detectors
 - .5 Power requirements
 - .6 Size, orientation, construction

1.3 MAINTENANCE DATA

- .1 Provide maintenance data for incorporation into manual specified in general requirements.

1.4 MAINTENANCE MATERIALS

- .1 Provide following:
 - .1 6 fusible links of each type.

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	SMOKE DAMPERS
.1	Provide a complete system, consisting of the damper, damper actuator, smoke detector with duct sample tube, sleeve and all other components necessary for a complete and operable system. The assembly shall be factory assembled as a single unit. Field assembly shall be permitted at contractor discretion provided all listings are maintained and the installation follows all manufacturer installation guidelines.
.2	Damper
.1	Damper shall be ULC listed and labelled
.2	Both damper and damper actuator to be ULC listed and labelled.
.3	Normally closed smoke/seal: folding blade type. Blade edge seals of flexible stainless steel shall provide required constant sealing pressure. Stainless steel negator springs with locking devices shall ensure positive closure for units.
.4	Damper shall have Class I leakage rating.
.5	Suitable for horizontal or vertical installations.
.3	Actuator
.1	Actuator shall be ULC listed and labelled
.2	Motorized actuator: 2-position, spring return, normally open with power on. When power is interrupted damper shall close automatically. Upon return of power, damper shall automatically reset open. Actuators are to be located outside of airstream, unless otherwise specified or shown on drawings.
.3	Exterior visualization of damper position.
.4	Damper actuator end switches for monitoring damper position by the BAS.
.4	Factory sleeve.
.1	Type and style: matching application.
.5	Operating Temperature: 0° Celsius to 99° Celsius ambient temperature rating for 300 fpm to 4000 fpm air velocity.
.6	Smoke Detector:
.1	ULC approved photoelectric duct smoke detector;
.2	operates from 100 to 4000 ft/min air velocity, -4 to 158°F temperature, and 0 to 95% non-condensing humidity;
.3	test/reset button with LED display;
.4	The detector housing shall be ULC listed specifically for use in air handling systems; capable of local testing via magnetic switch and test button; duct mounted smoke detector with sampling tube, housing.
.5	Sensor may be mounted in duct in areas of renovation work when ductwork is over 450mm (18") wide.
.7	Damper assembly to operate at 120V with single point power connection.

- .8 Large damper sizes can be provided in multiple sections. Field assembly is acceptable following manufacturer's installation guidelines.
- .9 Size: as indicated on drawings.
- .10 Acceptable materials:
 - E H Price
 - NCA Ltd.
 - Nailor Industries Inc.
 - Ruskin
 - Alumavent
 - United Enertech
 - Safeair-Dowco (stainless steel)

2.2 COMBINATION FIRE AND SMOKE DAMPERS

- .1 Provide a complete system, consisting of the damper, damper actuator, smoke detector with duct sampling tube, sleeve and all other components necessary for a complete and operable system. The assembly shall be factory assembled as a single unit. Field assembly shall be permitted at contractor discretion provided all listings are maintained and the installation follows all manufacturer installation guidelines.
- .2 Damper
 - .1 Damper shall be ULC listed and labelled
 - .2 Both damper and damper actuator to be ULC listed and labelled.
 - .3 Normally closed smoke/seal: folding blade type. Blade edge seals of flexible stainless steel shall provide required constant sealing pressure. Stainless steel negator springs with locking devices shall ensure positive closure for units.
 - .4 Damper shall have Class I leakage rating.
 - .5 Suitable for horizontal or vertical installations.
- .3 Actuator/Link
 - .1 Actuator shall be ULC listed and labelled
 - .2 Motorized actuator: 2-position, spring return, normally open with power on. When power is interrupted damper shall close automatically. Upon return of power, damper shall automatically reset open. Actuators are to be located outside of airstream, unless otherwise specified or shown on drawings.
 - .3 Exterior visualization of damper position.
 - .4 Damper actuator end switches for monitoring damper position by the BAS.
 - .5 Combined actuator: electrical control system actuated from smoke sensor or smoke detection system and from fusible link.
 - .6 Fusible link, or electric re-settable link (ERL).
 - .7 Electric fire sensor capable of remote openable control is to be provided in place of fusible link where specifically indicated in project documents.
 - .8 Where ERL or electric fire sensor is used in place of fusible link, this device shall fail closed upon power failure.

- .4 Factory sleeve.
 - .1 Type and style: matching application.
- .5 Operating Temperature: 0° Celsius to 99° Celsius ambient temperature rating for 300 fpm to 4000 fpm air velocity.
- .6 Smoke Detector:
 - .1 ULC approved photoelectric duct smoke detector;
 - .2 operates from 100 to 4000 ft/min air velocity, -4 to 158°F temperature, and 0 to 95% non-condensing humidity;
 - .3 test/reset button with LED display;
 - .4 The detector housing shall be ULC listed specifically for use in air handling systems; capable of local testing via magnetic switch and test button; duct mounted smoke detector with sampling tube, housing;
 - .5 Sensor may be mounted in duct in areas of renovation work when duct work is over 450mm (18") wide.
- .7 Damper assembly to operate at 120V with single point power connection.
- .8 Large damper sizes can be provided in multiple sections. Field assembly is acceptable following manufacturer's installation guidelines.
- .9 Fire rating to match wall assembly i.e. 1 hour/1 ½ hour/2 hour/ 3 hour.
- .10 Size: as indicated on drawings.
- .11 Acceptable materials:
 - E H Price
 - NCA Ltd.
 - Nailor Industries Inc.
 - Ruskin
 - Alumavent
 - United Enertech
 - Safeair-Dowco (stainless steel)

2.3 NUMBER OF AIR TYPE SMOKE DETECTORS

- .1 Where air velocities are greater than 1.5 m/s (300 feet per second), one air duct type detector shall be installed for every 1.5 meters square (16 square feet) of cross-sectional duct area.
- .2 Where air velocities are less than 1.5 m/s (300 feet per second), one duct type smoke detector shall be installed for every 0.5 meters square (5.3 square feet) or cross-sectional duct area.

