

TECHNICAL SPECIFICATIONS FOR

TORONTO DISTRICT SCHOOL BOARD
DOOR & WINDOW REPLACEMENT AND INTERIOR RENOVATION
AT GREENLAND PUBLIC SCHOOL

15 Greenland Road, North York, ON, M3C 1N1

TDSB PROJECT NO.: TR-19-0160
EAI Project No.: 219113
Issued for Tender: December 19th, 2019



ARCHITECTURAL CONSULTANT
ETUDE ARCHITECTS INC.

MECHANICAL/ELECTRICAL CONSULTANT
SURI & ASSOCIATES LTD.

SET NUMBER

**DOOR & WINDOW REPLACEMENT AND INTERIOR RENOVATION
AT GREENLAND PUBLIC SCHOOL**

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END OF DOCUMENT

1. General

- 1.1 Provide public way and overhead protection at all building entrances and public ways exits in accordance with applicable Acts and Regulations. Overhead protection on private property shall meet the same requirements as public way protection. A covered way shall be capable of supporting any load likely to be applied to it. As a minimum, the covered way shall be capable of supporting a load of at least 2.4kN/m². Submit overhead protection drawings, signed and sealed by a Professional Engineer licensed to practice in the Work location and having the appropriate Building Code certification. The overhead protection drawings shall include a comment confirming the overhead protection's capability to withstand likely impact loads.
- 1.2 Prior to the start of the work, submit written confirmation that the installation has been completed in accordance with the drawings submitted, signed by a Professional Engineer licensed to practice in the Work location.

2. Access Design

- 2.1 Scaffolding shall be designed by a Professional Engineer Registered in the location of the Work as required by applicable construction safety regulations. As a minimum, this shall be required for scaffolding over 15m high or 10m in height if constructed of a tube and clamp system. Submit stamped shop drawings for consultant review a minimum of one week prior to erection of scaffold.
- 2.2 Drawings shall indicate all materials to be used and fastening mechanisms.
- 2.3 Prior to the start of the work, submit written confirmation that the installation has been completed in accordance with the drawings, signed by a Professional Engineer licensed to practice in the Work location.
- 2.4 Prior to the start of the work, submit a work plan as per CSA Standard Z91, Health and Safety Code for Suspended Equipment Operations.

END OF SECTION

1 GENERAL

1.1 The requirements of the Articles of Agreement, Conditions of the Contract, Division 1 apply to and form all Sections of the Contract Documents and the Work.

1.2 Work in this Specification is divided into descriptive sections which are not intended to identify absolute contractual limits between Subcontractors, nor between the Contractor and their Subcontractors. The Contractor is responsible for organizing division of labour and supply of materials essential to complete the Contract.

1.3 It is intended that Work supplied under these Contract Documents shall be complete and fully operational in every detail for the purpose required. Including materials not herein mentioned, but which may be found necessary to complete or perfect any portion of Work in accordance with the Contract Documents.

1.4 Work designated as "N.I.C." is not included in this Contract.

1.5 Specifications, Schedules and Drawings are complementary and items mentioned or indicated on one may not be mentioned or indicated on the others.

1.6 Mention in the specifications or indication on the drawings of materials, Products, operations, or methods, requires that the Contractor Provide each item mentioned or indicated of the quality or subject to the qualifications noted; perform according to the conditions stated each operation prescribed; and provide labour, materials, Products, equipment and services to complete the Work.

1.7 Where the singular or masculine is used in the Contract Documents, it shall be read and construed as if the plural, feminine or neuter had been used when the context or the statement so requires and as required to complete the Work, and the rest of the sentence, clause, paragraph, or Article shall be construed as if all changes in grammar, gender or terminology thereby rendered necessary had been made.

1.8 The terms "approved", "review", "acceptance", "acceptable", "satisfactory", "selected", "directed", "required", "submit", or similar words or phrases are used in standards or elsewhere in Contract Documents, it shall be understood, that words "by (to) the Consultant" follow, unless context provides otherwise.

1.9 The terms "exposed" or "exposed to view" refers to surfaces that are within the line of vision of persons from any accessible viewpoint, both within and without the building. Where any part of a surface is exposed to view, all other portions of that surface shall also be considered as exposed to view.

1.10 Refer to TDSB General Requirements and shall take precedence in the case of any discrepancies.

2 EXISTING SITE CONDITIONS

2.1 Make a careful examination of the site, and investigate and be satisfied as to all matters relating to the nature of the Work to be undertaken, as to the means of access and egress thereto and therefrom, as to the obstacles to be met with, as to the extent of the Work to be performed and any and all matters which are referred to in the Contract Documents.

2.2 Report any inconsistencies, ambiguities, discrepancies, omissions, and errors between Site conditions and Contract Documents to the Consultant prior to the commencement of Work. If inconsistencies, ambiguities, discrepancies, omissions, and errors are not reported and clarified, the most stringent requirement shall govern, as determined by the Consultant.

2.3 Before commencing the Work of any Section or trade, carefully examine the Work of other Sections and trades upon which it may depend, examine substrate surfaces, and report in writing to the Consultant, defects which might affect new Work. Commencement of Work shall constitute acceptance of conditions and Work of other sections, trades, and Other Contractors upon which the new Work depends. If repair of surfaces is required after commencement of specific work it shall be included in the work of the trade providing the specific system or finish.

2.4 Record pre-existing site conditions in accordance with TDSB General Requirements.

3 USE OF SITE

3.1 Accept full responsibility for assigned work areas from the time of Contract award until Substantial Performance of the Work.

3.2 Check means of access and egress, rights and interests which may be interfered with. Do not block lanes, roadways, entrances or exits. Direct construction traffic and locate access to site as directed by municipality.

3.3 Where encroachment beyond property limits is necessary make arrangements with respective property owners.

4 ACCESS/PROPERTY CONSTRAINTS

4.1 The building will remain occupied throughout construction and will require hoarding and access routes to be maintained during normal hours of operation. Areas of the Work in existing buildings shall be carried on at all times so that there will be a minimum of interference with the normal function of the facility.

4.2 Provide and maintain access facilities as may be required for access to the Work.

4.3 Minimize disruption, noise and dust to the functions of existing operational areas of existing buildings. Times of entry, routes of access and time required to complete the Work shall be arranged and scheduled in cooperation with the Owner.

- 4.4 Confine Work and operations of employees to limits indicated by the Contract Documents. Do not unreasonably encumber the premises with products.
- 4.5 Organize delivery of materials/equipment to and removal of debris and equipment from place of Work to permit continual progress of work and suitable for restricted site conditions.
- 4.6 Contractor to receive all construction deliveries and endeavour to avoid such deliveries interrupting the school office. School staff shall not sign for any construction related deliveries.
- 4.7 Determine and make arrangement as required for loading and unloading of equipment and Products at times that will not affect public traffic flow and that will be permitted by the City of Toronto. Conform to City by-laws with regard to parking restrictions and other conditions.
- 4.8 Make provisions and arrangements and provide allowances if times for loading and unloading allowed by the City of Toronto are other than regular working hours.
- 4.9 All Products, materials and equipment required on Site shall be portable and/or size suitable for access and movement on Site and without causing damage to buildings.
- 4.10 Workers shall not enter existing building beyond construction areas except where required for connection or modification to existing services or other such work. Arrange such requirements with Owner prior to entering existing occupied areas.
- 4.11 Provide locked doors in barriers, permit access by Owner and Consultant to Work areas and to areas Contractor is responsible for.
- 4.12 Personnel access and material deliveries to the Site shall be only by routes designated by the Owner. Coordinate delivery times with the Owner to be as permitted by the Owner.
- Owner's equipment such as trucks, bins, dollies, and other such equipment/facilities shall not be used by Contractors. Arrangements for handling items weighty or bulky enough to require special treatment must be made and reviewed with the Owner.
- 4.13 Advise the Owner 48 hours in advance of large or cumbersome item deliveries. Give particulars of item size and weight, protection to existing surfaces to be provided and safety precautions during movement.

5 ACCESS TO AND DRIVING IN SCHOOL YARDS

5.1 Access to School Yard: Vehicles shall not enter or be parked in school yards without first obtaining the authorization of the school principal or his/her designate, usually the Chief Caretaker.

5.2 Driving in School Yards: When a vehicle is being driven on the school grounds, the driver shall observe normal safe driving practices consistent with proximity to school zones, and escorted by a designated "flagman" on foot.

5.3 No vehicle shall be left unsupervised with keys in the ignition, nor with its engine running.

6 SECURITY

6.1 Be responsible for security of all areas affected by Work of this Contract until taken over by Owner. Take steps to prevent entry to the Work by unauthorized persons and guard against theft, fire and damage by any cause.

6.2 Provide suitable surveillance equipment and/or employ guard services, as required to adequately protect the work in accordance with TDSB General Requirements.

6.3 Make provisions to permit Owner's security personnel to view areas where all Work is being performed.

6.4 Take acceptable precautions to guard Work site, premises, materials and the public during and after working hours due to the Work of this Contract.

6.5 Any security service provided by the Owner is for the protection of the Owner's interest in the Work on the Site and shall not relieve the Contractor of the responsibility to protect the Site and the Work of the Contract.

7 SCHOOL SAFETY

7.1 Contractor shall understand, and ensure that all Trades understand that student safety is the first priority in all instances.

7.2 The building shall remain secure from intrusion at all times. Buildings which have a surveillance system shall have the surveillance system operational at all times. In such cases where the surveillance system must be shut down by the Contractor to effect repairs or other alterations of any description the Contractor shall be to protect the premises outside the school's normal hours of operation.

7.3 All personal injury incidents and property damage, no matter how minor, which occur on school property, shall be reported immediately to the school principal.

8 CONTINUITY OF EXISTING SERVICES

- 8.1 Contractor must organize work at the school in cooperation with the Principal, through the Consultant, so that the academic programme of the school is not disrupted.
- 8.2 Shutdowns and planning of operations that may affect Owner's use of services shall be coordinated with and in accordance with the Owner's written directions. Provide notice for all required interruptions to utility, heating, cooling, mechanical, electrical, and life safety systems.
- 8.3 Coordinate and provide necessary services, access, exiting and other facilities as required.
- 8.4 Make written requests for shutdown at least 5 working days in advance, unless specifically stated herein or as otherwise instructed by the Owner.
- 8.5 Shutdowns shall be scheduled in advance with Owner and shutdown period shall be minimized to Owner's convenience. Facilities in existing adjacent areas will be occupied during the Work.
- 8.6 Major shutdowns shall take place on weekends or at night by prior arrangement with and at no additional cost to the Owner.
- 8.7 Tag and mark switches and valves used by the Contractor to isolate services with name of Contractor, tradesman's name, date and time of shut-off, and date and time to be turned back on.
- 8.8 Arrange work so that physical access to existing adjacent facilities is not unduly interrupted at any one time except as provided otherwise.
- 8.9 Protect existing work to remain at the commencement of each work shift in occupied areas, as completely as possible to hold the replacing of damaged work to a minimum. Provide covering and other protection material. Include protection for access routes and temporary storage areas. Make good damage to existing surfaces caused by lack of adequate protection. Protection in such areas shall be removed at the end of each work shift.
- 8.10 All areas shall be cleaned and left in condition suitable for use by Owner and building operations before commencement of their work day.

8.11 Minimize disruption, vibration, noise and dust to the function of existing building. Machine tools which are set up in fixed locations shall be so located as to minimize noise and suitable sound deflectors shall be used if directed by the Consultant. Air compressors and pneumatic hammers shall be used only with the express authorization of the Consultant. Gasoline welding machines or gasoline driven compressors shall not be used. The Contractor may be requested from time to time to suspend noisy or otherwise objectionable operations during certain functions, should such operations cause undue interference with the said functions. The Contractor will be expected to extend the fullest co-operation and courtesy in such cases.

8.12 These requirements are for security reasons and for the consideration of the Owner. Requirements shall not be construed as cause for elimination or restriction of Contractor's working schedule, claims for delay or work, nor additional cost.

9 **ASBESTOS (ACM's)**

9.1 No products, materials or equipment containing asbestos in any form will be permitted to be used on the project.

9.2 Prior to any work being done, the Contractor shall review the Asbestos Management Program Manual of each school and the Hazardous Materials Report in this specification with the Head Caretaker and determine whether ACM's will be disturbed by project work.

9.3 If it is determined by the Contractor that ACM's will be disturbed, the Contractor shall notify the Owner of their findings. The Owner shall arrange for appropriate remedial action prior to commencement of the project work.

9.4 If the Contractor encounters "unexpected" ACM's during the course of demolition of work, the Contractor shall temporarily cease such work at once, immediately inform Head Caretaker for fan shutdown, and report to the Consultant.

10 **WASTE AUDIT/PLANS FOR WASTE REDUCTION**

10.1 Comply with requirements of authorities having jurisdiction.

10.2 Prepare and submit waste audit and waste reduction plan in accordance with Ontario Regulation 102/94 Waste Audits and Waste Reduction Workplans.

10.3 Prepare and submit source separation plan in accordance with Ontario Regulation 103/94 Industrial, Commercial and Institutional Source Separation Programs.

10.4 Deliver to nearest appropriate depot all materials accepted for recycling by the region or municipality having jurisdiction over the Place of Work, including but not limited to cardboard, paper, plastic, aluminum, steel, and glass. Deliver to nearest appropriate depot all scrap and excess gypsum wallboard for recycling of this material. Pay all costs for this work.

END OF SECTION

1 GENERAL

1.1 Allowances included in the Tender Price Schedule are for items of Work which could not be fully quantified prior to Bidding.

1.2 Expend each allowance as directed by the Consultant in writing. Work covered by allowances shall be performed for such amounts and by such persons as directed by Consultant.

1.3 Each allowance will be adjusted to actual cost as defined hereunder and the Contract Price will be amended accordingly by Contract Change Order.

1.4 Progress payments for Work and Products authorized under allowances will be made in accordance with the payment terms set out in Conditions of the Contract.

1.5 A schedule shall be prepared jointly by the Consultant and Contractor to show when items called for under allowances must be authorized by the Consultant for ordering purposes so that the progress of the Work will not be delayed.

1.6 Where a Cash Allowance is for work performed under a Subcontract, the Contractor or Consultant shall Bid the work involved and submit the Bids received, with the Contractor's recommendations, for approval.

1.7 Refer to TDSB Supplementary Articles Definitions and Conditions.

2 CASH ALLOWANCES

2.1 Cash allowances, unless otherwise specified, cover the net cost to the Contractor of services, Products, construction machinery and equipment, freight, handling, unloading, storage, installation where indicated, and other authorized expenses incurred in performing the Work. Cash allowances shall not be included by a Subcontractor in the amount for their Subcontract work.

2.2 Overhead and Profit for cash allowances may only be charged against sum total of all cash allowances. Refer to TDSB Supplementary Articles, Definitions and Conditions. Overhead and profit for cash allowances shall be included in base bid price identified in the Bid Form.

2.3 Supply only allowances shall include:

- .1 Net cost of Products.
- .2 Delivery to Site.
- .3 Applicable taxes and duties, excluding HST.

2.4 Supply and install allowances shall include:

- .1 Net cost of Products.
- .2 Delivery to Site.
- .3 Unloading, storing, handling or Products on Site.
- .4 Installation, finishing and commissioning of Products.
- .5 Applicable taxes and duties, excluding HST.

2.5 Inspection and testing allowances shall include:

- .1 Net cost of inspection and testing services.
- .2 Applicable taxes and duties, excluding HST.

2.6 Other costs related to work covered by cash allowances are not covered by the allowance but shall be included in the Contract Price.

2.7 Where costs under a cash allowance exceeds the amount of the allowance, the Consultant will re-allocate other unexpended allowances to cover the difference. Refer to TDSB Supplementary Articles, Definitions and Conditions.

2.8 Progress payments on accounts of work authorized under cash allowances shall be included in the monthly certificate for payment.

2.9 Submit, before application for final payment, copies of all invoices and statements from suppliers and Subcontractors for work which has been paid from cash allowances.

END OF SECTION

1 GENERAL

- 1.1 Coordination of the Work of all Sections of the specifications as required to complete the Project is the responsibility of the Contractor.
- 1.2 Cooperate and coordinate with Other Contractors including Other Contractor's employed by Owner. Ensure that Subcontractors and trades cooperate and coordinate their work to have the Work performed expeditiously and to be satisfactory in all respects at completion. Ensure cooperation of workers in laying out and performing Work. Maintain efficient and continuous supervision.
- 1.3 Ensure that Subcontractors and trades cooperate with other subcontractors and trades whose work attaches to or is affected by their own work. Ensure that minor adjustments are made to make adjustable work fit fixed work.
- 1.4 Allow access of Owner's and Other Contractors on site and to areas of Work. Cooperate and coordinate with such Other Contractors. Schedule work to complement work of such Other Contractors.
- 1.5 Entry by the Owner's own forces and by Other Contractors shall not mean acceptance of the Work and shall not relieve the Contractor of their responsibility to complete the Contract.
- 1.6 Placing, installation, application and connection of work by the Owner's own forces or by Other Contractors on and to the Contractor's Work shall not relieve the Contractor of his responsibility to provide and maintain the specified warranties.
- 1.7 Coordinate with removals/installations specified in other Divisions and Other Contracts.
- 1.8 Coordinate the work of this Contract with work of designated substance removal work and demolition work under separate contract. No allowance shall be made subsequently by the Owner or Consultant for lack of coordination and no claim will be considered for circumstances and omissions which could have been coordinated, prevented or included for had these procedures been followed.
- 1.9 Coordination of the installation of systems specified in Divisions 15 and 16, including the interrelating operation and functioning between components of a system and between systems, is the responsibility of those performing the work of those Divisions, with final coordination the responsibility of the Contractor.
- 1.10 Coordinate relocation of existing mechanical and electrical items with work specified in Divisions 15, and 16.
- 1.11 Existing equipment shall remain in present locations unless designated otherwise. Protect from damage. Remove, store and reinstall existing fixed equipment, fixtures and components which interfere with construction and which are scheduled for relocation.