Part 3	Execution
3.1	INSTALLATION
.1	Provide smoke dampers where indicated and at all duct penetrations through smoke barrier partitions indicated on architectural drawings.
.2	Provide combination fire and smoke dampers where indicated and at all duct penetrations through fire rated smoke barrier partitions indicated on architectural drawings. To provide separated fire dampers and smoke dampers, obtain approval from the consultant for the alternate arrangement.
.3	Install in accordance with ANSI/NFPA 90A, in accordance with conditions of ULC listing and manufacturer's recommendation.
.4	Maintain integrity of smoke separation and fire rating.
.5	After completion and prior to concealment obtain approvals of complete installation from authority having jurisdiction.
.6	Install access door adjacent to each damper and smoke detector.
.7	Front grille access for through wall dampers that terminate in a grille is acceptable.
.8	Provide proper firestopping and duct seal to fire barrier wall.
.9	Confirm proper operation and test sheets.
.10	Should contractor provide separated devices mount smoke detector downstream of damper and within 1.5 m (5 ft) of damper.
.11	Ensure access doors/panels, fusible links, damper actuators and sensors are easily observed and accessible.
3.2	WIRING
.1	All fire alarm wiring shall be 1 hour rated and in conduit or as per electrical fire alarm wiring requirement.
.2	The BAS contractor to be used to provide the 120V power wiring.
3.3	DAMPER POSITION MONITORING
.1	In all cases the BAS contractor shall monitor the damper actuator end switches i.e. "closed position and open position".
3.4	CLEANING
.1	Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools, and equipment.

3.5 INTEGRATED LIFE SAFETY SYSTEMS TESTING

- .1 Obtain the integrated Life Safety Systems agent used by the electrical contractor to perform crossover testing, commission, and confirm proper operation of all operating smoke dampers, and associated Life Safety Systems, i.e. fire alarm.
- .2 Provide written confirmation as part of the Integrated Life Safety Systems Test report.

END OF SECTION

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- Part 1** **General a**
- 1.1** **GENERAL**
- .1 This section applies to operating dampers not specified in Controls Section.
- 1.2** **REFERENCES**
- .1 All codes, standards, etc. as referenced shall be the latest edition.
- .2 ASTM A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- 1.3** **PRODUCT DATA**
- .1 Submit product data in accordance with general requirements.
- .2 Indicate the following:
- .1 Performance data.
- 1.4** **MAINTENANCE DATA**
- .1 Provide maintenance data for incorporation into manual specified in general requirements.
- 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.
- Part 2** **Products**
- 2.1** **MOTORIZED DAMPERS**
- .1 Opposed blade type.
- .2 Extruded aluminum, interlocking blades, complete with extruded vinyl seals, spring stainless steel side seals, extruded aluminum frame.
- .3 Pressure fit self-lubricated bronze bearings.
- .4 Linkage: plated steel tie rods, brass pivots and plated steel brackets, complete with plated steel control rod.
- .5 Operator: Refer to BAS Section.
- .6 Performance:
- .1 Leakage: in closed position to be less than 2% of rated air flow at 250 kPa (36 psi) differential across damper.
- .2 Pressure drop: at full open position to be less than 100 kPa (15 psi) differential across damper.

- .7 Insulated aluminum dampers:
 - .1 Frames: insulated with extruded polystyrene foam with R factor of 5.0.
 - .2 Blades: constructed from aluminum extrusions with internal hollows insulated with polyurethane or polystyrene foam, R factor of 5.0.
 - .3 Use on services to the exterior.
- .8 Acceptable materials:
 - Honeywell
 - Johnson
 - T. A. Morrison
 - National Controlled Air (NCA)
 - Tamco
 - Ruskin
 - Nailor
 - Henderson Industrial
 - Ventex/Alumavent

2.2 BACK DRAFT DAMPERS

- .1 Automatic gravity operated, multi leaf, aluminum construction with nylon bearings, centre pivoted or counterweighted, as indicated.
- .2 Acceptable materials:
 - T.A. Morrison
 - Tamco Series 7000
 - Ruskin
 - Nailor
 - National Controlled Air (NCA)
 - Henderson Industrial
 - Ventex/Alumavent

Part 3 Execution

3.1 INSTALLATION

- .1 Install where indicated.
- .2 Install in accordance with recommendations of SMACNA and manufacturer's instructions.
- .3 Seal multiple damper modules with silicon sealant.
- .4 Install access door adjacent to each damper. See Duct Accessories Section.
- .5 Insulated dampers on all outside air intake and exhaust damper.
- .6 Non-insulated dampers on all interior motorized dampers not exposed to outside air.

3.2 ELECTRICAL ROOM DAMPER OPERATION

- .1 Outdoor air damper modulates open on increase of room temperature above 80°F.
- .2 When damper is fully open end switch start exhaust fan.
- .3 When temperature reaches below setpoint damper is closed and exhaust fan off.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 All codes, standards, etc. as referenced shall be the latest edition.
- .2 CAN/ULC-S110, Standard Methods of Test for Air Ducts.
- .3 UL 181, Factory Made Air Ducts and Air Connectors.
- .4 ANSI/NFPA 90A, Installation of Air Conditioning and Ventilating Systems.
- .5 ANSI/NFPA 90B, Installation of Warm Air Heating and Air Conditioning Systems.
- .6 SMACNA HVAC Duct Construction Standards - Metal and Flexible.

1.2 PRODUCT DATA

- .1 Submit product data in accordance with general requirements.
- .2 Indicate the following:
 - .1 Thermal properties.
 - .2 Friction loss.
 - .3 Acoustical loss.
 - .4 Leakage.
 - .5 Fire rating.

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 GENERAL

- .1 Factory fabricated to CAN/ULC S110.
- .2 Pressure drop coefficients listed below are based on relative sheet metal duct pressure drop coefficient of 1.00.
- .3 Flame spread rating not to exceed 25. Smoke developed rating not to exceed 50.

2.2 METALLIC – UNINSULATED

- .1 Spiral wound flexible aluminum, Class 1 duct material.
- .2 Performance:
 - .1 Factory tested to 2.5 kPa (10" w.c.) without leakage.
 - .2 Maximum relative pressure drop coefficient: 3.
 - .3 Operating pressure: 300 mm (12").

.3 Acceptable materials:

- .1 Flexmaster T/L
- .2 Ductmate

2.3 METALLIC –INSULATED

.1 Spiral wound flexible aluminum with factory applied, 25 mm (1") thick flexible glass fibre thermal insulation with vapour barrier and vinyl jacket, Class 1 duct material.