- 1.12 Pay particular attention to types of ceiling construction and clearances throughout, especially where recessed fixtures are required. Coordinate work with Other Contractors and Subcontractors wherever ventilation ducts or piping installations occur to ensure that conflicts are avoided.
- 1.13 Install ceiling mounted components in accordance with final ceiling plans. Inform Consultant of conflicting installations. Install as directed.
- 1.14 Install and arrange ducts, piping, tubing, conduit, equipment, fixtures, materials and product to conserve headroom and space with minimum interference and in neat, orderly and tidy arrangement. Run pipes, ducts, tubing and conduit, vertical, horizontal and square with building grid unless otherwise indicated. Install piping, ducts, and conduit as close to underside of structure as possible unless shown otherwise.
- 1.15 Make provision for unrestricted relocation of light fixtures to replace ceiling panels at grid spaces of the same size, without interference or restriction by items located within the ceiling space.
- 1.16 Where supports or openings are to be left for the installation of various parts of the Work furnish the necessary information to those concerned in ample time so that proper provision can be made for such items. Have cutting, drilling and other remedial work, and the subsequent patching or other work required for failing to comply with this requirement, performed at a later date at no additional Cost to Owner.
- 1.17 Properly coordinate the work of the various Sections and trades, taking into account the existing installations to assure the best arrangement of pipes, conduits, ducts and mechanical, electrical and other equipment, in the available space. Under no circumstances will any extra payment be allowed due to the failure by the Contractor to coordinate the work. If required, in critical locations, prepare interference and/or installation drawings showing the work of the various Sections as well as the existing installation, and submit these drawings to the Consultant for review before the commencement of work.
- 1.18 Coordinate with mechanical and electrical trades to ensure protecting supporting, disconnecting, cutting off, capping, diverting, relocating or removing of existing services in areas of Work before commencement of alteration work.
- 1.19 Execute Work at times to ensure a minimum of disturbance to building occupants and in compliance with the Tenant Leasehold Improvement Manual.
- 1.20 In case of damage to active services on utilities, notify Consultant and respective authorities immediately and make all required repairs under direction of Consultant and respective authorities. Carry out repairs to such damaged services and utilities continuously to completion, including working beyond regular working hours.

- 1.21 Existing areas shall remain in use except where alteration work is actually in progress. Confine effects of Work to areas indicated on Drawings unless otherwise approved by Owner.

2 **METRIC DIMENSIONS**

- 2.1 Measurements are expressed in metric (SI) units and depending on the progress made in the various sectors of the industry are either hard or soft converted units.
- 2.2 All metric units specified shall be taken to be the minimum acceptable unless otherwise noted.
- 2.3 It is the Contractor's responsibility to check and verify with manufacturers and suppliers on the availability of materials and products in either metric or imperial sizes. Be responsible for coordinating products supplied in metric (SI) and imperial units into the overall layout.
- 2.4 Where both metric and imperial sizes or dimensions are shown, the metric size or dimension shall govern.

3 **BUILDING DIMENSIONS**

- 3.1 Take necessary job dimensions for the proper execution of the work. Assume complete responsibility for the accuracy and completeness of such dimensions, and for coordination.
- 3.2 Verify that work, as it proceeds, is executed in accordance with dimensions and positions indicated which maintain levels and clearances to adjacent work, as set out by requirements of the Drawings, and ensure that work installed in error is rectified before construction resumes.
- 3.3 Check and verify dimensions referring to the work and the interfacing of services.
- 3.4 Do not scale directly from the Drawings. If there is ambiguity or lack of information, immediately inform the Consultant. Changes through the disregarding of this clause shall be the responsibility of the Contractor.
- 3.5 All details and measurements of any work which is to fit or to conform with work installed shall be taken at the building.
- 3.6 Advise Consultant of discrepancies and if there are omissions on Drawings, particularly reflected ceiling plans and jointing patterns for surfaces finishes, which affect aesthetics, or which interfere with services, equipment or surfaces. Do not proceed with work affected by such items without direction from the Consultant.
- 3.7 Provide written requirements for site conditions and surfaces necessary for the execution of respective work, and provide setting drawings, templates and all other information necessary for the location and installation of material, holes, sleeves, inserts, anchors, accessories, fastenings, connections and access panels. Inform respective contractors whose work is affected by these requirements and preparatory work.

4 INTERFERENCE AND COORDINATION DRAWINGS

- 4.1 Coordinate placement of equipment to ensure that components will be properly accommodated within the spaces provided prior to commencement of work.
- 4.2 Prepare interference and equipment placing drawings to ensure that all components will be properly accommodated within the spaces provided. Provide copies of interference drawings to Consultant when requested by Consultant.
- 4.3 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.
- 4.4 Take complete responsibility for any remedial work that results from failure to coordinate any aspect of the Work prior to its fabrication/installation.
- 4.5 Ensure that accesses and clearance required by jurisdictional authorities and/or for easy maintenance of equipment are provided in the layout of equipment and services.

5 SLEEVING AND INSERT DRAWINGS AND TEMPLATES

- 5.1 Prepare sleeving drawings for work of Divisions 15, and 16, showing size and location of all penetrations through load bearing elements. Submit sleeving drawings in the form of one transparency and 4 prints to Consultant for review not less than 15 days prior to construction of affected elements.
- 5.2 Prepare insert setting drawings for work to be cast into concrete and/or mortared into masonry elements. Submit insert setting drawings in the form of a transparency and 4 prints to Consultant for review not less than 15 days prior to construction of affected elements.
- 5.3 Ensure that setting drawings, templates, and all other information necessary for the location and installation of materials, fixtures, equipment, holes, sleeves, inserts, anchors, accessories, fastenings, connections, and access panels are provided by each Section whose work requires cooperative location and installation by other Sections, and that such information is communicated to the applicable installer. Have cutting, fixing and making good to the work of Other Contractors, Subcontractors and trades required for, and make up time lost as result of, failure to comply with this requirement, at no additional cost to Owner.

END OF DOCUMENT

1 PRE CONSTRUCTION MEETING

- 1.1 Attend a pre-construction meeting, arranged and conducted by the Consultant.
- 1.2 Co-ordinate and organize attendance by representatives of major Subcontractors and parties in contract with the Contractor.
- 1.3 Consultant will arrange attendance of other interested parties not responsible to the Contractor.
- 1.4 Consultant will distribute copies of Agenda prior to meeting.
- 1.5 Agenda will include but not be limited to the following topics as are pertinent to the Contract.
 - .1 Review project communications procedures.
 - .2 Review contract administration requirements including submittals, payment, and change order procedures.
 - .3 Identify all critical points on construction schedule for positive action.
 - .4 Identify any product availability problems and substitution requests.
 - .5 Establish site arrangements and temporary facilities.
 - .6 Review Consultants's inspection requirements.
 - .7 Review any points which, in Owner's, Consultants, and Contractor's opinion, require clarification.
- 1.6 Be prepared to provide specific information relative to agenda items as they are pertinent to the Contract.

2 PROGRESS MEETINGS

- 2.1 Attend regularly scheduled progress meetings to be held on Site at times and dates that are mutually agreed to by the Owner, Consultant, and Contractor.
- 2.2 Co-ordinate and organize attendance of individual Subcontractors and material suppliers when requested. Relationships and discussions between Subcontractor participants are not the responsibility of the Consultant and do not form part of the meetings content.
- 2.3 Ensure that Contractor representatives in attendance at meetings have required authority to commit Contractor to actions agreed upon. Assign same persons to attend such meetings throughout the contract period.

- 2.4 Inform the Consultant in advance of meetings regarding all items to be added to the agenda.
- 2.5 Be prepared to provide specific information relative to agenda items at each meeting as they are pertinent to the Contract.

- 2.6 Agenda will include but not be limited to the following topics as are pertinent to the Contract.
 - .1 Review and agreement of previous minutes.
 - .2 Construction safety.
 - .3 Status of submittals.
 - .4 Quality control.
 - .5 Co-ordination.
 - .6 Contract Schedule
 - .7 Work plan up to next scheduled meeting.
 - .8 Requests for information/clarification.
 - .9 Contemplated changes.

- 2.7 Record minutes of meeting and distribute type written copies to all participants and other interested parties, within one week of meeting date.

END OF SECTION

1 GENERAL

1.1 Be responsible for planning and scheduling of the Work. As a minimum, prepare and update the following schedules:

- .1 Contract Schedule.
- .2 Detailed Construction Schedule.

1.2 Be responsible for ensuring that Subcontractors plan and schedule their respective portions of the Work. Subcontractor's schedules shall form part of the above mentioned schedules.

2 CONTRACT SCHEDULE

2.1 Prepare and submit the Contract Schedule within 5 days following award of Contract. This schedule, once it is reviewed by the Consultant and if it meets the Consultant's project requirements, will become contractual.

2.2 The Contract Schedule shall be developed using a logic network technique for planning and scheduling.

2.3 The Contract Schedule shall be submitted for approval in its optimum levelled form. This presentation may be in either a time scaled network or a bar chart form. It shall be subdivided into either work areas or systems as applicable.

2.4 The Contract Schedule shall include the following information:

- .1 Starting and ending dates of each activity including the float periods;
- .2 Manpower requirements for each activity;
- .3 Order and delivery dates for major or critical equipment.
- .4 Interdependency with activities of other Contractors;
- .5 Dates specified in the Contract Documents;
- .6 Dates on which specific data will be required for submittal, i.e., Vendor data, shop drawings, samples, etc.

2.5 This schedule shall be reviewed and updated monthly by the Contractor so as to reflect any Contract changes as well as major changes to the schedule.

3 DETAILED CONSTRUCTION SCHEDULE

3.1 Prepare and submit a detailed construction schedule within 14 days of final review and acceptance of the Contract Schedule. This schedule, once it is reviewed and accepted by the Consultant, will be updated and submitted monthly with the Contract Schedule and weekly once the Contractor starts on Site.

3.2 This schedule shall cover the construction period. It will show, in detail, activities on a daily basis indicating durations, manpower and constraints. The activities shown on this schedule shall further clarify or detail the activities shown on the Contract Schedule.

3.3 The detailed construction schedule shall be presented in a bar chart form.

END OF SECTION

1 GENERAL

1.1 Provide labour, Products, equipment, services tools and supervision necessary for submittals. Make submittals specified in this Section to Consultant unless otherwise specified.

- .1 Verify accuracy and completeness of submittals prior to submission.
- .2 Verify field measurements, field construction criteria, catalogue numbers and similar data.
- .3 Co-ordinate each submittal with requirements of the Work and the Contract Documents.
- .4 Notify Consultant in writing at time of submission, of any deviation in submittals from requirements of the Contract Documents.

1.2 Submit in accordance with dates established under Section 01 33 00 for shop drawings, fabrication, manufacture, erection and installation to provide adequate time for reviews, securing necessary approvals, possible revisions and resubmittals, placing orders, securing delivery and to avoid construction delays.

1.3 Accompany each submittal with a letter of transmittal in duplicate containing all pertinent information required for identification and checking of submittals including but not limited to the following:

- .1 Date of initial submission and date of each subsequent submission if required.
 - .2 Project title and Consultant's project number.
 - .3 Names of: .1 Contractor. .2 Subcontractor. .3 Supplier/manufacturer as applicable.
 - .4 Specification section numbers to which submission is related.
 - .5 Countersigned stamp of Contractor certifying that they have reviewed the submission.
- 1.4 Allow two week for the Consultant's review of each submission.
- 1.5 When submittals are resubmitted, transmit under a new letter of transmission.
- 1.6 Do not carry out Work until Consultants review of submittals has been completed.
- 1.7 Be responsible for payment of charges for delivery of submissions and resubmission to Consultant.

2 **PRODUCT DATA**

2.1 Before delivery of Products to the Site, submit Product data as specified in each section or as requested by the Consultant.

2.2 Submit manufacturer's Product data for systems, materials, and methods of installation proposed for use. Such literature shall identify systems, each component, and shall certify compliance of each component with applicable standards.

3 **SAMPLES**

3.1 Before delivery of Products to the Site, submit samples of Products as specified or as requested by the Consultant. Label samples as to origin and intended use in the Work and in accordance with the requirements of the Specification Sections. Samples must represent physical examples to illustrate materials, equipment or work quality and to establish standards by which completed Work is judged.

3.2 Ensure samples are of sufficient size and quantity, if not already specified, to illustrate:

.1 The quality and functional characteristics of Products, with integrally related parts and attachment devices.

.2 Full range of colours available.

3.3 Notify the Consultant in writing, at time of submission, of any deviations in samples from requirements of the Contract Documents, and state the reasons for such deviations.

3.4 Identify samples with Project name, Contract number, date, Contractor's name, number and description.

3.5 If samples are not acceptable, both samples will be returned. If samples are acceptable, one sample will be so indicated and returned. Be responsible for the cost of samples that are not accepted and for resubmission of samples.

3.6 Acceptable samples shall serve as a model against which the products incorporated in the work shall be judged.

3.7 Each Product incorporated in the Work shall be precisely the same in all details as the acceptable sample.

3.8 Should there be any change to the accepted sample, submit in writing for approval of the revised characteristics and resubmit samples of the Product for approval if requested.

3.9 When samples are very large, require assembly, or require evaluation at the Site, they may be delivered to the Site, but only with approval and as directed.

4 **SHOP DRAWINGS**

4.1 Arrange for the preparation of shop drawings as called for in the Contract Documents or as may be reasonably requested by the Consultant. The Contractor and each Subcontractor shall operate as experts in their respective fields and all shop drawings and samples shall conform to the requirements of the Contract Documents.

4.2 The term “shop drawings” means drawings, diagrams, schematics, illustrations, schedules, performance charts, brochures and other data which are required to illustrate details of the Work.

4.3 In addition to shop drawings specified in the specification sections, submit shop drawings required by jurisdictional authorities in accordance with their requirements.

4.4 Shop drawings for openings, sleeving and conduit

.1 Prior to preparation of shop drawings, coordinate sizes of all structural openings and sleeves with respective fabricators for mechanical ducting. Adjustments to the opening sizes indicated on the Contract Drawings shall not be made without the approval of the Consultant.

.2 Prior to detailing structural reinforcement on shop drawings, arrange for the Engineer of structure to review formed holes, recesses and sleeving. Completely dimension openings, recesses and sleeves and relate to suitable grid lines and elevation.

.3 Prior to forming of the structure, arrange for the preparation of shop drawings for review by the Consultant showing embedded conduit to be cast within the structure. Shop drawings shall include conduit from all sources.

4.5 Shop drawings shall indicate the following minimum criteria and any additional criteria indicated in the individual specification sections requiring shop drawings:

.1 Clear and obvious notes of any proposed changes from the Contract Documents.

.2 Fabrication and erection dimension.

.3 Provisions for allowable construction tolerances and deflections provided for live loading.

.4 Details to indicate construction arrangements of the parts and their connections, and interconnections with other work.

.5 Location and type of anchors and exposed fastenings.

.6 Materials, physical dimensions including thicknesses, and finishes.

.7 Descriptive names of equipment.

- .8 Mechanical and electrical characteristics when applicable.
 - .9 Information to verify that superimposed loads will not affect function, appearance, and safety of the work detailed as well as of interconnection work.
 - .10 Assumed design loadings, and dimensions and material specifications for load-bearing members.
- 4.6 Include in shop drawing submissions detailed information, templates, and installation instructions required for incorporation and connection of the Work.
- 4.7 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 drawing shall be indicated by stamp, date and signature of a qualified and responsible person possessing the appropriate authorization.
- 4.8 Be responsible for dimensions to be confirmed and correlated at the Site, for information that pertains solely to fabrication processes or to techniques of construction and installation and for coordination of the Work of all subtrades.
- 4.9 Submit shop drawings for the Consultant's review with reasonable promptness and in orderly sequence so as to cause no delay in the Work nor in the work of Other Contractors. At the time of submission, notify the Consultant in writing of any deviations in the shop drawings from the requirements of the Contract Documents. The Contractor will be held responsible for changes made from the Contract Documents which are not indicated or otherwise communicated in writing with the submission.
- 4.10 Drawings submitted by the Contractor as required herein are the property of the Owner who may use and duplicate such drawings where required in association with the Work.
- 4.11 Submit shop drawings, as indicated in each section of the Work, signed and sealed by a licensed Professional Engineer registered in the place of the Work.
- 4.12 Shop drawings shall have distinct, uniform letters, numerals and line thicknesses that will ensure the production of clear legible prints and also facilitate microfilming and reduced reproduction.
- 4.13 Submit six (6) copies of shop drawings. Any shop drawing submitted electronically must be followed up by hard copies. All drawings exceeding 8-1/2" x 11" format shall have a reproducible copy submitted along with 3 prints. However, in instances where catalogue items are specified, three clean copies of the manufacturer's catalogue may be submitted.

- 4.14 Shop drawings shall contain the following identification:
- .1 Project name and Contract number.
 - .2 Applicable 5-digit Contract Specification number describing the item.
 - .3 Location (unit, level, room number, etc.).
 - .4 Name of equipment or Product.
 - .5 Name of Subcontractor or supplier.
 - .6 Signature of Contractor certifying that Shop drawing is in conformance with Contract Documents.
 - .7 On submissions subsequent to the first, the following additional identification:
 - .1 The revision number.
 - .2 Identification of the item(s) revised.
- 4.15 Dimensions and designations of elements shall be shown in the same system of measurement used on the applicable Contract Drawings.
- 4.16 The Consultant reserves the right to refuse acceptance of drawing submissions not meeting the above requirements.
- 4.17 The Consultant's review will be for conformity to the design concept and for general arrangement only and such review shall not relieve the Contractor of responsibility for errors or omissions in the shop drawings or of responsibility for meeting all requirements of the Contract Documents unless a deviation on the shop drawings has been approved in writing by the Consultant.
- 4.18 The Contractor shall make any changes in shop drawings which the Consultant may require consistent with the Contract Documents and re-submit unless otherwise directed by the Consultant. When re-submitting the shop drawings, the Contractor shall notify the Consultant in writing of any revisions other than those requested by the Consultant.
- 4.19 Only drawings noted for revision and resubmission need be resubmitted.
- 4.20 File one copy of each submitted shop drawing at the Site.