.2 Performance:

- .1 Factory tested to 2.5 kPa (10" w.c.) without leakage.
- .2 Maximum relative pressure drop coefficient: 3.
- .3 Operating pressure: 300 mm (12").

.3 Acceptable materials:

- .1 Flexmaster T/L – VT
- .2 Ductmate

Part 3 Execution

3.1 DUCT INSTALLATION

- .1 Install in accordance with: SMACNA.
- .2 Maximum length of flexible duct: 1.8 m (6' 0").
- .3 Minimum length of acoustical ductwork; 1.5 m (5' 0") with minimum of 1 bend.
- .4 Provide support at centre of flexible duct with 25 mm (1") wide galvanized hanger.
- .5 **Insulated flexible ductwork in areas where ceilings are not utilized as return air plenums.**
- .6 **Uninsulated flexible ductwork in areas where ceilings are utilized as return air plenums.**

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 All codes, standards, etc. as referenced shall be the latest edition.
- .2 SMACNA HVAC Duct Construction Standards, Metal and Flexible.
- .3 ASTM C553, Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
- .4 ANSI/NFPA 90A, Installation of Air Conditioning and Ventilating Systems.
- .5 ANSI/NFPA 90B, Installation of Warm Air Heating and Air Conditioning Systems.
- .6 **ASTM C177, Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.**
- .7 **CAN/ULC-S102, Surface Burning Characteristics of Building Materials and Assemblies.**

1.2 PRODUCT DATA

- .1 Submit product data in accordance with general requirements.

Part 2 Products

2.1 DUCT LINER

- .1 General:
 - .1 Rigid fibrous glass duct liner: air stream side faced with mat facing.
 - .2 Flame spread rating shall not exceed 25. Smoke development rating shall not exceed 50 when tested in accordance with CAN/ULC-S102.
 - .3 Acceptable material:
 - .1 Johns Manville, Permacote Linacoustic R-300
 - .2 Owen Corning
- .2 Rigid:
 - .1 Use on flat surfaces.
 - .2 25 mm (1") thick, to CGSB 51-GP-10M, fibrous glass rigid board duct liner.
 - .3 Density: 36 kg/m² (7.4 lb/ft²).
 - .4 Thermal resistance to be minimum 750 mm (30") C/W for 25 mm (1") thickness 1150 mm (45") C/W for 40 mm (1½") thickness when tested in accordance with ASTM C177, at 24°C (75°F) mean temperature.

2.2 ADHESIVE

- .1 Meet requirements of ANSI/NFPA 90A and ANSI/NFPA 90B.
- .2 Flame spread rating shall not exceed 25. Smoke development rating shall not exceed 50. Temperature range -29°C (-20°F) to 93°C (200°F).

- .3 Acceptable material:
 - .1 Duro Dyne 1A-22
 - .2 Ductmate

2.3 FASTENERS

- .1 Weld pins 2.0 mm (14 gauge) diameter, length to suit thickness of insulation. Metal retaining clips, 32 mm (1¼") square.
- .2 Acceptable material:
 - .1 Duro Dyne
 - .2 Ductmate

2.4 JOINT TAPE

- .1 Poly-Vinyl treated open weave fiberglass membrane 50 mm (2") wide.
- .2 Acceptable materials:
 - .1 Duro Dyne FT2
 - .2 Ductmate

2.5 SEALER

- .1 Meet requirements of ANSI/NFPA 90A and ANSI/NFPA 90B.
- .2 Flame spread rating shall not exceed 25. Smoke development rating shall not exceed 50. Temperature range -68°C (-90°F) to 93°C (200°F).
- .3 Acceptable materials:
 - .1 Duro Dyne 1A-94
 - .2 Ductmate

Part 3 Execution

3.1 GENERAL

- .1 Do work in accordance with recommendations of SMACNA duct liner standards as indicated in SMACNA HVAC Duct Construction Standards, Metal and Flexible, except as specified otherwise.
- .2 Line inside of ducts where indicated.
- .3 Duct dimensions, as indicated, are clear inside duct lining.
- .4 Provide an interior of ductwork from fans from minimum distance of 3 m (10'-0").

3.2 DUCT LINER

- .1 Install in accordance with manufacturer's recommendations, and as follows:
 - .1 Fasten to interior sheet metal surface with 100% coverage of adhesive.
 - .2 In addition to adhesive, install weld pins not less than 2 rows per surface and not more than 300 mm (12") on centres.
- .2 Weld pins are to have cupped or beveled heads to prevent damage to lining surface.
- .3 Store foam liners away from sunlight.

3.3 JOINTS

- .1 Seal all butt joints, exposed edges, weld pin and clip penetrations and all damaged areas of liner with joint tape and sealer. Install joint tape in accordance with manufacturer's recommendations, and as follows:
 - .1 Bed tape in sealer.
 - .2 Apply 2 coats of sealer over tape.
- .2 Replace damaged areas of liner at discretion of Consultant.
- .3 Protect leading and trailing edges of each duct section with sheet metal nosing having 15 mm (1/2") overlap and fastened to duct.

END OF SECTION

Part 1 General

1.1 GENERAL

- .1 This section is to read in conjunction with Division 1, the general condition, and the General Requirements of the mechanical trades.

1.2 REFERENCES

- .1 Tested to ANSI/UL Standard 508.
.2 UL-508 certified for the building and assembly.
.3 CSA or C-UL stickers shall be applied to both the VFD and option panels.
.4 Manufacturers shall be ISO 9001 certified facilities.

1.3 SUBMITTALS

- .1 Submit manufacturer's performance data including dimensional drawings, power circuit diagrams, installation and maintenance manuals, warranty description, VFD's FLA rating, certification agency file numbers and catalogue information.
.2 The specification lists the minimum VFD performance requirements for this project. Each supplier shall list any exceptions to the specification. If no departures from the specification are identified, the supplier shall be bound by the specification.
.3 Harmonic filtering. The manufacturer shall, with the aid of the buyer's electrical power single line diagram, providing the data required by IEEE-519, perform an analysis to initially demonstrate the supplied equipment will meet the IEEE standards after installation. If, as a result of the analysis, it is determined that additional filter equipment is required to meet the IEEE recommendations, then the cost of such equipment shall be included in the bid. A harmonic analysis shall be submitted with the approval drawings to verify compliance with the latest version of IEEE-519 voltage and current distortion limits as shown in table 10.2 and 10.3 at the point of common coupling (PCC). The PCC shall be defined as the consumer–utility interface or primary side of the main distribution transformer.