5 CERTIFICATES

- 5.1 Submit certificates that are required by authorities having jurisdiction or that are requested in the specification sections.
- 5.2 Clearly show on each certification the name and location of the Work, name and address of Contractor, quantity and date of shipment and delivery and name of certifying company.

5.3 Certificates shall verify that Products and/or methods meet the specified requirements and shall include test reports of acceptable testing laboratories to validate certificates.

5.4 Submit certificates in duplicate and signed by an authorized representative of the certifying company.

6 CERTIFICATION OF TRADESMEN

6.1 Provide certificates, at the request of the Consultant, to establish qualifications of personnel employed on the Work where such certification is required by authorities having jurisdiction, by the Consultant or by the Contract Documents.

7 WARRANTIES

7.1 Submit extended warranties as requested in sections of the Specifications showing title and address of Contract, warranty commencement date and duration of warranty.

7.2 Extended warranties shall commence on termination of the standard warranty specified in the conditions of the contract and shall be an extension of these provisions. Clearly indicate what is being warranted and what remedial action is to be taken under the warranty. Ensure warranty bears the signature and seal of the Contractor.

7.3 Submit each extended warranty on a form that is acceptable to the Owner and Consultant.

8 INSPECTION AND TEST REPORTS

8.1 Submit inspection and test reports as specified in the Sections of the specifications for "Source Quality Control" and "Field Quality Control" within 3 working days of inspection or testing. If immediate action is required by the Contractor or Consultant inform the Consultant immediately and submit inspection and testing report within one working day.

8.2 Submit 3 copies of reports submitted with certificates of compliance indicating but not limited to the following:

- .1 Project name and number.
- .2 Date of inspection or test and date report is issued.
- .3 Name and address of inspection and testing company.
- .4 Name and signature of inspector or tester.
- .5 Identification of Product and Specification Section covering inspected or tested work.

- .6 Specified requirements for which the inspection or testing was performed and results of inspections or tests.
 - .7 Location of inspection or from which tested material was derived.
 - .8 Overview of inspection and testing methods and procedures.
 - .9 Remarks and observations on compliance with Contract Documents.
- 8.3 Inspection and test reports shall be signed by a responsible officer of the inspection and testing company.

9 **PROGRESS PHOTOGRAPHS**

- 9.1 Contractor to record progress with digital photographs and must be ready to submit photos of progress as requested.

10 **PROGRESS REPORTS**

- 10.1 Prepare a monthly progress report current to the last Friday of each month. The report shall indicate the period covered and include but not be limited to the following:

- .1 Executive Summary.
- .2 Areas of Concern/Action Required.
- .3 Work Accomplished This Period.
- .4 Work Planned Next Period.
- .5 Schedule Status.
- .6 Budget Status.
- .7 Status of Submittals.
- .8 Quality Control.
- .9 Contract Changes.
- .10 Outstanding Actions.

- 10.2 Submit the monthly progress report such that it is received by the Consultant no later than the Wednesday following the last Friday of the month, regardless of whether or not the Monday is a public holiday.

11 OPERATION AND MAINTENANCE MANUALS

- 11.1 Refer to TDSB General Requirements Section and submit Operation and Maintenance Manuals in accordance with Section 01730.

12 RECORD DOCUMENTS

- 12.1 Refer to TDSB General Requirements Section and submit record documents in accordance with Section 01720.

END OF SECTION

1 GENERAL

- .1 Be responsible for inspection and testing as required by the Contract Documents, statutes, regulations, by-laws, standards or codes or any other jurisdictional authority. Give the Consultant timely notice of the readiness for inspection, date and time for such inspection for attendance by the Consultant.
- .2 Verify by certification that specified products meet the requirements of reference standards specified in the applicable specification sections.
- .3 Conduct testing, balancing and adjusting of equipment and systems specified in applicable mechanical and electrical specifications sections by independent testing company.

2 INSPECTION AND TESTING BY THE OWNER

- .1 The Owner may appoint an independent inspection and testing company to carry out inspection and testing of the Work for conformance to the Contract Documents. Such costs for inspection and testing will be paid by the Owner. However, any additional inspection and testing due to non-conformance to the Contract Documents shall be at the Contractor's expense.
- .2 Inspections and testing by the Owner will be promptly made. Uncover for examination any Work covered up prior to inspection or without approval of the Consultant. Make good such Work at no cost to the Owner.
- .3 The Owner may inspect and test Products during manufacture, fabrication, shop testing, installation, construction and testing phases of the Contract. The Consultant will ascertain the quantity and quality of testing to be performed. Inspection and testing may be performed at the place of manufacture/fabrication, storage, or at the Site as designated by the Consultant. Where inspection and testing is done either during manufacture, fabrication, or at Site, ensure that proper facilities and assistance are provided.

3 INSPECTION AND TESTING

- .1 Source and Field Quality Control specified in Other Sections:
 - .1 This Section includes requirements for performance of inspection and testing specified under Source Quality Control and Field Quality Control in other Sections of the specifications.
 - .2 Do not include in work of this Section responsibilities and procedures that relate solely to an inspection and testing company's functions that are specified in another Section which is paid for directly by the Owner. Such information is included in this Section for Contractor's information only.
- .2 Do not limit responsibility for ensuring that products and execution of the work meet Contract requirements, and inspection and testing required to this end, to specified inspection and testing.
- .3 Arrange for inspection of all work by authorities having jurisdiction. Submit final unconditional certificate of approval by inspecting authorities.
 - .1 Provide Consultant and Owner's Representative 24 hour notice of date

when tests will occur.

- .2 Do not conceal work until tested and approved.
- .3 Re-testing and re-inspections of work found deficient, and costs of making good, shall be paid for by the Contractor.

4 QUALIFICATIONS OF INSPECTION AND TESTING COMPANIES

- .1 Inspection and testing companies to be certified by the Standards Council of Canada.
- .2 Companies engaged for inspection and testing shall provide equipment, methods of recoding and evaluation, and knowledgeable personnel to conduct tests precisely as specified in reference standards.
- .3 If requested, submit affidavits and copies of certificates of calibration made by an accredited calibrator to verify that testing equipment was calibrated and its accuracy ensured within the previous twelve months.

5 RESPONSIBILITIES OF THE CONTRACTOR

- .1 Be responsible for quality control methods and procedures to ensure performance of the work in accordance with the Contract Documents.

6 RESPONSIBILITIES OF INSPECTION AND TESTING COMPANIES

- .1 Determine from specifications and Drawings the extent of inspection and testing required for Work of the Contract. Subcontractors shall notify Consultant of any omissions or discrepancies in the work inspected and/or tested.
- .2 Perform applicable inspection and testing described in the Specifications and as may be additionally directed.
- .3 Provide competent inspection and testing personnel when notified by the Contractor that applicable work is proceeding. Inspection personnel shall cooperate with the Consultant and Contractor to expedite the Work.
- .4 Subcontractors shall notify the Consultant and Contractor of deficiencies and irregularities in the Work immediately when they are observed in the course of inspection and testing.
- .5 Inspection and testing companies shall not perform or supervise any of the Contractor's work, and shall not authorize:
 - .1 Performance of work that is not in strict accordance with the Contract Documents.
 - .2 Approval or acceptance of any part of the Work.

7 INSPECTION AND TESTING PROCEDURES

- .1 Perform specified inspection and testing only in accordance with specified reference standards, or as otherwise approved.
- .2 Observe and report on compliance of the Work to requirements of Contract Documents.
- .3 Ensure that inspectors are on site or at fabricator's operations for full duration of

critical operations, and as otherwise required to determine that the Work is being performed in accordance with the contract Documents.

- .4 Identify samples and sources of materials.
- .5 Review and report on progress of the work. Report on count of units fabricated and inspected at fabricator's operations.
- .6 Observe and report on conditions of significance to work in progress at time of inspection or at fabricator's operations. Include where applicable and if critical to the work in progress:
 - .1 Time and date of inspection.
 - .2 Temperature of air, materials, and adjacent surfaces.
 - .3 Humidity of air, and moisture content of materials and adjacent materials.
 - .4 Presence of sunlight, wind, rain, snow and other weather conditions.
- .7 Include in reports all information critical to inspection and testing.
- .8 Ensure that only materials from the work and intended for use therein are tested.
- .9 Determine locations for work to be tested

8 TOLERANCES FOR INSTALLATION OF WORK

- .1 Unless specifically indicated otherwise, work shall be installed plumb, level, square and straight.
- .2 Unless acceptable tolerances are otherwise specified in specification sections or are otherwise required for proper functioning of equipment, site services, and mechanical and electrical systems:
 - .1 "Plumb and level" shall mean plumb or level within 1 mm in 1 m.
 - .2 "Square" shall mean not in excess of 10 seconds lesser or greater than 90 degrees.
 - .3 "Straight" shall mean within 1 mm under a 1 m long straightedge.
 - .4 "Flush" shall mean within:
 - .1 6 mm for exterior concrete, masonry, and paving materials.
 - .2 1 mm for interior concrete, masonry, tile and similar surfaces.
 - .3 0.05 mm for other interior surfaces.
- .3 Allowable tolerances shall not be cumulative.

9 REFERENCE STANDARDS

- .1 Perform inspection and testing in accordance with Standards quoted and as required by procedures described in specified reference standards that are applicable to the work being inspected and tested.

10 DEFECTS

- .1 Defective products, materials and workmanship found at any time prior to

Contract Completion will be rejected regardless of previous inspections, testing, and reviews of the Work. Inspections, testing, and reviews shall not relieve the Contractor from their responsibility, but are a precaution against oversight or error. Remove and replace defective and rejected products, materials, systems, and workmanship. Be responsible for delays and expenses caused by rejection.

11 MOCK UPS

- .1 Where required by Contract Documents construction, unless indicated herein, mock-ups of work on Site, in size and at location directed by Consultant.
- .2 Construct mock-ups prior to start of affected work. Allow sufficient time for Consultant's review. Work affected by mock-ups may not commence prior to acceptance of mock-ups.
- .3 Construct mock-ups to include all related specified materials and workmanship. Make revisions as directed by Consultant, in accordance with the intent of the Contract Documents, until mock-ups are acceptable.
- .4 Mock-ups, reviewed and accepted by Consultant, shall become the standard of quality against which installed work will be measured.
- .5 Mock-ups, by prior arrangement, may be incorporated into finished work if approved by Consultant only.

12 DOCUMENTS ON SITE

- .1 Maintain at job site, one copy of each of the following:
 - .1 Contract Documents including Drawings, Specifications, Addenda, and other modifications to the Contract.
 - .2 'Review' or 'Reviewed as Modified' Shop Drawings.
 - .3 Project Construction and Shop Drawing Schedules.
 - .4 Site Instructions and Change Orders.
 - .5 Field Test Reports.
 - .6 Reports by Authorities having Jurisdiction.
 - .7 Building and other applicable permits.
 - .8 Daily log including:
 - .1 Weather conditions.
 - .2 Excavation conditions.
 - .3 Start and finish date of each Trade Contractor.
 - .4 Erection and removal dates of formwork.
 - .5 Date, quantities and particulars of each concrete pour.
 - .6 Dates and quantities roofing and waterproofing work.
 - .7 Visits to the Site by Owner, Consultants, Jurisdictional Authorities, Testing and Inspection companies, and material and equipment supplier representatives.

- .9 Material Safety Data Sheet pursuant to WHMIS (Occupational Health & Safety Act.).
- .10 As-built drawings recording as-built conditions, instructions, changes for structure, equipment, wiring, plumbing, etc., as called for in Section 01 72 00 and division 15 and 16, prior to being concealed.
- .11 Copies of applicable codes.
- .12 The above material shall be made available to the Consultant at their request.

13 BUILDING ENVELOPE

- .1 Requirements specified herein apply to all elements of the exterior building envelope.
- .2 Continuity of air barrier/vapour retarder and insulation components is critical and must be maintained at all locations. Where different systems meet, ensure proper interface and continuity between adjacent components by implementing suitable construction sequences and by using compatible materials only.
- .3 Maximum air leakage shall be $0.10L/(sAm^2)$ when measured with a warm-side relative humidity of 27-55% at 21°C and a measured air pressure difference of 75Pa.
- .4 Anchor exterior cladding components to structure in manner suitable to accommodate structural deflection and creep and to withstand loads from expected temperature gradients. Design anchorage to withstand expected wind loads, positive and negative, in accordance with applicable regulations.
- .5 Ensure that air spaces within exterior building components are firestopped in accordance with applicable regulations.
- .6 Ensure the air spaces on the outside of vertical air barrier/vapour retarder (walls), window systems, and curtain wall systems are constructed with adequate drainage provisions to the exterior.
- .7 Owner may complete a thermographic scan upon completion of the building envelope. Contractor will be responsible to correct identified thermal anomalies.

14 DRAINAGE

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

END OF SECTION

1 GENERAL

- 1.1 Provide Labour, Products, equipment, services, tools and Supervision to ensure that Work complies with minimum acceptable standards of materials and performance of Work in accordance with codes and standards referenced in the Specification.
- 1.2 Consider contract forms, codes, Specifications, standards, manuals, and installation and application instructions referred to in these specifications to be the latest published editions at the date of submission of the bid unless otherwise stated in the Specifications or otherwise required by the authorities having jurisdiction.

2 BY-LAWS, PERMITS, AND FEES

- 2.1 The Building Code - Ontario Regulation 350/06, including all amendments, shall govern the construction of the Work.
- 2.2 Comply with all By-Laws and regulations of authorities having jurisdiction. These codes and regulations constitute an integral part of the Contract Documents.
- 2.3 Pay for construction damage deposit required by authorities having jurisdiction.
- 2.4 Where permits, licenses, and inspection fees are required by authorities having jurisdiction for specific trade functions, they shall be obtained by particular subtrade responsible for that work.
- 2.5 Arrange for inspection, testing of Work and acceptance required by the authorities having jurisdiction. Be responsible for necessary preparations, provisions and pay all costs.
- 2.6 Be responsible for ensuring that no work is undertaken which is conditional on permits, approvals, reviews, licences, fees, until all applicable conditions are met. No time extension will be allowed for delay in obtaining necessary permits.
- 2.7 Obtain permit required to work on Municipal rights of way. Obtain damage deposits for sidewalks, roads and services work, as applicable.
- 2.8 Give notice of completion of project prior to occupancy, as required by applicable legislation.

3 EXISTING PUBLIC SERVICE LINES

- 3.1 Where existing public services are indicated to be removed and/or relocated, perform Work in compliance with authorities having jurisdiction.
- 3.2 Make good public roads, walkways and curbs soiled or damaged due to construction to the requirements of local authorities.

4 **CODES**

- 4.1 Reference is made to standards in the specifications to establish minimum acceptable standards of materials, products and workmanship. Ensure that materials, products and workmanship meet or exceed requirements of the reference standards specified.
- 4.2 In the event of conflict between documents specified herein, execute the Work in accordance with the most stringent requirements.

5 **STANDARDS**

- 5.1 Where a material or product is specified in conjunction with a referenced standard, do not supply the material or product if it does not meet the requirements of the standard. Supply another specified material or product, or an acceptable material or product of other approved manufacture which does meet the requirements of the standard, at no additional cost to the Owner.
- 5.2 Where no standard is referred to, provide materials, products and workmanship which meet requirements of the applicable standards of the Canadian Standards Association, Canadian General Standards Board, Standards Council of Canada, Ontario Provincial standard specifications (OPSS), Ontario Provincial Standard Drawings (OPSD) and the applicable building code. References to "Measurement for Payment" and "Basis of payment" in OPSS standard documents are not applicable to this Contract.
- 5.3 If there is question as to whether a material, product or system is in conformance with applicable standards, the Consultant reserves the right to have such materials, products or systems tested to prove or disprove conformance. The cost for such testing will be paid by the Owner in the event of conformance with contract Documents or by the Contractor in the event of non-conformance.
- 5.4 Where application, installation and workmanship standards are cited, it is intended that referenced standards form the basis for minimum requirements of the specified item and specifications supplement the standards unless specified otherwise.
- 5.5 Matters may be dealt with in part by these specifications which are also dealt with, under the same or similar headings in cited standard. It is not intended that these specifications take the place of the standards but supplement them, unless specified otherwise.
- 5.6 Where reference is made to manufacturer's directions, instructions or specifications they shall include full information on storing, handling, preparing, mixing, installing, erecting, applying, or other matters concerning the materials pertinent to their use and their relationship to materials with which they are incorporated.

Where standards, specifications, associations, and regulatory bodies are listed in the Specifications by their abbreviated designations. These are but not limited to the following:

AA	The Aluminum Association
AAMA	Architectural Aluminum Manufacturers Association
AASHTO	American Association of State Highway and Transportation Officials
ACI	American Concrete Institute
AFBMA	Anti-Friction Bearing Manufacturer's Association
AIEE	American Institute of Electrical Engineers
AISI	American Iron and Steel Institute
AMCA	Air Movement and Control Association
AMEU	Association of Municipal Electric Utilities
ANSI	American National Standards Institute
ARI	Air-Conditioning and Refrigeration Institute
ASA	American Standards Association
ASHRAE	American Society of Heating, Refrigeration and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society of Testing and Materials
AWMAC	Architectural Woodwork Manufacturers Association of Canada
AWWA	American Water Works Association
CEMA	Canadian Electrical Manufacturer's Association
CGA	Canadian Gas Association
CGSB	Canadian General Standards Board
CISC	Canadian Institute of Steel Construction
CMHC	Canadian Mortgage and Housing Corporation
CMPA	Canadian Paint Manufacturers Association
COFI	Council of Forest Industries of British Columbia
CRCA	Canadian Roofing Contractors Association
CSA	Canadian Standards Association
CSSBI	Canadian Sheet Steel Building Institute
CWB	Canadian Welding Bureau
CWC	Canadian Wood Council
EEMAC	Electrical and Electronic Manufacturers Association Canada
FM	Factory Mutual
IEEE	Institute of Electrical and Electronic Engineers
MFMA	Maple Flooring Manufacturers Association
MIL	Military Standards
MSS	Manufacturer's Standardization Society
MTO	Ministry of Transportation Ontario
NAAMM	National Association of Architectural Metal Manufacturers
NFPA	National Fire Protection Association
NEMA	National Electrical Manufacturer's Association (U.S.A.)
NLGA	National Lumber Grades Authority
NRC	National Research Council of Canada
OCBA	Ontario Concrete Block Association
OHESC	Ontario Hydro Electrical Safety Code

OPSS	Ontario Provincial Standard Specification
PEI	Porcelain Enamel Institute
PDI	Plumbing Drainage Institute
PHA	Public Health Act
SMACNA	Sheet Metal and Air Conditioning Contractors National Association
SSPC	Steel Structures Painting Council
TEMA	Tubular Exchange Manufacturer's Association
TTMAC	Terrazzo, Tile and Marble Association of Canada
UL	Underwriters Laboratories Inc. (U.S.)
ULC	Underwriters Laboratories of Canada

6 FIRE RATINGS, ASSEMBLIES AND SEPARATIONS

- 6.1 Where a material, component, assembly, or separation is required to be fire rated, the fire rating shall be as determined or listed by one of the following testing authorities acceptable to the authorities having jurisdiction:
1. Underwriters' Laboratories of Canada.
 2. Underwriters' Laboratories Inc.
 3. Factory Mutual Laboratories.
 4. The National Research Council of Canada.
 5. The National Board of Fire Underwriters.
 6. Intertek Testing Services.
- 6.2 Where reference is made to only one testing authority an equivalent fire rating as determined or listed by another of the aforementioned testing authorities is acceptable if approved by authorities having jurisdiction. Obtain and submit such approval of authorities, in writing when requesting acceptance of a proposed equivalent rating or test design.
- 6.3 Fire rated door assemblies shall include doors, frame, anchors, and hardware and shall bear label of fire rating authority showing opening classification and rating.
- 6.4 Material having a fire hazard classification shall be applied or installed in accordance with fire rating authorities printed instructions.
- 6.5 Fire rated assemblies shall be constructed in accordance with applicable fire test report information issued by fire rating authority. Deviation from fire test report will not be allowed.

- 6.6 Construct fire separations as continuous, uninterrupted elements except for permitted openings. Extend fire rated walls and partitions from floor to underside of structural deck above.
- 6.7 Fire separations may be pierced by openings for electrical and similar service outlets provided such boxes are non-combustible and are tightly fitted and sealed with a ULC approved sealant for the assembly being sealed.
- 6.8 Construction that abuts on or is supported by a non-combustible fire separation shall be constructed so that its collapse under fire conditions will not cause the collapse of the fire separation.
- 6.9 Do not use combustible members, fastenings, attachments and similar items to anchor electrical, mechanical or other fixtures to fire separations.
- 6.10 At penetration through fire rated walls, ceilings or floors, completely seal voids with ULC approved firestopping material; full thickness of the construction element. In locations that require a smoke seal, provide appropriate ULC approved system installed in accordance with the manufacturer's recommendations.

7 **DRAWINGS REQUIRED BY AUTHORITIES**

- 7.1 Supply copies of detail drawings for various building components if requested by the Municipal Building Departments, Provincial Agencies and the Local Fire Department.

END OF SECTION

1 **TEMPORARY CONTROLS**

1.1 Hoarding and barriers:

.1 Provide temporary enclosures as required to protect the building 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, all as required by the Construction Safety Act and other jurisdictional authorities.

1.2 Hoarding shall be provided to protect school operations from construction activity, secure the work areas, restrict non-authorized personnel from the work areas, and protect the Contractor's property and the Ontario Health & Safety Act.

1.3 Prevent unauthorized entry to the Site. Barricade, guard or lock access points to the satisfaction of the Consultant and post "NO TRESPASSING" signs.

1.4 Install signs for movement of people around Work Site as required and directed by the Consultant.

1.5 Provide secure, rigid guide rails and barricades around deep excavations, open shafts, open stair wells, open edges of floors and roofs as required for protection of Work, workers, and the public.

1.6 Remove hoarding, barriers, building enclosures, guide rails and barricades upon Contract Completion unless otherwise noted on the Contract Drawings or as directed by the Consultant.

1.7 Contractor shall install hoarding in accordance with Contract Drawings.

2 **SERVICE AND UTILITY SYSTEMS**

2.1 Consult with utility companies and other authorities having jurisdiction to ascertain the locations of existing services on or adjacent to site.

2.2 Information as to the location of existing services, if shown on the Drawings, does not relieve the Contractor of his responsibility to determine the exact number and location of existing services.

2.3 Give proper notices for new services as may be required. Make arrangements with authorities and utilities for service connections required.

- 2.4 Pay any charges levied by utilities or authorities for work carried out by them in connection with this Contract, unless specified otherwise.
- 2.5 Operate and maintain all utility systems affected by work of this Contract, until the building or specific portions thereof have been accepted by the Owner.
- 2.6 Report existing unknown services encountered during excavation to Consultant for instructions; cut back and cap or plug unused services. Be responsible for the protection of all active services encountered and for repair of such services if damaged.

5 PROTECTION

- 5.1 Protection of Public Area: Protect surrounding private and public property from damage during performance of the Work.
- 5.2 Protection of Building Finishes and Equipment:
 - .1 Provide protection for existing structure, finished and partially finished building finishes, waterproofing systems, and equipment during performance of the Work.
 - .2 Cover Owner's equipment and plant within the Site with 6 mil PVC sheet, or equal, taped to make it dust-tight. Equipment and existing work moved or altered to facilitate construction, movement of Products or equipment shall be stored, protected with dust-tight covers and subsequently returned to its original location.
 - .3 Obtain approval from the Consultant prior to the installation of temporary supporting devices into existing roof, ceiling, or wall members for the erecting of equipment or machinery. Repair roof, ceiling, and wall members used for this purpose to the satisfaction of the Consultant.
 - .4 Provide necessary screens, covers and hoarding as required.
 - .5 Any Products or equipment damaged while carrying out the Work shall be restored with new Products or equipment matching the original equipment. Damage shall include harm resulting from all construction work, such as falling objects, wheel and foot traffic, failure to remove debris, operation of machinery and equipment, and scaffolding and hoisting operations.
- 5.3 Protection of Off-Site Structures, Surfaces and Trees: Accept all cost and responsibility for any injury or damage to existing structures, surfaces and trees on the City's property which may be caused by the Contractor's workforce and material suppliers.
- 5.4 Fire Protection:
 - .1 Take precautions to prevent fires. Provide and maintain temporary fire protection equipment of a type appropriate to the hazard anticipated in accordance with authorities having jurisdiction, governing codes, regulations, by-laws and to the satisfaction of the Consultant and insurance authorities.
 - .2 Excessive storage of flammable liquids and other hazardous materials is not allowed

on Site. Flammable liquids must be handled in approved containers. Remove combustible wastes frequently.

- .3 Inspect temporary wiring, drop cords, extension cables for defective insulation or connections frequently.
- .4 Open burning of rubbish is not permitted on the Site.
- .5 Handle, transport, store, use and dispose of gasoline, benzene or other flammable materials with good and safe practice as required by authorities having jurisdiction.
- .6 Provide fire extinguishers of the non-freezing chemical type in each temporary building, enclosure and trailer. Use only fire-proofed tarpaulins.
- .7 A fire watch shall be required for each of the following activities regardless of the number, duration or size of the activity in operation: .1 any open flame activities(e.g., soldering and welding); .2 shutdown of fire detection system; .3 shutdown of sprinkler system.

5.5 Maintain adequate cover over services as required by Utility Authorities.

6 FIRST-AID FACILITIES

6.1 Provide site equipment and medical facilities necessary to supply first-aid service to injured personnel in accordance with regulations of the Workmen's Compensation Act. Maintain facilities for duration of Contract.

7 USE OF NEW PERMANENT SERVICE & EQUIPMENT

7.1 Do not use any new permanent service or equipment without Owner's written approval.

7.2 Where permission is granted to use permanent services and equipment provide competent persons to operate services and equipment; inspect frequently and maintain facilities in proper operating condition at all times.

7.3 Permanent services and equipment shall be turned over to Owner in "as new" and perfect operating condition.

7.4 Use of permanent systems and equipment as temporary facilities shall not affect the warranty conditions and warranty period for such systems and equipment. Make due allowance to ensure that Owner will receive full benefits of equipment manufacturers warranty after project takeover.

8 PROJECT IDENTIFICATION

8.1 If required, obtain approvals from jurisdictional authorities for temporary signs.

8.2 Do not display signs without the Consultant's and Owners written consent.

8.3 Maintain signs in good condition for the duration of Contract.

9 SITE MAINTENANCE

- 9.1 Maintain the Site and adjacent premises in a clean and orderly condition, free from debris and other objectionable matter. Immediately remove rubbish and surplus Products, equipment and structures from the Site. If the Site is not cleaned (within 48 hours after the Contractor has been instructed to do so), the Consultant may clean the Site and retain the cost from monies due, or to become due, to the Contractor.
- 9.2 When the Work is substantially performed, remove surplus Products, tools, construction machinery and equipment not required for the performance of the remaining Work.

10 SITE STORAGE AND OVER LOADING

- 10.1 Confine the Work and operations of employees to limits indicated by the Contract Documents. Do not unreasonably encumber the Site with Products.
- 10.2 Products shall be stored only in areas designated or approved by the Consultant, and shall not be left lying on streets, sidewalks, boulevards or elsewhere within public view. Products which the Consultant may permit to be stored elsewhere than in the Contractor's storage areas shall be neatly stacked or otherwise disposed and shall be so maintained.
- 10.3 Fabrication shops shall not be set up within the structure except as directed by or with the permission of the Consultant.
- 10.4 Do not load or permit to be loaded any part of the Work with a weight or force that it is not calculated to bear safely. Be solely responsible and liable for damages resulting from violation of this requirement. Provide temporary supports as strong as permanent support.
- 10.5 Do not cut, drill or sleeve load bearing members unless shown on drawings or otherwise approved by the Consultant in writing for each location.
- 10.6 Site storage and loading requirements to be in accordance with the Ontario Occupational Health and Safety Act and Regulations for Construction Projects.

11 PUBLIC CONVENIENCE AND SAFETY

- 11.1 Maintain sidewalks at and adjacent to the Site in a safe condition throughout the Contract. Promptly remove ice and snow.

12 PUBLIC UTILITIES AND SERVICES

- 12.1 Verify limitations imposed on project work by presence of utilities and services, and ensure no damage occurs to them.
- 12.2 Notify service authorities concerned so that they protect, remove, relocate, or discontinue them, as they may require.
- 12.3 Make arrangements and pay for connection charges for services required for project

work.

- 12.4 Locate poles, pipes, conduit, wires, fill pipes, vents, regulators, meters, and sanitary services work in inconspicuous locations. If not shown on Drawings, verify location of service work with Consultant before commencing installation.

13 CONSTRUCTION PARKING

- 13.1 Parking may be permitted on Site with the School principal's permission provided it does not disrupt the performance of Work, Site safety or the movement of vehicular or pedestrian traffic and is acceptable to the Consultant.
- 13.2 Contractor vehicles are not to be parked along school access routes and staff/visitor parking lots.

14 SITE VISITORS

- 14.1 During the progress of the Work, afford access to visitors duly authorized by the Consultant and facilitate inspections or tests they may desire to make. Record site visitors in log book maintained on site.
- 14.2 Ensure Site visitors wear appropriate safety apparel.

15 POLLUTION (DUST, DEBRIS, AND NOISE) CONTROL

- 15.1 Cover or wet down dry materials and rubbish to prevent blowing dust and debris.
- 15.2 Keep premises free of waste material.
- 15.3 Arrange and pay for removal of all waste generated by the work in manner acceptable to authorities having jurisdiction.
- 15.4 Limit noise levels in accordance with requirements of authorities having jurisdiction.
- 15.5 Maintain temporary erosion and pollution control features installed under this contract.
- 15.6 Control emissions from equipment and plant to local authorities emission requirements.
- 15.7 Prevent abrasive-blasting and other extraneous materials from contaminating air beyond application area, by providing temporary enclosures.

16 TREE PROTECTION

- 16.1 Provide tree protection as stipulated in 'City of Toronto Tree Protection Policy and Specifications Near Trees' and refer to Tree Protection Zone Specifications appended to this Document for information on existing trees to be protected.
- 16.2 Leave fenced areas undisturbed; do not use areas for storage, stockpiling or any other purpose. Do not dump or flush any contaminants in areas of tree feeder roots.
- 16.3 Do not attach rigging cables to trees.
- 16.4 Where limbs or portions of plants are required to be removed to accommodate new work, they shall be removed in accordance with accepted arboricultural practice.
- 16.5 Where root systems of protected trees adjacent to construction are exposed or damaged, they shall be neatly trimmed and the area backfilled with suitable material to prevent desiccation.
- 16.6 Where necessary give plants an overall pruning to restore the balance between roots and top growth and/or to restore appearance.
- 16.7 Except at locations where specific procedures are included in Contract Documents do not alter grades around existing trees/plants without first obtaining Consultant's consent and directions.

END OF SECTION

Tree Protection Zone Specifications

Background Information

This document concerns tree protection zone specifications, which are surface and sub-surface **root protection standards** that will impact on landscape design, construction techniques and maintenance practices.

Trees should be included as part of our overall infrastructure, as they are valuable, virtual environmental vacuum cleaners. They purify (clean) the air that we breathe, replacing tons of pollutants every day with fresh oxygen, and these specifications are in support of maintaining and improving the health of our TDSB urban forests. Trees are living organisms just like you and me, and if they are stressed from salt, soil compaction, heat, drought, root zone restrictions, poor growing medium, changes in hydrology or damaged root systems, the trees are then very vulnerable to disease and insect infestation.

We must understand and respect tree biology. It must be remembered that trees are living assets whose roots are generally found in the top 18" to 24" of the soil profile, however, they can extend out from the trunk two to three times the distance of the drip line. The drip line is a point on the ground that equals the distance from the trunk of the tree to the outer tips of the branches. Tree protection requires space, above and below the ground. Different species of trees vary in their ability to respond to maintenance and construction impacts. Age, size, structure and health of the tree also impact on their ability to recover. Young, healthy, vigorous trees, for example, have a greater capacity to recover because of their ability to compartmentalize wounds.

All of our TDSB trees over 30 cm. dbh (diameter breast height) are **protected by City by-laws** and must not be removed, injured or destroyed in any way without written authorization from the City. Please note that the term "tree" refers to all parts of the tree, including the roots. In addition, the Commissioner of Urban Forestry Services may require *Letters of Credit*, or *Letters of Acceptance of Responsibility* to secure the protection of these trees. These initial "damage deposits" usually change attitudes and responsibility.

Our TDSB tree replacement program outlines that if healthy, stable trees must be removed, or if they die because of construction activities, a tree replacement plan will be required in accordance with the pre-project value of the affected tree. If the affected trees are dead or seriously declining, a tree replacement plan of "one for one" (as a minimum) will be required.

This tree protection plan will only work if all parties (owners, designers, engineers, construction crews, supervisors and maintenance staff) are committed to the tree protection vision and the value of the trees. We must all exercise care, caution and

respect when working around trees to prevent injuring the tree or degrading the tree's environment.

Tree protection must begin at the design phase of the project with the TDSB critique and approval of the preliminary drawings, and this arboricultural professionalism must carry on right through to standard maintenance practices. Early involvement is essential in assessing design opportunities and constraints. A thorough understanding of what is planned is critical. Tree protection must become an integral part of the development process. It is an additional step, but an important one.

Trees need to be inventoried and assessed (resource evaluation) at the site level to determine what trees should be protected and what trees should be removed (current or future liability).

We must anticipate and evaluate the impacts that the designs will have on the tree's health and stability, and then suggest modifications, or make adjustments, to those construction plans if the impacts are too severe. To do that, we need accurate site information about the trees in relation to construction activity. Accurate trunk size (and location) and canopy drip lines (including trees on neighboring fence lines) must be plotted on all drawings. After the critique of the drawings has been submitted to the design team, we must respond to the designer's comments and alterations that have been made to the design.

All survey drawings must show elevations around the base of existing trees (record the grades on the high side and the low side of the tree and take the average). Three grade measurements should be taken at the drip line of trees that are over 30 cm. diameter breast height, as subtle grade changes inside and outside of the drip line will change soil hydrology.

The designers, project managers, supervisors, grounds team leaders and lead hands must know and understand the critical factors involved in tree protection. Site inspection of these trees is required before, during (especially when excavating and trenching occurs) and after the construction process. Field situations during the project may change, requiring a re-assessment of instructions and/or corrective actions. We must build positive relationships and teamwork by listening, communicating, and interacting in a professional manner. This process should also be coupled with appropriate signoffs at the end of the project.

The goal of these specifications is to protect existing trees by coordinating landscape design, construction techniques and maintenance practices. Tree root injury must be limited to a tolerable level, however, the goal here is to protect trees rather than repair injury. Our trees should be an asset to the project and the property for years to come. Trees that are healthy and structurally stable are the focus of this discussion.

Specifications

The following tree protection specifications must be included with **all drawings** where the land features of our school properties are impacted by landscaping or other construction activities.