1.4 WARRANTY

- .1 The VFD shall be warranted by the manufacturer for a period of five (5) years from date of substantial completion. The warranty shall include parts, labour, travel costs and living expenses incurred by the manufacturer to provide factory authorized on-site service. The warranty shall be provided by the VFD manufacturer.

Part 2	Products
2.1	ACCEPTABLE MANUFACTURERS
.1	Danfoss Graham.
.2	ABB.
.3	AC Tech.
2.2	GENERAL
.1	The VFD shall convert incoming fixed frequency three-phase AC power into a variable frequency and voltage for controlling the speed of three-phase AC motors. The motor current shall closely approximate a sine wave. Motor voltage shall be varied with frequency to maintain desired motor magnetization current suitable for centrifugal pump and fan control and to eliminate the need for motor derating.
.2	With the motor's rated voltage applied to the VFD input, the VFD shall allow the motor to produce full rated power at rated amps, RMS fundamental volts, and speed without using the motor's service factor. VFD's utilizing sine weighted/coded modulation (with or without 3rd harmonic injection) must provide data verifying that the motors will not draw more than full load current during full load and full speed operation.
.3	Include an input full-wave bridge rectifier and maintain a fundamental power factor near unity regardless of speed or load.
.4	Provide DC link reactors on both the positive and negative rails of the DC bus to minimize power line harmonics. VFD's without DC link reactors shall provide a minimum 5% impedance line reactor.
.5	Full load amp rating shall meet or exceed NEC Table 430-150. The VFD shall be able to provide full rated output current continuously, 110% of rated current for 60 seconds and 160% of rated current for up to 0.5 second while starting.
.6	Provide full torque at any selected frequency from 28 Hz to base speed to allow driving direct drive fans without derating.
.7	An automatic energy optimization selection feature shall be provided in the VFD. This feature shall automatically and continually monitor the motor's speed and load and adjust the applied voltage to maximize energy savings and provide up to an additional 3% to 10% energy savings.
.8	Input and output power circuit switching shall be able to be accomplished without interlocks or damage to the VFD. Switching rate may be up to 1 time per minute on the input and unlimited on the output.
.9	An automatic motor adaptation test algorithm shall measure motor stator resistance and reactance to optimize performance and efficiency. It shall not be necessary to run the motor or de-couple the motor from the load to run the test.

- .10 Galvanic and/or optical isolation shall be provided between the VFD's power circuitry and control circuitry to ensure operator safety and to protect connected electronic control equipment from damage caused by voltage spikes, current surges, and ground loop currents. VFD's not including either galvanic or optical isolation on both analog I/O and discrete I/O shall include additional isolation modules.
- .11 VFD shall minimize the audible motor noise through the use of an adjustable carrier frequency. The carrier frequency shall be automatically adjusted to optimize motor and VFD efficiencies while reducing motor noise.
- .12 VFD's operating 600/3/60 motors not designed to meet Nema MG1 Part 31 should include Output dv/dt (LC) Reactors.

2.3 PROTECTIVE FEATURES

- .1 VFD shall be provided with an integral disconnect and Integral Fast Blow Semiconductor fuses sized as specified by ULC. Fuses shall be Bussman JJS type or equivalent.
- .2 A minimum of Class 20 I₂t electronic motor overload protection for single motor applications and thermal-mechanical overloads for multiple motor applications shall be provided.
- .3 Protection against input transients, loss of AC line phase, output short circuit, output ground fault, over-voltage, under-voltage, VFD over-temperature and motor over-temperature. The VFD shall display all faults in plain English. Codes are not acceptable.
- .4 Protect VFD from sustained power or phase loss. The VFD shall provide full rated output with an input voltage as low as 90% of the nominal.
- .5 The VFD shall incorporate a motor preheat circuit to keep the motor warm and prevent condensation build up in the stator.
- .6 To prevent breakdown of the motor winding insulation, the VFD shall be designed to comply with IEC Part 34-17. Motors shall have inverter rated insulation (1600V).
- .7 VFD shall include a "signal loss detection" circuit to sense the loss of an analog input signal such as 4 to 20 mA or 2 to 10 V DC, and shall be programmable to react as desired in such an instance.
- .8 VFD shall function normally when the keypad is removed while the VFD is running and continue to follow remote commands. No warnings or alarms shall be issued as a result of removing the keypad.
- .9 VFD shall catch a rotating motor operating forward or reverse up to full speed.
- .10 VFD shall be rated for 100,000 amp interrupting capacity (AIC).
- .11 VFD shall have externally mounted EMI electromagnetic suppressor to limit the EMI and RFI output from the VFD. VFD to be mounted in an all metal cabinet to limit radiated RFI.
- .12 VFD shall include current sensors on all three output phases to detect and report phase loss to the motor. The VFD will identify which of the output phases is low or lost.

- .13 VFD shall continue to operate without faulting until input voltage reaches 300 V AC on 208/230 volt VFD's, and 701V AC on 575 volt VFD's.
- .14 For remote VFD installations, provide an output filter (load side reactor) at each VFD to protect the equipment motor. Coordinate installation with equipment manufacturer.

2.4 INTERFACE FEATURES

- .1 Hand/Start, Off/Stop and Auto/Start selector switches shall be provided to start and stop the VFD and determine the speed reference.
- .2 The VFD shall be able to be programmed to provide a 24 V DC output signal to indicate that the VFD is in Auto/Remote mode.
- .3 The VFD shall provide digital manual speed control. Potentiometers are not acceptable.
- .4 Lockable, alphanumeric backlit display keypad can be remotely mounted up to 10 feet away using standard 9-pin cable.
- .5 The keypads for all sizes of VFD's shall be identical and interchangeable.
- .6 To set up multiple VFD's, it shall be possible to upload all set-up parameters to the VFD's keypad, place that keypad on all other VFD's in turn and download the set-up parameters to each VFD. To facilitate setting up VFD's of various sizes, it shall be possible to download from the keypad only size independent parameters.
- .7 Display shall be programmable to display in 9 languages including English, Spanish and French.
- .8 The display shall have four lines, with 20 characters on three lines and eight large characters on one line.
- .9 A red FAULT light, a yellow WARNING light and a green POWER-ON light shall be provided. These indications shall be visible both on the keypad and on the VFD when the keypad is removed.
- .10 A quick set-up menu with factory preset typical HVAC parameters shall be provided on the VFD eliminating the need for macros.
- .11 The VFD shall include a standard RS-485 communications port for connection to a Johnson Controls N2 and Siemens FLN serial communication system. The connection shall be software selectable and addressable by the user. The option for Lonworks and BacNet communication must also be available.
- .12 As a minimum, the following points shall be controlled and/or accessible:
VFD Start/Stop, Speed reference, Fault diagnostics, and Meter points as follows;
Motor power in HP, Motor power in kW, Motor kW-hr, Motor current, Motor voltage, Hours run, Feedback signal #1, Feedback signal #2, DC link voltage, Thermal load on motor, and Thermal load on VFD, Heat sink temperature.
- .13 Four additional Form C 230 volt programmable relays shall be available for factory or field installation within the VFD.

- .14 Two set-point control interface (PID control) shall be standard in the unit. VFD shall be able to look at two feedback signals, compare with two set-points and make various process control decisions.
- .15 Floating point control interface shall be provided to increase/decrease speed in response to contact closures.
- .16 Four simultaneous displays shall be available. They shall include frequency or speed, run time, output amps and output power. VFD's unable to show these four displays simultaneously shall provide panel meters.
- .17 Sleep mode shall be provided to automatically stop the VFD when its speed drops below set "sleep" level for a specified time. The VFD shall automatically restart when the speed command exceeds the set "wake" level.
- .18 The sleep mode shall be functional in both follower mode and PID mode.
- .19 Run permissive circuit shall be provided to accept a "system ready" signal to ensure that the VFD does not start until dampers or other auxiliary equipment are in the proper state for VFD operation. The run permissive circuit shall also be capable of sending an output signal as a start command to actuate external equipment before allowing the VFD to start.
- .20 The following displays shall be accessible from the control panel in actual units: Reference Signal Value in actual units, Output Frequency in Hz or percent, Output Amps, Motor HP, Motor kW, kWhr, Output Voltage, DC Bus Voltage, VFD Temperature in degrees, and Motor Speed in engineering units per application (in GPM, CFM, etc.). VFD will read out the selected engineering unit either in a linear, square or cubed relationship to output frequency as appropriate to the unit chosen.
- .21 The display shall be programmed to read in inches of water column (in-wg) for an air handler application, pressure per square inch (psi) for a pump application, and temperature (oF) for a cooling tower application.
- .22 VFD shall be able to be programmed to sense the loss of load and signal a no load/broken belt warning or fault.
- .23 If the temperature of the VFD's heat sink rises to 80°C, the VFD shall automatically reduce its carrier frequency to reduce the heat sink temperature. If the temperature of the heat sink continues to rise the VFD shall automatically reduce its output frequency to the motor. As the VFD's heat sink temperature returns to normal, the VFD shall automatically increase the output frequency to the motor and return the carrier frequency to its normal switching speed.
- .24 The VFD shall have temperature controlled cooling fans for quiet operation and minimized losses.
- .25 The VFD shall store in memory the last 10 faults and related operational data.
- .26 Eight programmable digital inputs shall be provided for interfacing with the systems control and safety interlock circuitry.
- .27 Two programmable relay outputs, one Form C 240 V AC, one Form A 30 V AC, shall be provided for remote indication of VFD status.

- .28 Three programmable analog inputs shall be provided and shall accept a direct-or-reverse acting signal. Analog reference inputs accepted shall include two voltage (0 to 10 V DC, 2 to 10 V DC) and one current (0 to 20 mA, 4 to 20 mA) input.
- .29 Two programmable 0 to 20 mA analog outputs shall be provided for indication of VFD status. These outputs shall be programmable for output speed, frequency, current and power. They shall also be programmable to provide a selected 24 V DC status indication.
- .30 Under fire mode conditions, the VFD shall be able to be programmed to automatically default to a preset speed.

2.5 ADJUSTMENTS

- .1 VFD shall have an adjustable carrier frequency in steps of not less than 0.1 kHz to allow tuning the VFD to the motor.
- .2 Sixteen preset speeds shall be provided.
- .3 Four acceleration and four deceleration ramps shall be provided. Accel and decel time shall be adjustable over the range from 0 to 3,600 seconds to base speed. The shape of these curves shall be automatically contoured to ensure no-trip acceleration and deceleration.
- .4 Four current limit settings shall be provided.
- .5 If the VFD trips on one of the following conditions, the VFD shall be programmable for automatic or manual reset: under-voltage, over-voltage, current limit and inverter overload.
- .6 The number of restart attempts shall be selectable from 0 through 20 or infinitely and the time between attempts shall be adjustable from 0 through 600 seconds.
- .7 An automatic "on delay" may be selected from 0 to 120 seconds.

2.6 SERVICE CONDITIONS

- .1 Unit shall operate in ambient temperature of -10 to 40°C (14 to 104°F).
- .2 Unit shall operate in 0 to 95% relative humidity, non-condensing.
- .3 Operate in elevation up to 3,300 feet without derating.
- .4 Maximum AC line voltage variation, -10 to +10% of nominal with full output.
- .5 No side clearance shall be required for cooling of any units. All power and control wiring shall be done from the bottom.

2.7 FACTORY TESTING

- .1 To ensure quality and minimize infantile failures at the jobsite, the manufacturer shall test the complete VFD. The VFD shall operate a dynamometer at full load and speed and shall be cycled during the test.
- .2 All optional features shall be functionally tested at the factory for proper operation.

2.8 BYPASS SWITCH

- .1 Bypass Controller - Automatic transfer to line power via contactors. When in the "Drive" mode, the bypass contactor is open and the drive output contactor is closed. In the "Bypass" position, the drive output contactor is open, and the bypass contactor is closed via Start/stop command. Start/stop via customer supplied maintained contact shall be Dry type 115V compatible and shall function in both the "Drive" and "Bypass" modes. The design shall include single-phase protection in both the VFD and bypass modes.