The tree protection zone is described as the area around a tree in which no grading, trenching, excavating (which includes new post-holes for footings) or soil compaction is to occur. Within this tree protection zone there will also be;

- no root cutting
- no alteration or disturbance to existing grades of any kind
- no changes to the grade by adding fill, excavating or scraping
- no storage of construction materials or equipment
- no stockpiling of soil, debris or construction waste
- no movement or storage of heavy vehicles or equipment

Each tree will be evaluated according to factors such as species (and it's tolerance to impacts), age, health, vigor, size, form, structure, drainage patterns, location and surrounding features. In general, however, **the minimum tree protection zone will be the drip line of the tree.** This is why it is most important that the designer has accurate canopy dimensions shown on the drawings for all existing trees on TDSB property, as well as adjacent City or neighboring trees whose canopies (and underground root systems) will impact on TDSB property and construction plans.

Every effort should be made to travel over, and work from, hard surfaces, however, if heavy equipment such as trucks, tractors, loaders need to travel over tree root zones during the construction process, a minimum layer of 9" of tub grinder mulch should be spread where the traffic will be occurring to reduce root damage and soil compaction. This depth must be maintained for the duration of the job and then recycled on site when the job is complete. The use of light equipment and/or alternate routes should be considered.

If you can't get a good tree protection zone, consider using specialized construction techniques that will reduce or limit the root damage impacts, such as low pressure hydro-vacuuming, air knifing, directional boring or tunnelling, and arboricultural techniques such as root pruning by hand before mechanized excavating takes place. These techniques could also include hand digging, shoot pruning, mulching, irrigating and fertilizing.

Tree protection barriers must be included and priced as part of the project. If it is a short term project (up to 2 months), standard T-bars and plastic safety fence can be used. Light duty T-bars should not be used because they snap and break. If it is a longer term project, use 10gauge chain link fence and standard T-bars. In all cases, standard T-bars should not be spaced more than 6 to 7 feet apart. These protection barriers must be

erected before the project starts, must be maintained throughout the project, and taken down when final inspection and signoffs are completed.

Questions or concerns regarding these TDSB tree protection zones should be directed to:
Aileen Leadbeater, <aileen.leadbeater@tdsb.on.ca>

1 SPECIFIED PRODUCTS

1.1 Work of this Contract is based on Products specified by:

- .1 Manufacturer's catalogued trade names and/or;
- .2 References to standards (i.e. CAN, CGSB, CSA, ASTM) or;
- .3 Prescriptive Specifications or;
- .4 Performance Specifications.

1.2 When one or more manufacturer's trade name is specified for a Product, any one of the specified Products will be acceptable. Products by other manufacturers are subject to the Consultant's acceptance as an equivalent substitution in accordance with the specified requirements of substitutions.

1.3 When more than one manufacturer's catalogued trade name Product is specified along with a referenced standard, any one of the specified Products will be acceptable on condition the Product complies with the referenced standard.

1.4 When a Product is specified by reference to a standard only, the Contractor may select any Product that meets or exceeds the specified standard for the intended purpose. The onus shall be on the Contractor to establish that such Products meet the reference standard requirements. Products exceeding minimum requirements established by reference standards will be accepted for the Work if such Products are compatible with the Work with which they are incorporated.

1.5 When a Product is specified by prescriptive or performance Specification, any Product meeting or exceeding the Specification will be accepted.

1.6 When a Product is specified by reference to a standard or by prescriptive or performance Specification, upon request of the Consultant, obtain from the manufacturer, an independent testing laboratory report showing that the Product meets or exceeds the specified requirements.

1.7 Unless otherwise indicated in the Specifications, maintain uniformity of manufacture for any particular or like item throughout the Work.

2 SUBSTITUTIONS

2.1 Requests for substitutions will not be accepted prior to the Notification of Award. Substitutions will be considered by the Consultant provided that:

- .1 The proposed substitutions have been investigated and complete data are submitted which clearly includes highlighting all aspects that meet the specifications. Consultant will only review data submitted. Incomplete data will be grounds for non-acceptance.

.2 Data relating to changes in the Contract Schedule, if any, and relation to other Work have been submitted.

.3 Same warranty is given for the substitution as for the original Product specified.

.4 All claims are waived for additional costs related to the substitution which may subsequently arise.

.5 Installation of the accepted substitution is co-ordinated into the Work and that full responsibility is assumed when substitutions affect other work. Make any necessary changes required to complete the Work. Revisions to the drawings for incorporation of the substitutions shall be made by the Consultant and all costs associated with the revisions shall be borne by the Contractor.

2.2 Substitutions to methods or process described in the Specifications or drawings, may be proposed for the consideration of the Consultant. Ensure that such substitutions are in accordance with the following requirements:

.1 Time spent by the Consultant in evaluating the substitution shall not be the basis for a claim by the Contractor for extensions to the Contract Time.

.2 Clearly indicate how the proposed substitutions would be advantageous to the Owner or in the opinion of the Contractor would improve the operation of the installation.

.3 Be responsible for substitutions to methods or processes concerning such Work and ensure that the warranty covering all parts of the Work will not be affected.

.4 The cost of all changes in the work of Other Contractors, necessitated by the substituted methods or processes, if accepted, is borne by the Contractor.

.5 The substituted methods or processes fit into space allotted for the specified methods or processes. Revisions to the drawings for incorporation of the substitutions shall be made by the Consultant and all costs associated with the revisions shall be borne by the Contractor.

2.3 Substitutions will not be considered if:

.1 They are indicated or implied on shop drawings or Product data without formal request.

.2 Acceptance will require substantial revision of the Specifications and Drawings.

2.4 Do not substitute Products or methods or processes into the Work unless such substitutions have been specifically approved for the Work by the Consultant.

2.5 Approved substituted Products shall be subject to the Consultant's inspection and testing procedures. Approved substituted Products shall only be installed after receipt of the Consultant's written approval.

2.6 The Contract Price will be adjusted accordingly to any and all credits arising from the substitutions mentioned above.

3 APPROVAL OF PRODUCTS AND INSTALLATION METHODS

3.1 Wherever in the Specifications it is specified that Products and installation methods shall meet approval of Authorities having Jurisdiction, underwriters, the Consultant, or others, such approval shall be in writing.

4 PRODUCT DELIVERY CONTROL

4.1 It is the responsibility of the Contractor to ensure that the supplier or distributor of materials specified or alternatives accepted, which he intends to use, has materials on the site when required. The Contractor shall obtain confirmed delivery dates from the supplier.

4.2 The Contractor shall contact the Consultant immediately upon receipt of information indicating that any material or item, will not be available on time, in accordance with the original schedule, and similarly it shall be the responsibility of all subcontractors and suppliers to so inform the Contractor.

4.3 The Consultant reserves the right to receive from the Contractor at any time, upon request, copies of actual purchase or work orders of any material or products to be supplied for the work.

4.4 If materials and products have not been placed on order, the Consultant may instruct such items to be placed on order, if direct communication in writing from the manufacturer or prime suppliers is not available indicating that delivery of said material will be made in sufficient time for the orderly completion of the Work.

4.5 The Consultant's review of purchase orders or other related documentation shall in no way release the Contractor, or his subcontractors and suppliers from their responsibility for ensuring the timely ordering of all materials and items required, including the necessary expediting, to complete the work as scheduled in accordance with the Contract Documents.

4.6 In the event of failure to notify the Consultant at commencement of Work and should it subsequently appear that Work may be delayed for such reason, the Consultant reserves the right to direct the Contractor to take the following measures at no increase in Contract Price:

.1 Substitute more readily available Products of similar or better quality and character,
or

.2 Temporarily install another Product until such time as the specified Product becomes available, at which time the temporarily installed product shall be removed and the specified Product installed.

5 TRADEMARKS AND LABELS

5.1 Permanent labels, trademarks and nameplates on Products are not acceptable in the finished Work, except where required by authorities having jurisdiction, for operating instructions, or when located in service rooms.

5.2 Remove trademarks and labels by grinding, if necessary, painting out where the particular surface is being painted, or if on plated parts, replace with new plain plated or non-ferrous metal parts.

6 DELIVERY, STORAGE, HANDLING AND PROTECTION

6.1 Be responsible for handling and delivery of Products. Protect Products from damage during handling, storage and installation. Deliver store and handle items in accordance with manufacturer's instructions and as specified. Be responsible for all costs of delivery, loading and off-loading, and for transportation back to its origin for correction, if required, due to damage or defect. Reject materials and Products delivered to the Site which are damaged.

6.2 Manufacture, pack, ship, deliver, and handle Products so that no damage occurs to structural qualities and finish appearance, nor in any other way which is detrimental to their function and appearance.

6.3 Ensure that Products, while transported, are not exposed to an environment which would increase their moisture content beyond the maximum specified.

6.4 Organize delivery of materials, Products and equipment to, and removal of debris and equipment from, the site and surrounding property.

6.5 Schedule early delivery of Products to enable Work to be executed without delay. Before delivery, arrange for receiving at the Place of the Work.

6.6 Coordinate mechanical and electrical equipment and apparatus deliveries with the manufacturer's and suppliers such that equipment and apparatus is delivered to the site when it is required, or so that it can be stored within the building and protected from the elements.

6.7 Shop assemble work for delivery to site in size easily handled and to ensure passage through building openings.

6.8 Deliver packaged Products, in original unopened wrapping or containers, with manufacturer's seals and labels intact.

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

- 6.10 Labels attesting that materials conform to specified reference standards will be acceptable as verification that contents meet specified requirements. In the absence of labels, submit affidavits to validate conformance of Product to reference standards, as requested by the Consultant.
- 6.11 Label fire-rated Products to indicate Underwriters' Laboratories approval.
- 6.12 Handle and store materials and products in such a manner that no damage is caused to the materials and products, the Work, the site and surrounding property.
- 6.13 Do not obstruct or disrupt local traffic flow during construction period.
- 6.14 Allocate an area within the limits of the Work acceptable to the Owner for storage of Products brought to the site by all trades. Keep storage area tidy at all times and do not use other parts of the property for storage. Arrange and pay for off-site storage when required.
- 6.15 Locate products on site in a manner to cause minimal interference with the Work and building activities.
- 6.16 Store Products off the ground, in a manner to prevent damage, adulteration, deterioration and soiling to the Products, other building components, assemblies, other products, the structure, the site and surrounding property, and in accordance with manufacturer's instructions when applicable.
- 6.17 Store packaged or bundled Products in original and undamaged condition complete with written application instructions. Keep manufacturer's seals and labels intact. Do not remove from packaging or bundling until required in the Work.
- 6.18 Do not place or store materials and Products in corridors, public areas, streets, lanes, passageways or similar locations.
- 6.19 Store Products so as not to create any overloading conditions to any part of the building, structure, falsework, form work and scaffolding.
- 6.20 Store Products subject to damage from weather in weatherproof enclosures.
- 6.21 Store cementitious Products clear of earth or concrete floors, and away from walls.
- 6.22 Keep sand, when used for grout or mortar materials, clean and dry. Store sand on wooden platforms and cover with waterproof tarpaulins during inclement weather.
- 6.23 Store sheet materials and lumber on flat, solid supports and keep clear of ground. Slope to shed moisture.
- 6.24 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 material in bulk within the Work.

- 6.25 Store and mix paints in a heated and ventilated room or area assigned for this purpose. Keep this room or area locked when unattended. Remove oily rags and other combustible debris from the Place of the Work daily. Take every precaution necessary to prevent spontaneous combustion.
- 6.26 Protect prefinished metal surfaces by protective coatings or wrappings until time of final cleanup specified in Section 01710. Protection shall be easily removable under work of Section 01710 without damage to finishes. Do not permit strippable tape or coatings to become baked on surfaces which they protect.
- 6.27 Touch-up damaged factory finished surfaces to Consultant's satisfaction. Use primer and paint to match original.
- 6.28 Protect glass and other finishes against heat, slag and weld splatter by provision on adequate shielding. Do not apply Visible markings to surfaces exposed to view in finished state or that receive transparent finishes.
- 6.29 Protect surfaces of completed work exposed to view from staining, disfigurement and all other damage by restriction of access or by use of physical means suitable of the material and surface location.
- 6.30 Adequately protect trowelled concrete floors from damage. Take special measure when moving heavy loads or equipment on them.
- 6.31 Keep finished concrete floors free from oils, grease or other material likely to damage or discolour them or affect bond of applied finishes. Once building is enclosed, keep floors as dry as possible after curing.
- 6.32 Protect finished flooring from pedestrian traffic with reinforced kraft paper as a minimum, secured in place and with joints sealed by reinforced pressure sensitive tape. Maintain protection in place until contract completion.
- 6.33 Protect finished flooring from continuing construction work and delivery of products with plywood panels of minimum 6 mm thickness with joints between panels sealed with reinforced pressure sensitive tape. Maintain protection in place until work and deliveries are complete.
- 6.34 Make good or replace damaged materials to the satisfaction of the Consultant.
- 6.35 Hazardous Materials Information:
- .1 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of hazardous materials; and regarding labelling and provision of material safety data sheets (MSDS) in accordance with jurisdictional authorities.
 - .2 Deliver copies of Material Safety Data Sheets (MSDS) to the Consultant on all Products intended for use in the Work and designated as a "controlled product."

7 MANUFACTURER'S INSTRUCTIONS

7.1 Unless otherwise indicated in the Specifications, fabricate, install, apply, connect, install, erect, use, clean, and condition Products in accordance with manufacturer's instructions except where more stringent requirements are specified. Do not rely on labels or enclosures provided with Products. Obtain written instructions directly from manufacturers.

7.2 Notify the Consultant in writing, of conflicts between the Specifications and manufacturer's instructions, so that the Consultant may establish the course of action. If requested, make a copy of those instructions available at the site.

7.3 In cases of improper installation or erection of Products, due to failure in complying with these requirements, the Consultant may direct removal and re-installation at no increase in Contract Price.

8 WORKMANSHIP

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

8.2 Decisions as to the quality or fitness of workmanship in cases of dispute rest solely with the Consultant, whose decision is final.

8.3 Give particular attention to finished dimensions and elevations of the Work. Make finished Work fit indicated spaces accurately. Make finished Work flush, plumb, true to lines and levels and accurate in all respects.

8.4 In finished areas, conceal pipes, ducts, conduit and wiring in floors, walls, ceilings, chases, or behind furring except where indicated otherwise.

8.5 Ensure that service poles, fill-pipes, vents, regulators, meters and similar service installations are located in inconspicuous locations. If not indicated on drawings, verify location of service installations with Consultant prior to commencing installation.

8.6 Ensure that integrity of fire separations is maintained where they are penetrated.

8.7 Finish access panels and doors to match adjacent wall and/or ceiling finish unless otherwise specified or indicated.

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

8.9 Enforce fire prevention methods at site. Do not permit fires, open flame heating devices or accumulation or debris. Use flammable materials only if all safety precautions are taken. Provide and maintain in working order ULC labelled fire extinguishers of types suitable for fire hazard in each case, and locate them in prominent location and to approval of jurisdictional authorities.

8.10 Where flammable materials are being applied, ensure that adequate ventilation is provided, spark-proof equipment is used, and smoking and open flames are prohibited.

9 DIMENSIONS

9.1 Check all dimensions at the site before fabrication and installation commences and report discrepancies to the Consultant.

9.2 Where dimensions are not available before fabrication commences, ensure that dimensions required are agreed upon between the parties concerned.

9.3 Prior to commencing work, ensure that clearances required by jurisdictional authorities can be maintained

9.4 Wall thicknesses and openings shown on the drawings may be nominal only; ascertain actual sizes at the site.

9.5 Verify dimensions of shop fabricated portions of the Work at the site before shop drawings and fabrications are commenced. The Owner will not accept claims for extra expense by reason of non-compliance with this requirement.

9.6 Fabricate and erect manufactured items, shop fabricated items, and items fabricated on or off site, to suit site dimensions and site conditions.

9.7 In areas where equipment is to be installed, check dimensional data on equipment to ensure that area and equipment dimensions are compatible with necessary access and clearance provided. Ensure that equipment supplied is dimensionally suitable for space provided.

9.8 The mechanical and electrical drawings are intended to show approximate locations of mechanical apparatus, fixtures, equipment, piping and duct runs, electrical apparatus, fixtures, outlets, equipment, units, and conduit in diagrammatic form and wherein the mechanical and electrical items are not dimensioned, consider their locations to be approximate. Check the drawings and confer with the Consultant to settle the actual locations of these items as may be required to suit aesthetic and site conditions. Such relocation shall be done without change to the Contract Price.

9.9 Leave areas clear where space is indicated to be reserved for future equipment, including access to such future equipment.

9.10 Whether shown on the Drawings or not, leave adequate space and provision for servicing of equipment and removal and reinstallation of replaceable items such as motors, coils and tubes.

10 RELOCATION OF MECHANICAL AND ELECTRICAL ITEMS

10.1 The Owner and the Consultant reserve the right to relocate outlets at a later date, but prior to installation, without additional cost to Owner, assuming that the relocation per outlet does not exceed 3000 mm from the original location. No credits will be anticipated where relocation per outlet of up to and including 3000 mm reduces materials, products and labour.

10.2 Should relocations per outlet exceed 3000 mm from the original location the Contract Price will be adjusted in accordance with the provisions for changes in the Contract Documents.

10.3 Alter the location of pipes and other equipment, without additional cost to the Owner, if approved, provided the change is made before installation.

10.4 Make necessary changes, due to lack of coordination, as required and when approved, at no additional cost, to accommodate structural and building conditions.

11 EXPANSION, CONTRACTION, AND DEFLECTION

11.1 Conform to manufacturer's recommended installation temperatures. If items, components, assemblies, systems, and finishes are installed at temperatures different from operation or service temperatures, make provisions for expansion and contraction in service as acceptable to manufacturer and consultant. Repair all resulting damage should expansion and contraction provisions provide inadequate.

11.2 Make provisions for expansion and contraction due to temperature changes within components, Products and assemblies, and between adjacent components, Products and assemblies, and due to building movements including but not limited to creep, column shortening, deflection, sway and twist. Ensure provisions for expansion, contraction and building movements prevent damages from occurring to and within components, Products and assemblies.