Part 3 Execution

3.1 START-UP SERVICE

- .1 The manufacturer shall provide start-up and commissioning of the VFD and its optional circuits by a factory certified service technician who is experienced in start-up and repair services. Sales personnel and other agents who are not factory certified shall not be acceptable as commissioning agents. Start-up services shall include checking for verification of proper operation and installation for the VFD, its options and its interface wiring to the building automation system.

3.2 EXAMINATION

- .1 Contractor to verify that job site conditions for installation meet factory recommended and code-required conditions for VFD installation prior to start-up, including clearance spacing, temperature, contamination, dust, and moisture of the environment. Separate conduit installation of the motor wiring, power wiring, and control wiring, and installation per the manufacturer's recommendations shall be verified.

3.3 INSTALLATION

- .1 Install to manufacturer's recommendations.
.2 Install to the requirements of the local Hydro codes. Obtain hydro permits and pay all fees.
.3 Install in an accessible location and proper service height from floor.
.4 Install in clean, dry, and conditioned environment.
.5 The VFD is to be covered and protected from installation dust and contamination until the environment is cleaned and ready for operation. The VFD shall not be operated while the unit is covered.
.6 Wiring of devices to be to the standards of Electrical Division.
.7 Provide one manufacturer of VFD's throughout the project.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 All codes, standards, etc. as referenced shall be the latest edition.
- .2 CSA 22.2 No. 152 Combustible Gas Detection Instruments.

1.2 PRODUCT DATA

- .1 Submit product data in accordance with general requirements.
- .2 Indicate the following:
 - .1 Electrical power supply.
 - .2 Installation instructions.
 - .3 Control function.

Part 2 Products

2.1 CO AND NO2 MONITOR

- .1 Dual or single channel gas monitoring system with remote solid state carbon monoxide sensor and remote electrochemical nitrogen dioxide sensor/transmitter. Each set of sensors shall control exhaust fan(s).
- .2 Unit shall include:
 - .1 Monitoring panel
 - .1 Monitor shall be enclosed in NEMA 12 cabinet.
 - .2 Dual alarm trip points (CO trip points will be at 25 and 100 ppm, NO₂ trip points will be at 1 ppm and 3 ppm).
 - .3 Dual DPDT 10A relays for alarm actuation and control of ventilation equipment and/or auxiliary alarms. Connect alarm to respective exhaust fan.
 - .4 LEDs indicating power on, low and high alarms, and fail, plus a user selectable audio indicator capable of being silenced for high alarm.
 - .5 Test sequence activated by single push button.
 - .6 Alarms shall be equipped with user selectable time delays whereby, when chosen, low and high alarm conditions must prevail for five and ten minutes respectively before activation occurs.
 - .7 Alarms shall be equipped with dead band which requires gas levels to decline slightly below the original trip point before alarms will automatically reset.

- .2 Carbon monoxide sensor
 - .1 Range of 0 – 100 ppm CO.
 - .2 Solid state type sensor.
 - .3 Three wire hook-up.
 - .4 Capable of covering up to 697 m² (7500 ft²).
 - .5 To be mounted 1.2 m to 1.8 m (4' to 6') above floor level (breathing zone) to OBC requirements.
- .3 Nitrogen dioxide sensor/transmitter
 - .1 4 m to 20 m (13' 4" to 6' 8") A linear signal output corresponding to 0 – 10 ppm NO₂.
 - .2 Electrochemical type sensor.
 - .3 Remote calibration feature with non-interactive zero and span.
 - .4 Two wire hook-up.
 - .5 Capable of covering up to 697 m² (7500 ft²).
 - .6 To be mounted 1.2 m to 1.8 m (4' to 6') above floor level (breathing zone) to OBC requirements.
- .3 Approvals and warranty:
 - .1 All components shall be CSA certified and carry a full two year warranty against defects in labour and workmanship. Electrochemical sensors (NO₂) carry a one year warranty.
- .4 Type and placement: as indicated.
- .5 Acceptable materials:
 - .1 Armstrong Monitoring Corporation Model #1022-D monitor with #AMC-1220 carbon monoxide sensor and #AMC-1220 nitrogen dioxide sensor/transmitter.
 - .2 Mine Safety Appliances Model TGM combo panel and 215068 CO sensors with 212569 NO₂ sensors.
 - .3 Vulcain
 - .4 FCS Gas detection system by Critical Environment Technologies

Part 3 Execution

- 3.1 GENERAL**
- .1 Install in accordance with manufacturer's recommendations.
 - .2 Install in accordance with CSA standards and local authorities requirements.
 - .3 Field test system to verify operation in presence of manufacturer.
 - .4 Install in accordance to local hydro requirements and the Electrical Safety Code.
 - .5 Install wiring in EMT conduit to the standards of the Electrical Division.
 - .6 Mount devices at height required to properly detect gas.

3.2 COMMISSIONING

- .1 Prove operation at each sensor for all relevant gasses.
- .2 Prove Stage 1 Detection in each zones. System shall demonstrate the following:
 - .1 Zone intake and exhaust motorized dampers are interlocked, engaged, and fully operable.
 - .2 Zone exhaust fans are interlocked, engaged, and fully operable.
- .3 Prove Stage 2 Detection in each zone.
 - .1 Local detectors provide audible and visual alarm.
 - .2 Dampers remain open and exhaust fans remain operable.
- .4 Prove Stage 3 Detection in each zone
 - .1 When local detectors sense Stage 3 concentrations of toxic gases, all sensors in building will provide audible and visual alarm.
 - .2 Dampers remain open and exhaust fans remain operable.
- .5 Prove gas detectors enter a local alarm when in a fault condition.
- .6 Prove that all detectors audible alarm can be silenced by main gas detector control panel.
- .7 Submit supporting documents to local authority and consultants, signed by testing agency.

END OF SECTION

Part 1 General

1.1 CONTRACT REQUIREMENTS

- .1 Mechanical Contractor to provide standalone controls for each component. No BAS required on this building.
- .2 Include for all thermostats, temperature control valves, control wiring, and all other accessories. Provide a touch screen controller of each ERV, as well as the boiler. Supplied by manufacturer and install in closet mechanical space.

1.2 RELATED SECTIONS

- .1 Conform to the General Mechanical requirements.
- .2 Conform to the General Electrical requirements.

Part 2 Products

2.1 ELECTRIC DAMPER/VALVE ACTUATORS

- .1 The actuator shall have mechanical or electronic stall protection to prevent damage to the actuator throughout the rotation of the actuator.
- .2 For power-failure/safety applications, an internal mechanical, spring-return mechanism shall be built into the actuator housing.
- .3 For non-power safety applications, the valves shall remain in the same position. Program these valves to be open a minimum of 25% when freezing conditions exist outdoors.
- .4 Proportional actuators shall accept a 0 to 10 VDC or 0 to 20 mA control signal and provide a 2 to 10 VDC or 4 to 20 mA operating range.
- .5 All 24 VAC/VDC actuators shall operate on Class 2 wiring.
- .6 All actuators shall have an external manual gear release to allow manual positioning of the damper when the actuator is not powered.
- .7 Acceptable Manufacturers.
 - .1 Neptronic
 - .2 Belimo
 - .3 Johnson Controls
 - .4 Siemens
 - .5 Honeywell
 - .6 Schneider Electric

2.2 THERMOSTATS

- .1 Temperature Thermostat
 - .1 Digital room sensors shall have LCD display, day / night override button, and setpoint slide adjustment to $\pm 5^{\circ}\text{C}$ adjustment and override options. The setpoint slide adjustment can be software limited by the automation system to limit the amount of room adjustment.

Temperature monitoring range	+20/120°F (13° to 49°C)
Output signal	Changing resistance
Accuracy at Calibration point	$\pm 0.5^{\circ}\text{F}$ ($\pm 0.3^{\circ}\text{C}$)
Set Point and Display Range	55° to 95° F (13° to 35°C)
 - .2 Provide guards on thermostat in common areas.
 - .3 In corridors, washrooms, and gyms provide stainless steel plate type sensors (push button override and LCD display not required).
- .2 Acceptable Manufacturers
 - .1 Devices must be the same as the control manufacturers product.
 - .2 As per approved control system contractor and manufacturer list.

2.3 TEMPERATURE SENSORS

- .1 Temperature sensors shall be Resistance Temperature Device (RTD) or thermistor.
- .2 Duct sensors shall be single point or averaging as shown. Averaging sensors shall be a minimum of 1.5m (5ft) 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 set point adjustment, override switch, display, and/or communication port as shown.
- .5 Provide matched temperature sensors for differential temperature measurement.
- .6 Outdoor sensors shall have gasket cover connection and thermal radiation cover to protect the sensor from weather conditions.
- .7 Acceptable Manufacturers
 - .1 Siemens
 - .2 Honeywell
 - .3 Johnson Controls
 - .4 ACI
 - .5 Greystone

- 2.4 HUMIDITY SENSORS**
- .1 Duct and room sensors shall have a sensing range of 20% to 80%. Except for Arena, measurement to be in gr. / lb to a minimum of 10 gr./lb.
 - .2 Duct sensors shall be provided with a sampling chamber.
 - .3 Outdoor air humidity sensors shall have a sensing range of 20% to 95% RH. They shall be suitable for ambient conditions of -40°C to 75°C (-40°F to 170°F).
 - .4 Humidity sensor's drift shall not exceed 1 % of full scale per year.
 - .5 Acceptable Manufacturers
 - .1 Siemens
 - .2 Honeywell
 - .3 Johnson Controls
 - .4 ACI
 - .5 Greystone

Part 3 Execution

- 3.1 INSTALLATION OF THERMOSTATS**
- .1 Install sensors in accordance with the manufacturer's recommendations.
 - .2 Mount sensors rigidly and adequately for the environment within which the sensor operates.
 - .3 Room temperature sensors shall be installed on concealed junction boxes properly supported by the wall framing.
 - .4 All wires attached to sensors shall be air sealed in their raceways or in the wall to stop air transmitted from other areas affecting sensor readings.
 - .5 Install thermostats at handicapped elevations 1200 mm above finish floor (AFF).
 - .6 Where not indicated on drawing, place where directed by consultant.
 - .7 Co-ordinate location with architectural and electrical items.
- 3.2 INSTALLATION OF SENSORS**
- .1 Install sensors in accordance with the manufacturer's recommendations.
 - .2 Mount sensors rigidly and adequately for the environment within which the sensor operates.
 - .3 Room temperature sensors shall be installed on concealed junction boxes properly supported by the wall framing.
 - .4 All wires attached to sensors shall be air in EMT raceways.
 - .5 Sensors used in mixing plenums and hot and cold decks shall be of the averaging type. Averaging sensors shall be installed in a serpentine manner vertically across the duct. Each bend shall be supported with a capillary clip.

- .6 Low-limit sensors used in mixing plenums shall be installed in a serpentine manner horizontally across duct. Each bend shall be supported with a capillary clip. Provide 3 m (10 ft.) of sensing element for each 1m² (1 ft of sensing element for each 1 ft²) of coil area.
- .7 All pipe-mounted temperature sensors shall be installed in wells. Install all liquid temperature sensors with heat-conducting fluid in thermal wells.
- .8 Install outdoor air temperature sensors on north wall, complete with sun shield at designated location.
- .9 Differential air static pressure.
 - .1 Supply Duct Static Pressure: Pipe the high-pressure tap to the duct using a pitot tube. Pipe the low-pressure port to a tee in the high-pressure tap tubing of the corresponding building static pressure sensor (if applicable) or to the location of the duct high-pressure tap and leave open to the plenum.
 - .2 **Return Duct Static Pressure: Pipe the high-pressure tap to the duct using a pitot tube. Pipe the low-pressure port to a tee in the low-pressure tap tubing of the corresponding building static pressure sensor.**
 - .3 The piping to the pressure ports on all pressure transducers shall contain a capped test port located adjacent to the transducer.
 - .4 All pressure transducers, other than those controlling VAV boxes, shall be located in field device panels, not on the equipment monitored or on ductwork. Mount transducers in a location accessible for service without use of ladders or special equipment.
 - .5 All air and water differential pressure sensors shall have gauge tees mounted adjacent to the taps. Water gauges shall also have shutoff valves installed before the tee.

3.3 FLOW SWITCH INSTALLATION

- .1 Use correct paddle for pipe diameter.
- .2 Adjust flow switch in accordance with manufacturer's instructions.

3.4 ACTUATORS

- .1 Mount and link control damper actuators according to manufacturer's instructions.
 - .1 To compress seals when spring-return actuators are used on normally closed dampers, power actuator to approximately 5° open position, manually close the damper, and then tighten the linkage.
 - .2 Check operation of damper/actuator combination to confirm that actuator modulates damper smoothly throughout stroke to both open and closed positions.
 - .3 Provide all mounting hardware and linkages for actuator installation.