11.3 Make adequate allowance at wall and partition heads for deflection of the structure above. Determine requirements from Consultant where additional information is required. Where partitions butt to underside of floor assembly, or structural framing, the clearance shall be based on the span of the members supporting the floor or structural framing. In making such allowance use methods which maintain the integrity of the wall or partition as a sound, and/or fire barrier.

11.4 Make provisions in pipes, plenums, ducts and vessels containing air and fluids as is necessary to prevent damage due to fluid and air induced pressure, surges and vibrations, to pipes, plenums, ducts and vessels and to adjacent components, assemblies and construction to which pipes, ducts, plenums and vessels are attached or pass through.

12 DIELECTRIC SEPARATION

12.1 Ensure that a dielectric separator is provided in a permanent manner over entire contact surfaces to prevent electrolytic action (galvanic corrosion) between dissimilar materials. Similarly, prevent corrosion to aluminum in contact with alkaline materials such as contained in cementitious materials.

13 PRODUCTS AT SOUND ATTENUATING PARTITIONS

13.1 Avoid sound transfer at sound attenuating partitions by careful location and treatment of mechanical and electrical equipments, ducts, grilles, diffusers, electrical outlets and boxes, and similar items. Where electrical boxes are back to back, serving each side, locate them at least 250 mm apart laterally and, if interconnected, use flexible connections.

14 FASTENINGS

14.1 Include in the work of each section necessary fastenings, anchors, inserts, attachment accessories, and adhesives. Where installation of devices is in work or other sections, deliver and locate devices in ample time for installation.

14.2 Do not install fibre, plastic or wood plugs or blocking for fastenings in masonry, concrete, or metal construction, unless specified or indicated on drawings.

14.3 Install work with fastenings or adhesives in sufficient quantity to ensure permanent secure anchorage of materials, construction, components and equipment under static conditions, and to resist building thermal movement, creep and vibration.

14.4 Provide metal fastenings and accessories in same material, texture, colour, sheen and finish as metal on which they occur, unless indicated otherwise.

14.5 Prevent electrolytic action between dissimilar metals and materials.

14.6 Use non-corrosive hot dip galvanized steel fasteners and anchors for securing exterior Work, and where attached to, or contained within, exterior walls and slabs, unless stainless steel or other material is specified. Leave steel anchors bare where cast in concrete.

14.7 Space anchors within their load limit or shear capacity and ensure they provide positive permanent anchorage. Wood, or any other organic material plugs are not acceptable.

14.8 Conceal fasteners where indicated. Keep exposed fastenings to a minimum, space evenly and in an organized symmetrical pattern.

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

-
- 14.10 Powder Actuated Fastenings:
- .1 Do not use powder actuated fasteners for the support of ceilings.
 - .2 Do not use powder actuated fastenings on any portion of the Work, unless written consent for a specific use is obtained from the Consultant.
 - .3 Only low velocity tools will be permitted under any condition. Operators to be qualified and to be in possession of a valid operator's certificate.
- 15 **ADJUSTING**
- 15.1 Ensure that all components of assemblies fit snugly, accurately and in true planes, and that moving parts operate positively and freely, without binding and scraping.
 - 15.2 Verify that work functions properly and adjust it accordingly to ensure satisfactory operation. Lubricate Products as recommended by manufacturer.

END OF SECTION

1 DEMONSTRATION AND INSPECTION OF PRODUCTS AND SYSTEMS

1.1 Arrange for a demonstration of systems and operating Products upon the 100% completion of their installation and prior to certification for Substantial Performance.

1.2 Include in the arrangements for the attendance of the Consultant, Owner, jurisdictional authorities, and personnel assigned by the Owner for the operation of the systems and/or Products.

1.3 Demonstrations shall be conducted by the Subcontractor responsible for the installation of the systems and/or Product, assisted by representatives of the manufacturer or supplier. All personnel conducting the demonstration shall be completely knowledgeable of all conditions of the operating, functioning and maintenance of the systems and/or Products.

1.4 Owner's representative will acknowledge the successful completion of each demonstration on a form provided by the Contractor. The form shall be agreed to by the Owner, Consultant and Contractor prior to demonstration and testing.

1.5 Submit copies of letters from manufacturers of Systems and/or Products before making application for certificate of Substantial Performance to verify that the Products has been installed and connected correctly, and that it is operating in a satisfactory manner. The certification shall be based upon inspection and testing of the Products by competent technical personnel. Include in letter of certification the names of personnel conducting the testing and inspection, the methods of inspection utilized, and the location in the building of the Products certified.

1.6 Following submission of letters of certification and their acceptance by the Owner, the owner shall have the right to use the Products on a trial basis and for instructing their personnel in its use.

2 FINAL INSPECTIONS AND CLOSE OUT

2.1 Submit proposed closeout procedures and schedule of inspection to Consultant for approval before final demonstrations and inspections commence.

2.2 Submit layout and survey requirements required by Owner and Authorities having jurisdiction.

2.3 Arrange for, conduct and document final demonstrations, inspections, close-out and take-over at completion of the Work in accordance with procedures described in OAA/OGCA TAKE-OVER PROCEDURES, OAA/OGCA Document No. 100. Where "Architect" is referred to in Document No. 100 it shall mean Consultant.

3 CERTIFICATE OF COMPLIANCE

3.1 Submit Certificates of Compliance, prior to the application for Substantial Performance, for each of the following items.

- .1 An affidavit relative to the use of lead-free solder for all domestic water lines, regardless of location.
- .2 Products for which Material Safety Data Sheets have been submitted and accepted.
- .3 Other Work/Products identified in the Contract Documents as requiring a Certificate of Compliance.

3.2 Each Certificate of Compliance shall indicated names and addresses of the project, the Owner, the date of issue, product description including name, number, manufacturer, with a statement verifying that the Work/Product installed meets specified requirements and, if applicable, complies with the submitted and accepted Material Safety Data Sheets.

3.3 Each Certificate of compliance shall be issued on the subcontractor's letterhead, properly executed, under whose work the prospective Work/Product has been provided.

3.4 Each Certificate of Compliance shall be endorsed by the Contractor with his authorized stamp/signature. Ensure that submissions are made to allow sufficient time for review without delaying progress of scheduled completion.

END OF SECTION

1 CONSTRUCTOR

- 1.1 For the purposes of the Contract, the term "Constructor", as defined in the Occupational Health and Safety Act, shall mean the Contractor who shall be responsible for ensuring that the provisions of the statutes, regulations and by-laws pertaining to the safe performance of the Work are to be observed. The "Constructor" shall submit the Notice of Project.
- 1.2 In the event of conflict between any of the provisions of Statutes, Regulations and Bylaws, and other requirements of authorities, the most stringent provision applies.
- 1.3 The Contractor's representative shall be responsible for ensuring that the provisions of statutes, regulations and by-laws pertaining to safe performance of the Work and the work of Other Contractors and Owner's own forces working on the Site are observed and that the methods of performing the Work do not endanger the personnel employed thereon and the general public, and are in accordance with the latest edition of the Occupational Health and Safety Act. Contractor to include representatives of Other Contractors working on Site on the Joint Health and Safety Committee.
- 1.4 Prior to the Contractor's representative being absent from the Site, the Contractor's representative will name another person, in writing to the Consultant, who is competent to assume these responsibilities. The Contractor shall advise the Consultant of any change in the individual identified as the Contractor's representative.
- 1.5 At the discretion of the Consultant, the "Constructor" designation may be transferred to/from a Contractor at any time at no additional cost to the Owner.

2 PROJECT RESPONSIBILITIES

- 2.1 The Contractor's representative shall ensure that:
- 2.2 All measures and procedures prescribed by the following Acts and Regulations are carried out on Site:
 - .1 The Occupational Health and Safety Act;
 - .2 The Regulations for Construction Projects;
 - .3 WHMIS Regulations;
 - .4 The Environmental Protection Act and regulations,
 - .5 All other legislation, regulations and standards as applicable.
- 2.3 Every employer and every worker performing Work on the Site must comply with the requirements referred to above.

- 2.4 Ensure that the health and safety of workers, employees of the Owner and the general public are protected in relation to the Work performed on the Site.
- 3 WORKPLACE HAZARDOUS MATERIALS INFORMATION SYSTEM (WHMIS)**
- 3.1 Be familiar with and comply with WHMIS regulations.
- 3.2 Properly label controlled products. Provide proper warning labels and training at the Site.
- 3.3 Maintain on site for duration of Contract a hazardous materials log containing all required MSDS. Log shall be open for inspection by Owner, Consultant and all personnel on Site.
- 3.4 Provide copies of material safety data sheets (MSDS) for any controlled products prior to delivery to the Site.
- 3.5 Be responsible for all applicable requirements of the regulations.
- 3.6 Before commencing any Work on Site, attend the pre-construction meeting and provide the Consultant with a proposal as to how hazardous materials will be stored and dispensed on Site. In addition, specifically outline the measures which will be undertaken to prevent damage or injury in the event of an accidental spill.
- 3.7 Provide Handling Procedure for Hazardous Materials”.
- 4 JOINT HEALTH AND SAFETY COMMITTEE**
- 4.1 The Contractor shall be responsible for the establishment and operation of the Joint Health and Safety Committee as required by the Occupational Health and Safety Act.
- 5 DELIVERABLES**
- 5.1 The Contractor shall deliver to the Consultant:
- .1 The Contractor's Occupational Health and Safety Policy.
 - .2 The Contractor's safety program to implement the Occupational Health and Safety Policy for the Contract, which will effectively prevent and control accidents for the Contract.
 - .3 A copy of all communications with, and including all orders by, the Ministry of Labour or other occupational health and safety enforcement authority.
 - .4 A copy of all accident/injury investigation reports, not just the WSIB Form 7. Each report must contain a statement of actions that will be taken to prevent a recurrence.

- .5 A copy of all inspection reports made by the Contractor in compliance with the employer's responsibility under the Occupational Health and Safety Act.
 - .6 A copy of all safety information pertaining to the Contract made and furnished by the Contractor's own "Safety Personnel" or outside consultants/advisers engaged for the purpose of inspecting the workplace for occupational health and safety.
 - .7 A verification that all workers in the employ of the Contractor on Site, have had a WHMIS training or refresher course within the last twelve months.
 - .8 A verification that all workers in the employ of the Contractor have had "Explosive Activated Tool Training" on the type of tools being used.
 - .9 A verification that the instruction manuals are on Site for all tools and equipment being used.
 - .10 A copy of the most recent workers compensation experience rating account, i.e. CAD-7, NEER, and/or an insurance carrier's experience rating account.
 - .11 Statistical information for the purpose of determining injury frequency and severity rates (hours worked, first-aid injuries, medical aid injuries, lost time injuries, restricted workday injuries, near-miss accident/incident and significant occurrence data), in a timely manner as required by the Consultant.
 - .12 The immediate reporting to the Consultant of all instances that are defined in the Occupational Health and Safety Act as "Notices of Injuries" and "Occurrences" and any occasion that a worker exercises their "Right to Refuse Unsafe Work".
- 5.2 The Consultant reserves the right to require additional or amended deliverables pertaining to safety during the duration of the Work at no additional cost to the Owner.
- 5.3 Items specified above shall be delivered to the Consultant prior to the Contractor commencing Work on the Site.

6 DUE DILIGENCE

- 6.1 The Contractor acknowledges that it has read and understands the measures and procedures relating to occupational health and safety as prescribed above. The Contractor acknowledges and understands its duties as therein set out and hereby expressly undertakes and agrees to comply with all such requirements and standards in their entirety and at the Contractor's expense.
- 6.2 The Contractor further agrees to fully cooperate with all health and safety requirements, rules, regulations, standards and criteria set out in the Contract Documents, which agreement is in furtherance of the Contractor's duties and responsibilities under occupational health and safety legislation.

- 6.3 The Contractor agrees that if, in the opinion of the Consultant or Owner, the health and safety of a person or persons is endangered or the effective operation of the system put in place to ensure the health and safety of workers on the Site is not being implemented, the Consultant or Owner may take such action as it deems necessary and appropriate in the circumstances, including, without limitation, the following:
- .1 Require the Contractor to remedy the condition forthwith at its own expense;
 - .2 Require that the Site be shut down in whole or in part until such time as the condition has been remedied;
 - .3 Remedy the problem and the Owner shall back-charge the Contractor for the cost of such remedial work, together with an appropriate overhead factor as determined by the Owner in its sole discretion; and
 - .4 Terminate the Contract without further liability in the event the Contractor fails to comply with these provisions.
- 6.4 If a lien is registered, in respect to any monies held back, back-charged or assessed in accordance with these paragraphs, the Contractor shall consent to an order vacating such registration and shall indemnify the Owner for any and all loss, whereby direct or consequential which the Owner may sustain as a consequence of such registration.

7 **SITE SAFETY PERSONNEL**

- 7.1 In the event the Consultant deems it necessary, because of the Work, the Contractor shall assign a "Competent Safety Person" to assist the Contractor's representative in the discharging of safety responsibility, at no additional cost to the Owner.

END OF SECTION

1 GENERAL

- 1.1 Provide labour, Products, equipment, services, tools, and supervision necessary for cutting and patching work in accordance with the Contract Documents.
- 1.2 Obtain Consultant's approval prior to cutting, boring or sleeving load-bearing members.

2 DEFINITION(S)

- 2.1 The terms "make good", "making good", "made good", "restore to existing", "patch", "repair", or similar words or phrases are used in standards and these Contract Documents to mean the following, unless context provides otherwise:
 - .1 Make good materials and finishes which are damaged or disturbed during the process of additions and reconstruction under the Contract.
 - .2 Where existing work is to be made good, match new work exactly with the existing work in material, form, construction and finish unless otherwise noted or specified.
 - .3 Where existing work is to be made good, there shall be no visible difference in appearance, performance, or aesthetics between the existing work and the new work by the naked eye at a distance of 3 metres from the surface being made good.

3 SUBMITTALS

- 3.1 Submit written request in advance of cutting or alteration which affects:
 - .1 Structural integrity of any element of the Structure or Contract.
 - .2 Integrity of weather-exposed or moisture-resistant elements.
 - .3 Efficiency, maintenance, or safety of any operational element.
 - .4 Visual qualities of sight-exposed elements.
 - .5 Work of Owner's or Other Contractors.
- 3.2 Include in request:
 - .1 Identification of Contract.
 - .2 Location and description of affected Work.
 - .3 Statement of necessity for cutting or alteration.
 - .4 Description of proposed Work and products to be used.
 - .5 Alternatives to cutting and patching.
 - .6 Effect on work of Owner's or Other Contractors.
 - .7 Date and time Work will be executed.

- 3.3 Obtain Consultant's approval of proposed method of cutting prior to proceeding with the Work.

4 **PRODUCTS**

- 4.1 Same quality or better than Products incorporated in original installation.

5 **PREPARATION**

- 5.1 Inspect existing conditions, including elements subject to damage or movement during cutting and patching.
- 5.2 After uncovering, inspect conditions affecting performance of the Work.
- 5.3 Beginning of cutting or patching means acceptance of existing conditions.
- 5.4 Provide supports to assure structural integrity of surroundings; devices and methods to protect other portions of the project from damage.
- 5.5 Provide protection from elements for areas which may be exposed by uncovering Work; maintain excavations free of water.
- 5.6 Protect work such as floors, finishes, trim, etc., as completely as possible to hold the replacing of damaged work to a minimum.
- 5.7 Preparation for new finishes:
 - .1 Remove existing finishes, including painting.
 - .2 Fill cracks and depressions with suitable filler and finish smooth, as recommended by the manufacturer of the new finishes.
 - .3 Grind protrusions level with substrates and finish smooth.
 - .4 Remove all evidences of existing adhesive, grease, oil, soil and other encrustations of foreign material by washing, scraping and grinding if necessary.
 - .5 Clean and prepare substrates to receive new work.

6 **EXECUTION**

- 6.1 Execute Work to avoid damage to other Work.
- 6.2 Execute cutting, fitting and patching including excavation and fill to complete the Work.

- 6.3 Employ appropriate trades with skilled labour to perform cutting Work.
- 6.4 Fit Work segments together, to integrate with penetrations through surfaces and with other Work.
- 6.5 Remove and replace defective and non-conforming Work.
- 6.6 Do any drilling, cutting, fitting, patching and finishing that may be required to make the various classes and kinds of other Work fit together in a professional and finished manner. Make watertight connections with adjoining structures.
- 6.7 Provide openings in non-structural elements of Work for penetrations of mechanical and electrical Work.
- 6.8 Execute Work by methods to avoid damage to other Work and which will provide proper surfaces to receive patching and finishing.
- 6.9 Cut Products using proper equipment and methods. On rigid materials, use a masonry saw or core drill. Pneumatic or impact tools are not allowed on masonry work without prior approval.
- 6.10 Where new Work connects with existing structures, cut, patch and make good existing work to match original condition.
- 6.11 Be responsible for correct formation and bridging of openings in masonry and structural walls as required.
- 6.12 Ensure compatibility between installed Products and security of installation.
- 6.13 Restore Work with new Products in accordance with requirements of the Contract Documents.
- 6.14 Fit Work airtight to pipes, sleeves, ducts, conduits and other penetrations through surfaces.
- 6.15 Properly prepare surfaces to receive patching and finishing.
- 6.16 Refinish surfaces to match adjacent finishes; for continuous surfaces refinish to nearest intersection; for an assembly, refinish entire unit.

END OF SECTION

1 **PROGRESS CLEANING**

1.1 Remove from finish work, spatters, droppings, soil, labels, and debris, before they set up.

1.2 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.

1.3 Maintain building work areas "broom clean" at least on a daily basis, but shall also be done immediately before finishing work.

1.4 No waste material may be burned or buried at site. Remove as often as required to avoid accumulation, no less than, at the end of each working day.

1.5 Remove packaging materials and debris from the site immediately product and equipment is unwrapped or uncrated.

1.6 Ensure that volatile fluid wastes are not disposed of in storm or sanitary sewers, in open drain courses, or anywhere on site.

1.7 Do not allow waste material and debris to accumulate in an unsightly or hazardous manner. Sprinkle dusty accumulations with water. Provide containers in which to collect waste material and debris. Dispose of hazardous products in accordance with requirements of jurisdictional authorities.

1.8 Ensure that cleaning operations are scheduled to avoid deposits, of dust or other foreign matter on surfaces during finishing work and until wet or tacky surfaces are cured.

1.9 Provide instructions for final cleaning of finishing work, and for inclusion in Maintenance and Operating Manuals.

2 **FINAL CLEANING**

2.1 Before final inspection, replace glass and mirrors broken, damaged, and etched during construction, or which are otherwise defective.

2.2 In addition to requirements for progress cleaning, Work shall include final cleaning by skilled cleaning specialists on completion of construction.

2.3 Remove temporary protections and make good defects before commencement of final cleaning.

- 2.4 Final cleaning shall remove dust, stains, paint spots, soil, grease, fingerprints, and accumulations of construction materials, interior and exterior to the building for all new work throughout new and existing Building. Work shall be done in accordance with manufacturer's instructions for each material. This work shall include:
- .1 Washing of concrete floors.
 - .2 Cleaning and polishing of glass, mirrors, porcelain, enamel and finish metals.
 - .3 Vacuum cleaning of ceilings, walls and floors.
 - .4 Cleaning and polishing of ceramic tile floors.
 - .5 Cleaning of resilient flooring.
 - .6 Buffing of resilient flooring followed by two light coats of wax, each buffed.
 - .7 Washing clean of glazed wall surfaces.
 - .8 Cleaning of hardware, mechanical fixtures, plumbing fixtures, lighting fixtures, cover plates, and equipment, including polishing of their finish metal, porcelain, vitreous, and glass components.
 - .9 Cleaning of windows and entrances, both interior and exterior surfaces.
- 2.5 Maintain cleaning until Owner has taken possession of building or portions thereof.

END OF SECTION

1 GENERAL

- 1.1 Hand over to the Consultant one hardcopy and 2 digital copies of a comprehensive operations and maintenance manual and material suitable for the Owner's maintenance employees. Manuals shall cover all Products supplied and installed under the Contract.
- 1.2 Submit digital draft of the operation and maintenance manuals for the Consultant's review at least 15 days before testing systems and equipment. Incorporate alterations and additions, as found to be necessary during testing, and prepare the final version of the manual from the corrected draft.
- 1.3 Operation and Maintenance manuals shall be submitted at time of application for Substantial Completion.
- 1.4 Testing of systems and equipment will not be deemed to be complete until the requisite number of copies of the final version of the manuals has been handed over to the Consultant.
- 1.5 If standard literature is incorporated into the operations and maintenance manual, any irrelevant information shall be deleted, or suitably noted.
- 1.6 The manuals shall have sufficient detail in order that the Owner can totally maintain the equipment without outside help.
- 1.7 Submit all material in English.

2 FORMAT

- 2.1 Organize data in the form of an instructional manual.
- 2.2 Binders: Commercial quality, 219 x 279 mm, maximum "D" ring size.
- 2.3 Digital copies on USB or DVD as required by TDSB.
- 2.4 Cover: Identify each binder with type or printed title "Contract Record Documents"; list title of Contract, identify subject matter of contents.
- 2.5 Arrange content by systems or process flow, under Section numbers and sequence of Table of Contents.
- 2.6 Provide tabbed fly leaf for each separate Product and system, with typed description of Product and major component parts of equipment.
- 2.7 Text: Manufacturer's printed data, or typewritten data on 20 pound paper.
- 2.8 Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.

3 CONTENTS

- 3.1 Operation and maintenance manuals shall contain the following minimum information and data:
- .1 Table of Contents: Provide title of contract; names, addresses, and telephone numbers of Consultants and Contractors with the name of responsible parties; schedule of Products and systems, indexed to content of the volume.
 - .2 For each Product or system: List addresses and telephone numbers of Subcontractors, suppliers and service representatives, including local source of replacement supplies and parts including telephone numbers.
 - .3 Warranties: Warranties are between the Contractor and Owner. Warranties shall include, as a minimum:
 - .1 Description of warranty coverage
 - .2 Date warranty starts (being date of Contract completion)
 - .3 Date Warranty expires
 - .4 Contact name, address and phone number (the Contractor shall also be responsible for advising the Owner of changes in contact information during the warranty period)
 - .5 Equipment and components, performance curves
 - .6 Hydro certificates
 - .4 Reports: For each product or system provide the following:
 - .1 Manufacturer's certified reports
 - .2 Factory test reports
 - .3 Field testing reports
 - .5 Details of design, construction and/or fabrication features, component function and maintenance requirements, to permit effective start-up, operation, maintenance, repair, modification, extension and expansion of any portion or feature of the installation.
 - .6 Technical data, product data, supplemented by bulletins, component illustrations, detailed views, technical descriptions of items and parts list.
 - .7 Schematics, interconnection lists: manuals shall be complete with schematic and wiring diagrams, wiring interconnection lists and diagrams fully cross referenced and coordinated, printed circuit board layouts including the component identification, component parts list with electronic substitution equivalent. Provide cross referenced components list and sequence of operations.

- .8 Trouble shooting and fault location guide: Instructions to facilitate quick return of malfunctioning equipment to operation.
- .9 Routine servicing and preventative maintenance schedule for Products and/or estimated hours required for routine servicing and preventative maintenance tasks.
- .10 List of recommended spare parts and recommended quantity of each item to be stocked based on spare part availability and re-order time.
- .11 Complete set of reviewed shop drawings.
- .12 Product data: Mark each sheet to clearly identify specific Products and component parts, and data applicable to installation; delete inapplicable information.
- .13 Drawings: Supplement Product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams and as required in the Specifications.
- .14 Typed text: As required to supplement Product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions and as required in the Specification.

4 DRAWINGS

- 4.1 Prepare all required drawings on CAD, using AutoCAD. AutoCAD version to suite Owner's CAD requirements.
- 4.2 Prepare CAD drawings to meet the requirements of the Owners or Consultant's CAD Standards and Procedures.
- 4.3 Supply and hand over to the Consultant, one original photographic reproduction for each final drawing prepared under this Contract, including but not limited to circuit drawings, equipment layout drawings, and shop drawings.
- 4.4 Prior to Contract Completion, supply and hand over to the Consultant, one complete set of CAD Drawing Files in AutoCAD format on compact disk (CD) for each final drawing prepared under this Contract and one complete 11" x 17" hard copy set, including but not limited to circuit drawings, equipment layout drawings, and shop drawings.
- 4.5 Text files shall be written in word processing program acceptable to Owner.

5 TRANSMITTAL

- 5.1 Forward storage media to the Owner through the Consultant with a transmittal form. Transmittal shall contain the list of file names contained on the storage media.
- 5.2 Data forwarded to the Owner shall contain the following files in addition to the design information:

- .1 Library parts/cells used in the design files.
- .2 Level convention used for each design file.
- .3 Plotting instructions used to prepare hard copies including colour tables, pen tables and plot scale.
- .4 Working units of the design files.
- .5 Font library, if the standard is not used.

END OF SECTION

1 **PROGRESS RECORDS**

1.1 Maintain on site, permanent written records of daily progress of the Work. Records shall be open to review by Consultant and Owner at all times and a copy shall be furnished to Consultant on a weekly basis.

1.2 Records shall show dates of commencement, progress and completion of various trades and items of work. Particulars pertaining to number of employees of various trades and type and quantity of equipment employed daily, temperature, protection methods and other such data shall be noted.

2 **RECORD DRAWINGS**

2.1 Authorized deviations from drawings shall be marked in red accurately on one set of drawing prints in a neat, legibly printed manner and shall be dated. Prior to final inspection, neatly transfer the recorded information to a second set of drawing prints of the most recent revision to the drawings and submit both sets to the Consultant.

2.2 Maintain record drawings up to date as Work progresses. Status of maintained record drawings may be considered as a condition for validation of applications for payment.

2.3 Identify each record drawing as "Contract Record Copy" and maintain the record drawings in good condition. Make record drawings available to the Consultant at all times.

2.4 Record drawings shall include accurate dimensioned record of deviations and changes in Work from drawings.

2.5 Record drawings shall be signed and dated by Contractor.

2.6 Submit record drawing to Consultant for review and make corrections as directed by Consultant.

2.7 Record accurately all deviations in the Work.

2.8 Accurately record locations of concealed structure, mechanical and electrical services and similar Work not clearly in view, the location of which is required for maintenance, alteration Work and future additions. Do not conceal such Work until the location has been recorded.

2.9 Accurately record locations of equipment bases, anchors, concrete pads and roof curbs, sleeves, piping, conduits, ducts, maintenance holes and valves, etc. located either below, outside or within structure.

2.10 Where piping, conduits and ducts are underground, underfloor, embedded in concrete or otherwise in inaccessible locations, accurately record with respect to structure column lines or walls and elevations with respect to finished floor levels or grades referenced to the centre line of components.

- 2.11 Accurately record any components which will be in inaccessible locations for Consultant's review before the component is covered, or buried, or made inaccessible.
- 2.12 CAD drawings of Contract Drawings can be obtained from Consultant at a cost of \$50.00 per drawing.
- 2.13 Clearly and prominently mark each drawing "RECORD DRAWING prepared by (name of Contractor)"

3 **AS-BUILT DRAWINGS**

- 3.1 Contractor shall provide as-built drawings and specifications for all disciplines in AutoCad and PDF format upon construction completion.

END OF SECTION

1 General

.1 SECTION INCLUDES

- .1 Labour, Products, equipment and services necessary for demolition and removals Work in accordance with the Contract Documents.
- .2 Work included: Requirements for demolishing, salvaging and removing wholly or in part the various items designated on the drawings or required to be removed or partially removed for the receipt of the Work of this Contract, including not necessarily limited to:
 - 1. Removal of existing Windows, Blinds and items interfering with window removal and installation.
 - 2. Removal of Doors, Screens and Frames.
 - 3. Alteration and renovations to the existing building.
 - 4. Cutting and removing of walls, masonry, window sills, in the existing buildings as indicated on Drawings.
 - 5. Patching, making good openings and chases in walls, floors, ceilings, including the supply and installation of lintels, channels and finishes.
 - 6. Removal of rubbish, debris, demolished fixtures, fitments and items not scheduled to remain the Owner's property, resulting from the demolition and preparatory work.
 - 7. Remove abandoned services such as conduits, pipes, wiring, ducts, fixtures, equipment, etc. where required for the work or indicated on the drawings.
 - 8. Removal of all mechanical items including services etc. where required for the work or indicated on drawings and or where not required to be relocated.
 - 9. Removal of existing electrical items including fixtures, etc. where required for the work or indicated on the drawings and not required to be relocated.
 - 10. Dust control during the operations of the work of this Section.
 - 11. Removal shall mean removal from site and safe disposal in a legal manner.
 - 12. Removal of paint from soffit and flashing at canopies.

.2 REFERENCES

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

.3 SUBMITTALS

- .1 Where required by Authorities having jurisdiction, submit a Fire Plan to local fire department for review and approval.
- .2 Submit shop drawings, diagrams and details in accordance with the Conditions of the Contract.
- .3 30 calendar days prior to start of demolition and removals Work, submit for review, drawings, diagrams or details showing sequence of disassembly Work and shoring of supporting structures in accordance with authorities having jurisdiction.

- .4 Submit for approval, a plan showing impacts, interruptions and delays to Owners operations.
- .5 Submit Dust Control Plan conforming to requirements of the City of Toronto's Public Health Services.
- .6 Have submissions signed and sealed by Professional Engineer licensed in Province of Ontario.
- .7 Submit to Consultant, details of where rubble, debris and other materials are to be disposed or reused. Include each disposal/reuse site location, operator's name and business address, type of license under which site operates, and criteria used by site to assess suitability of rubble, debris and other materials for disposal.
- .8 Give notice to Utility Authorities controlling services and appurtenances which will be affected by demolition Work.

.4 QUALITY ASSURANCE

- .1 Prepare waste audits, waste reduction workplans, source separation programs and recycling programs as required by jurisdictional authorities and update programs and implement such programs as required.
- .2 Perform the work of this section in accordance with the 'Environmental Protection Act' including Ontario Regulation 102 and the 'Environmental Assessment Act' including Ontario Regulation 103.
- .3 Conform to Fire Code, Regulation under the Fire Marshals Act.
- .4 The demolition contractor must engage a registered professional engineer who holds a certificate of authorization and an appropriate level of liability insurance to prepare demolition procedures.
- .5 As part of the contract requirements, the engineer for the demolition contractor should be required to sign the general review commitment required by city building departments.
- .6 Roof Removal: Conform the requirements of Canadian Roofing Contractors Association.

.5 SITE CONDITIONS

- .1 Interruptions to Owners operations will not be permitted.
- .2 Perform operations, machine and equipment movements, deliveries and removals at time or times that will permit uninterrupted operations in and around structures, including parking, deliveries, and Site access and egress.

- .3 Take over structures to be demolished based on condition on date that Tenders close.
- .4 Do not remove existing roofing membrane when weather conditions threaten the integrity of the building contents or intended continued occupancy.

2 Products

.1 MATERIALS

- .1 All materials requiring removal shall become the Contractor's property and shall be removed and disposed of from the site, as the work progresses, unless indicated otherwise.
 - .2 Salvaged material:
 - .1 Salvage and stockpile Products, materials, and equipment as specified herein, indicated on Site or indicated on drawings.
 - .2 Coordinate items to be salvaged with Consultant and Owner.
 - .3 Salvaged materials shall not be chipped, cracked, split, stained or damaged.
 - .4 Store items off of moist surfaces.

3 Execution

.1 GENERAL

- .1 Close and secure all openings to prevent public access to the building, and to prevent any damage from elements.
Schedule work to coincide with commencement of new roofing system installation.
- .2 Remove only enough existing roofing system materials that can be replaced with new roof system the same day of as the weather will permit in a day.
- .3 Clean up rubble and debris, resulting from Work promptly and dispose at end of day or place in waste disposal bins. Empty bins on regular basis.
- .4 Stockpiling of rubble, debris, and surplus Products on Site will not be permitted.
- .5 Remove, handle and transport Products indicated to be salvaged and stored for future use. Transport Products to storage area(s) designated by Consultant. Perform Work to prevent any damage to Products during removal and in storage. Products damaged during removal, will be inspected by Consultant. Consultant will determine extent of damage and accept or refuse Products.
- .6 Communicate Dust Control Plan procedures to all appropriate personnel on site and their head offices and due diligence measures to be maintained to control all fugitive emissions.

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

.2 EXAMINATION

- .1 Verify condition and dimensions of previously installed Work upon which this Section depends. Report defects to Consultant. Commencement of Work means acceptance of existing conditions.
- .2 Examine adjacent structures and other installations prior to commencement of demolition and removals Work.
- .3 Verify that openings are ready for new window installation.
- .4 Verify that existing roof surface is clear and ready for work of this section.

.3 PRESERVATION OF REFERENCES

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

.4 PROTECTION

- .1 Prevent movement or damage of adjacent structures, services, and parts of existing structure to remain. Supply and install bracing, and shoring as required. Make good damage caused by demolition to acceptance of Consultant.
- .2 Protect adjacent structures and property against damage which might occur from falling debris or other causes. Repair or replace damage caused from Work of this Section to acceptance of Consultant.
- .3 Do not interfere with use of adjacent structures and Work areas. Maintain free, safe passage to and from adjacent structures and Work areas.
- .4 Take precautions to support affected structures. If safety of structure being demolished, adjacent structures or services are endangered, cease demolition operations and take necessary action to support endangered item. Immediately inform Consultant. Do not resume demolition until reasons for endangering have been determined and corrected and action taken to prevent further endangering.
- .5 If movement or settlement occurs, install additional bracing and shoring as necessary and make good damage to acceptance of Consultant.

- .6 Hang tarpaulins where debris and other materials are lowered. Build in around openings with wood and plywood at locations used for removal of debris and materials.
- .7 Prevent debris from blocking surface drainage system, elevators, mechanical, and electrical systems which are required to remain in operation.
- .8 Pay particular attention to prevention of fire and elimination of fire hazards which would endanger Work or adjacent structures and premises.
- .9 Supply and install adequate protection for materials to be re-used, set on ground and prevent moisture pick-up. Cover stockpiles of materials with tarpaulins.
- .10 Close off access to areas where demolition is proceeding by barricades and post warning signs.
- .11S Supply, install and maintain legal and necessary barricades, guards, railings, lights, warning signs, security personnel and other safety measures, and fully protect persons and property.
- .12 Dust/weather partitions:
 - .1 Prior to demolition Work proceeding in existing structures, temporarily enclose Work areas, access and supply and install dustproof and weatherproof partitions. Design partitions to prevent dust and dirt infiltration into adjoining areas, prevent ingress of water, and to resist loads due to wind.
 - .2 Prevent dust, dirt and water from demolition operations entering operational areas.
 - .3 Adjust and relocate partitions as required for various operations of Work.
 - .4 Upon completion of Work, remove and dispose of partitions from Site.
- .13 Dust protection:
 - .1 Perform dust control procedures in accordance with approved Dust Control Plan and work of this Section.
 - .2 Clean water to be applied to hard and soft surfaces and on open excavation faces on Site daily to eliminate dust.
 - .3 Roadways and sidewalks to be cleaned daily or as required.
 - .4A designated truck loading area on granular material or existing asphalt to be used to mitigate tracking of potentially contaminated soil and demolition debris off Site. Contaminated loading points to be cleaned or re-established.
 - .5 Loaded vehicles leaving Site to be cleaned of loose soil and debris with power washing or alternative method.
 - .6 Trucks loaded with indigenous soil or demolition debris to be covered by tarps or attached screens.
- .14 Blasting is not permitted.