.2 Electric/Electronic

- .1 Dampers: Actuators shall be direct-mounted on damper shaft or jackshaft unless shown as a linkage installation. For low-leakage dampers with seals, the actuator shall be mounted with a minimum 5° available for tightening the damper seals. Actuators shall be mounted following manufacturer's recommendations.
- .2 Valves: Actuators shall be connected to valves with adapters approved by the actuator manufacturer. Actuators and adapters shall be mounted following the actuator manufacturer's recommendations.

3.5 CLEANING

- .1 The contractor shall clean up all debris resulting from his/her activities daily. The contractor shall remove alt cartons, containers, crates, etc., under his/her control as soon as their contents have been removed. Waste shall be collected and placed in a designated location.
- .2 keeping it free from dust, dirt, and debris, etc.
- .3 At the completion of work, all equipment furnished under this section shall be checked for paint damage, and any factory-finished paint that has been damaged shall be repaired to match the adjacent areas. Any cabinet or enclosure that has been deformed shall be replaced with new material and repainted to match the adjacent areas.

3.6 TRAINING

- .1 Provide a minimum of **one** on-site or classroom training sessions, throughout the contract period for personnel designated by the owner.
- .2 Provide two additional training sessions at **one** month following building's turnover. Each session shall be for **one** day in length and must be coordinated with the building owner.
- .3 Train the designated staff of owner's representative and owner to enable them to do the following:

Day-to-day Operators:

- .1 Proficiently operate the system.
- .2 Understand control system architecture and configuration.
- .3 Understand DDC system components.
- .4 Understand system operation, including DDC system control and optimizing routines (algorithms).
- .5 Operate the workstation and peripherals.
- .6 Log on and off the system.
- .7 Access graphics, point reports, and logs.
- .8 Adjust and change system set points, time schedules, and holiday schedules.
- .9 Recognize malfunctions of the system by observation of the printed copy and graphical visual signals.

- .10 Understand system drawings and Operation and Maintenance manual.
- .11 Understand the job layout and location of control components.
- .12 Access data from DDC controllers and ASCs.
- .13 Operate portable operator's terminals.
- .4 Provide course outline and materials in accordance with the "Submittals" article in Part I of this specification. The instructor(s) shall provide one copy of training material per student.
- .5 The instructor(s) shall be factory-trained instructors experienced in presenting this material.
- .6 Classroom training shall be done using a network of working controllers representative of the installed hardware.

3.7 CONTROL VALVE INSTALLATION

- .1 Valve submittals shall be coordinated for type, quantity, size, and piping configuration to ensure compatibility with pipe design.
- .2 Slip-stem control valves shall be installed so that the stem position is not more than 60 degrees from the vertical up position. Ball type control valves shall be installed with the stem in the horizontal position.
- .3 Valves shall be installed in accordance with the manufacturer's recommendations.
- .4 Control valves shall be installed so that they are accessible and serviceable and so that actuators may be serviced and removed without interference from structure or other pipes and/or equipment.
- .5 Isolation valves shall be installed so that the control valve body may be serviced without draining the supply/return side piping system. (*Note to designer: this must also be shown.*) Unions shall be installed at all connections to screw-type control valves.
- .6 Provide tags for all control valves indicating service and number. Tags shall be brass, 1.5 inch in diameter, with 1/4 inch high letters. Securely fasten with chain and hook. Match identification numbers as shown on approved controls shop drawings.

3.8 CONTROL DAMPER INSTALLATION

- .1 Damper submittals shall be coordinated for type, quantity, and size to ensure compatibility with sheet metal design.
- .2 Duct openings shall be free of any obstruction or irregularities that might interfere with blade or linkage rotation or actuator mounting. Duct openings shall measure 1/4 in. larger than damper dimensions and shall be square, straight, and level.
- .3 Individual damper sections, as well as entire multiple section assemblies, must be completely square and free from racking, twisting, or bending. Measure diagonally from upper corners to opposite lower corners of each damper section. Both dimensions must be within 0.3 cm (1/8 in.) of each other.

- .4 Follow the manufacturer's instructions for field installation of control dampers. Unless specifically designed for vertical blade application, dampers must be mounted with blade axis horizontal.
- .5 Install extended shaft or jackshaft according to manufacturer's instructions. (Typically, a sticker on the damper face shows recommended extended shaft location. Attach shaft on labeled side of damper to that blade.)
- .6 Damper blades, axles, and linkage must operate without binding. Before system operation, cycle damper after installation to ensure proper operation. On multiple section assemblies, all sections must open and close simultaneously.
- .7 Provide a visible and accessible indication of damper position on the drive shaft end.
- .8 Support ductwork in area of damper when required to prevent sagging due to damper weight.
- .9 After installation of low-leakage dampers with seals, caulk between frame and duct or opening to prevent leakage around perimeter of damper.

3.9 STARTUP AND CHECKOUT PROCEDURES

- .1 Start up, check out, and test all hardware and software and verify communication between all components.
 - .1 Verify that all control wiring is properly connected and free of all shorts and ground faults. Verify that terminations are tight.
 - .2 Verify that all analog and binary input/output points read properly.
 - .3 Verify alarms and interlocks.
 - .4 Verify operation of the integrated system.
- .2 Submit report to the consultant and include as built information.

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 17	:	Refrigeration
Division 22	:	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 ice slab and backfill with specified materials.
- .2 Excavation for two 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 ice pad. A provisional quantity has been estimated for disposal of this contaminated soil, if encountered. 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 coarse 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.
- .4 A topographic survey of the compacted sand layer for the ice pad is to be completed prior to placement of the insulation. The sand shall be placed level, within a tolerance of 3mm in 3m and 6mm overall.

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 22 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.

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 (Heavy Duty and fire routes)	-	150mm Gran. 'A' 450mm Gran. 'B'
TYPE 'B' PAVEMENT (Regular Duty)	-	150mm Gran. 'A' 300mm Gran. 'B'
TYPE 'C' PAVEMENT (Concrete or paved sidewalk)	-	300mm Gran. 'A'

- .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. Generally

- 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 ($\frac{1}{4}$ ") 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.