.5 PREPARATION

- .1 Provide, erect and maintain required hoarding, catch platforms, lights and other protection around Site before commencing work. Maintain such areas free of snow, ice, mud, water and debris. Lighting levels shall be equal to that prior to erection.
- .2 Disconnect and/or re-route electrical data, communication and telephone service lines entering structures to be demolished. Remove abandoned lines as indicated on Contract Drawings. Post warning signs on electrical lines and equipment which is required to remain energized.
- .3 Disconnect and cap designated mechanical services:
 - .1 Sewer and water lines: Remove and dispose of as indicated on Contract Drawings.
 - .2 Other underground services: Remove and dispose of as indicated on Contract Drawings.
- .4 Disassemble and remove mechanical equipment, ductwork and piping complete with supports and associated components.
- .5 Do not disrupt active or energized utilities designated to remain undisturbed.
- .6 Perform rodent and vermin control to comply with health regulations.

.6 CONCRETE CUTTING AND CORING

- .1 Prior to cutting or coring any concrete slab, suspended or on grade, or any concrete beam, investigate by telemetrically scanning the element for presence of embedded services (piping, cabling, conduit, etc.), and for locations of reinforcing steel in suspended concrete slabs and beams.
- .2 Acceptable telemetric scanning systems include:
 - .1 X-Ray scanning of suspended slabs and for concrete beams.
 - .2 (Ground-penetrating) radar for slab on grade, for suspended slabs and for concrete beams.
- .3 Magnetic radio scanners not acceptable for telemetric scanning.
- .4 The term x-rays include gamma ray methods, and procedures that use electrically generated x-rays.
- .5 Where x-rays employed:
 - .1 Provide Owner minimum 5 working days advance notice of scanning time in order to provide sufficient advance notice to personal that may be affected by the x-ray work.
 - .2 Conform to Owner's radiation protection requirements prior to start of any x-ray work.

- .6 Provide Owner and Consultant with inspection agency's written report, summarizing investigations and conclusions.
- .7 Obtain Consultant's direction where investigations reveal that cutting or coring required in Contract would cut or damage embedded services, or cut or damage reinforcing steel in suspended concrete slabs or beams.
- .8 Execute cutting and coring to prevent damage to all embedded services. Make good all damage arising from cutting embedded services.
- .9 Execute cutting and coring to prevent damage (cutting in whole or in part) reinforcing steel in suspended concrete slabs with Consultant's prior authorization.
- .10 Make good all damage arising from cutting reinforcing steel in suspended concrete slabs and beams.

.7 DEMOLITION

- .1 Perform demolition with extreme care. Confine effects of demolition to those parts which are to be demolished.
- .2 Perform Work and prevent inconvenience to persons outside those parts which are to be demolished.
- .3 Carry out demolition in accordance with the requirements of CSA S350-M.
- .4 Demolish parts of structure to permit remedial Work as indicated.
- .5 Demolition shall proceed safely in systematic manner from roof to grade and as necessary to accommodate remedial work indicated. Work on each floor level shall be complete before commencing work on supporting structure and safety of its supports are impaired. Parts of building which would otherwise collapse prematurely shall be securely shored. Walls and piers shall not be undermined.
- .6 Do not overload floor or wall with accumulations of material or debris or by other loads.
- .7 Roof Areas: Remove existing roofing gravel, perimeter flashings, base flashings, counter flashings, vent stack flashings, roofing membrane, insulation, vapour retarder, and all associated components.
- .8 Coordinate removal of roof mounted mechanical equipment, electrical equipment, and with relevant trades.
- .9 Prior to removing roofing materials, temporarily plug drains to prevent any debris from entering the drainage system. Unplug at the end of each day and prior to rain.

- .10 Perform Work to minimize dusting. Keep Work area wetted down with fog sprays to prevent dust and dirt rising. Supply and install temporary water lines and connections that may be required. Upon completion, remove installed temporary water lines. Use covered chutes, water down.
- .11 Do not sell or burn materials on Site.
- .12 Remove existing equipment, services, and obstacles where required for refinishing or making good of existing surfaces, and replace as Work progresses.
- .13 At end of day's Work, leave Work in safe condition with no part in danger of toppling or falling. Protect interiors of parts not to be demolished from exterior elements.
- .14 Drainage and sewer system protection:
 - .1 Ensure that no dust, debris or slurry enters drainage and sewer system on Site.
 - .2 Remove and dispose of debris and slurry promptly from Site.
 - .3 Comply with City of Toronto Sewer Use By-Law.
- .15 Concrete:
 - .1 Demolish concrete by methods which avoid impact loads on items which are not to be demolished.
 - .2 Where only part or parts of a concrete floor, wall, roof, foundation or other items are to be demolished, use saw cuts to isolate areas which are to be demolished except where existing reinforcing steel is to be left in place. Prior to such isolating, install suitable support to prevent premature movement of area(s) being isolated and undesirable transfer of loads as cutting progresses. If necessary remove area(s) to be demolished by successively isolating small sections.
 - .3 Where reinforcing steel is to be left in place, use saw cuts from surface of concrete around perimeter(s) of area(s) to be demolished, chip concrete without damaging reinforcing steel. Retouch damaged epoxy coating of existing reinforcing steel.
- .16 Masonry:
 - .1 Demolish block or brick or pre cast walls and veneers in small sections of not more than 2 m². Do not permit masonry to fall in mass from one level to another.
 - .2 Where only part(s) of a wall is to be demolished, install adequate support for adjacent part(s).
 - .3 After removal of masonry walls, grind smooth floors ready for new floor finish.
- .17 Steel: Where only part or parts of structure is to be demolished, dismantle and maintain structure stable. Do not place excessive loads on components. Install adequate temporary guys and supports to ensure stability and to prevent excessive loading. Support each component being disconnected from structure, and lower, do not drop, component after it is disconnected.

- .18 Cut openings through existing walls, partitions, roofs and floors. Establish exact location of steel reinforcing in existing concrete slabs or walls before cutting. Be responsible for damage to existing steel reinforcing and be liable for structural failure. Make good surfaces disturbed with materials to match existing.

- .19 Sheet metal flashings:
 - .1 Remove sheet metal flashings indicated on drawings.
 - .2 Consultant to inspect sheet metal flashings to determine suitability for reuse. Stockpile sheet metal flashings to be reused.

- .20 Scrape, repair, sand, clean and repaint fascias in accordance with Section 09 91 00.

- .21 Demolish all other items indicated or required.

.8 DISPOSAL OF MATERIALS

- .1 Remove from Site, rubble, debris, and other materials resulting from demolition and removals Work in accordance with Authorities having Jurisdiction, except where specified or indicated on Contract Drawings to be reused.

- .2 Conform to requirements of municipality's Works Department regarding disposal of waste materials.

- .3 Materials prohibited from municipality waste management facilities shall be removed from Site and dispose of at recycling companies specializing in recyclable materials.

.9 RESTORATION

- .1 Where demolition removed a structure or installation, rough grade and restore area in accordance with Authorities having Jurisdiction.

END OF SECTION

1 General

1.1 **SECTION INCLUDES**

- .1 Labour, Products, equipment and services necessary for rough carpentry Work in accordance with the Contract Documents.

1.2 **REFERENCES**

- .1 ASTM A153, Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
- .2 ASTM A325, Specification for Bolts Quenched/Tempered Steel Nominal Thread Diameter M16 - M36 For Structural Steel Joints.
- .3 ASTM A653, Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- .4 ASTM E84, Standard Test Method for Surface Burning Characteristics of Building Materials.
- .5 ASTM F1667, Driven Fasteners: Nails, Spikes and Staples.
- .6 CAN/CSA O80 Series M, Wood Preservation.
- .7 CSA O86, Engineering design in wood.
- .8 CSA O121-M, Douglas Fir Plywood.
- .9 CAN/CSA O141, Softwood Lumber.
- .10 CSA O151-M, Canadian Softwood Plywood.
- .11 NLGA, Standard Grading Rules for Canadian Lumber, National Lumber Grades Authority

1.3 **QUALITY ASSURANCE**

- .1 Lumber identification: Grade stamp of an agency certified by the Canadian Lumber Standards Accreditation Board.
- .2 Plywood identification: Grade mark in accordance with applicable CSA standards.
- .3 Lumber quality: Carefully select individual pieces so that knots and obvious defects will not interfere with placing bolts, proper nailing or making proper connections.
- .4 Moisture Content of wood at time of construction shall be 19% maximum.

1 General

1.1 **SECTION INCLUDES**

- .1 Labour, Products, equipment and services necessary for rough carpentry Work in accordance with the Contract Documents.

1.2 **REFERENCES**

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1.3 **QUALITY ASSURANCE**

- .1 Lumber identification: Grade stamp of an agency certified by the Canadian Lumber Standards Accreditation Board.
- .2 Plywood identification: Grade mark in accordance with applicable CSA standards.
- .3 Lumber quality: Carefully select individual pieces so that knots and obvious defects will not interfere with placing bolts, proper nailing or making proper connections.
- .4 Moisture Content of wood at time of construction shall be 19% maximum.

- .5 Each piece of pressure treated lumber and fire retardant treated lumber shall be shop marked with the pressure treatment brand and ULC monogram respectively, in accordance with CAN/CSA O80-M.
- .6 Dimensions of lumber shall conform to dressed sizes specified in CAN/CSA-0141 unless actual dimensions are otherwise indicated or specified.
- .7 Dimensional references to lumber on Drawings and in Specifications are to nominal sizes unless actual dimensions are indicated. Such actual dimensions shall be dry size.
- .8 Lumber defects: Discard wood with defects which will render a piece unable to serve its intended function. Lumber will be rejected by Consultant for excessive warp, twist, bow, crook, mildew, fungus, or mould, as well as for improper cutting and fitting, whether or not it has been installed.

1.4 ENVIRONMENTAL REQUIREMENTS

- .1 When it is required that wood maintain dimensional stability and tolerances to ensure accurate installation of later work, store and install it only in dry areas, and where no further installation of moist materials is contemplated.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

- .1 Store materials in a dry area. Cover materials with tarpaulins or polyethylene sheets to prevent moisture absorption and impairment of structural and aesthetic properties. Vent to allow air movement. Tie covering to keep in place.

2 Products

2.1 MATERIALS

- .1 General: All materials under Work of this Section, including but not limited to, adhesives are to have low VOC content limits.
- .2 Lumber: Softwood, G4S, moisture content 19% or less at time of installation, in accordance with the following:
 - .1 Lumber shall be of same species and grade, equally seasoned and shall be processed and stamped at same mill.
 - .2 CSA O141 and NLGA Standard Grading Rules for Canadian Lumber.
 - .3 Board quality: Construction or better.
 - .4 Dimension quality:
 - .1 Structural joists, planks, and framing: No. 1 Select Structural.
 - .2 Light framing: Construction.
 - .5 Decking: Commercial.
- .3 Plywood: CSA O121-M, G1S unsanded, T & G, standard construction, laminated with waterproof adhesive, exterior grade, Thickness as indicated on drawings.

- .4 Sheathing: Douglas Fir, CSA 0121-M or CSA O151-M; Select-Tight Face, exterior grade, T & G.
- .5 Wood Decking: NLGA, commercial, Western Red Cedar, Douglas Fir or Spruce, single or double tongue and groove and 'veed' one side, predrilled at 750 mm oc for lateral spiking. Kiln dry decking to 15% maximum moisture content. 1.8 to 6 m or longer with a minimum of 90% planks exceeding 3 m. Square end trimmed. For single spans shorter than 3 m use decking of same length as span.
- .6 Roof lumber: NLGA, Construction grade light framing, Jack Pine, S4S, pressure treated to CAN/CSA-O80 series using copper based waterborne preservative treatment, impregnated to a net retention of 4 kg/ m³ of preservative unless otherwise specified by preservative manufacturer.
- .7 Surface applied wood preservative: Green coloured copper naphthenate or 5% pentachlorophenol solution, water repellent preservative or same copper based preservative as used for shop impregnation, in accordance with CAN/CSA O80.
- .8 Fire retardant treatment of lumber and plywood (interior and protected locations): 'Dricon FRT' fire retardant treatment by Biewer Lumber or approved alternative, conforming to ASTM E84, to provide a flame spread rating of 25 or less.
- .9 Rough hardware: Conforming to ASTM F1667; Nails, bolts, screws, anchors, expansion shields, and other fastenings required to frame and fix rough carpentry as follows:
 - .1 Nails, spikes and staples: Spiral type.
 - .2 Bolts: ASTM A325; 12.7 mm diameter minimum with nuts and washers unless noted otherwise.
 - .3 Screws: Countersunk head, full thread type.
 - .4 Splines: galvanized metal, as recommended by decking manufacturer.
 - .5 Proprietary fasteners: Toggle bolts, expansion shields, lag bolts, screws, inorganic fibre plugs, recommended for purpose by manufacturer.
 - .6 Galvanize rough hardware used in fire treated wood and hardware exposed to the atmosphere.
- .10 Fasteners for use in pressure treated wood: Provide hot dipped galvanized fasteners complying to ASTM A153 and connectors in accordance with ASTM A653, Class G185 for non-structural members. Provide type 304 or 316 stainless steel fasteners and connectors for use in Structural, pressure treated wood.

3 Execution

3.1 EXAMINATION

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

3.2 GENERAL

- .1 Lay out work carefully and to accommodate work of others. Cut and fit accurately: erect in position indicated by Drawings.
- .2 Install rough carpentry to allow for expansion and contraction of the materials.
- .3 Cut work into lengths as long as practicable and with square ends. Align, level, square, plumb, and secure work permanently in place. Brace work temporarily as required. Join work only over solid backing.
- .4 Bore holes true to line and to same size as bolts. Drive bolts into place for snug fit, and use plates or washers for bolthead and nut bearings. Turn up bolts and lag screws tightly when installed, and again just before concealed by other work or at completion of Work.
- .5 Provide anchors, bolts, and inserts required for attachment of the work of this Section, to those performing the work of other Sections and who are responsible for their installation.
- .6 Do not attach work by wood plugs or blocking in concrete or masonry. Use lead shields, expansion shields, or similar methods only as approved by Consultant.

3.3 MISCELLANEOUS WOODWORK

- .1 Fit and install wood furring, strapping, grounds and blocking. Adequately size, correctly place and conceal members for finishes, fitments and for Work under other Sections. Do not assume that Drawings show required work exactly or completely. Anchor wood members securely in place.
- .2 Install rough bucks, nailing strips and linings to rough openings as required for backing for frames and other Work.
- .3 Except where steel supports are specifically shown, provide wood blocking and supports in metal stud partitions for fastening of item such as casework and other wall mounted accessories. Have respective trades approve the location of such wood blocking.
- .4 Bolt wood blocking or nailing strips to steel framing.
- .5 Align and plumb faces of furring and blocking to tolerance of 1:600.
- .6 Use fire retardant lumber for blocking/framing in ceiling\ spaces, partitions and bulkheads.

3.4 ROOF WOODWORK

- .1 Install continuous wood nailers around roof perimeters, curbs and roof openings larger than 150 x 150 mm, and at edges of insulation as detailed. Install cut cant strips and continuous nailers on copings and curbs as detailed.

- .2 Install wood backing, dressed, tapered and recessed slightly below top surface of roof insulation and roof hopper.
- .3 Fasten roof woodwork at maximum 400 mm o.c. in staggered pattern unless noted otherwise.

3.5 **WOOD DECKING**

- .1 Do wood deck work in accordance with CSA O86 except where specified otherwise.
- .2 Install decking in accordance with CSA O86, simple span pattern.
- .3 Provide minimum of one bearing support for each plank except for cantilevers which shall extend over two supports. Install sloping deck with tongues up. Join butt ends with splines to assure tight square fit.
- .4 Stagger end joints in adjacent planks minimum of 0.5 m. Separate joints in same area by at least two intervening courses. Avoid joints in first fifth of end spans. Minimize joints in middle third of any span.
- .5 Remove tool marks, bruises, and scratches.
- .6 Apply preservative to end cuts where pressure treated lumber is specified.

3.6 **BACKBOARDS**

- .1 Install plywood backboards, primed and painted white on both sides, with fire retardant paint.
- .2 Use minimum 19 mm thick plywood on 19 x 38 mm furring around perimeter and at maximum 300 mm intermediate spacing.

3.7 **FASTENERS**

- .1 Frame, anchor, fasten, tie and brace members for required strength and rigidity.
- .2 Use hot dipped galvanized fasteners for exterior Work and Work below grade.
- .3 Countersink bolts and bolt heads as required for clearance of other Work.
- .4 Size fasteners to penetrate base member by half of fastener length minimum. Minimize splitting of wood members by staggering nails in direction of grain.
- .5 For plywood use spiral, annular or resin coated nails and staples.

3.8 **SURFACE-APPLIED WOOD PRESERVATIVE**

- .1 Treat raw surfaces, drilled holes and cut ends of pressure treated wood with 2 coats of wood preservative immediately after cutting.

- .2 Apply preservative by dipping, by brush or by pouring into plugged holes to completely saturate surface.

END OF SECTION

1 General

1.1 **SECTION INCLUDES**

- .1 Labour, Products, equipment and services necessary for sealant Work in accordance with the Contract Documents.
- .2 Labour, Products, equipment and services necessary for the removal of existing sealant and installation of new sealant in accordance with the Contract Documents.
- .3 Work of this Section does not include sealant work identified in individual specification sections.

1.2 **REFERENCES**

- .1 ASTM C920, Specification for Elastomeric Joint Sealants.
- .2 ASTM C1330, Specification for Cylindrical Sealant Backing for Use with Cold Liquid Applied Sealants.

1.3 **SUBMITTALS**

- .1 Product data: Submit copies of Product data in accordance with the Conditions of the Contract describing type, composition and recommendations or directions for surface preparation, material preparation and material installation.
- .2 Samples:
 - .1 Submit following samples in accordance with the Conditions of the Contract.
 - .1 Two samples of sealant/caulking, for colour selection.
 - .2 Two samples of back-up material and primer for physical characteristics.

1.4 **QUALITY ASSURANCE**

- .1 Qualifications: Work of this Section shall be executed by trained applicators approved by sealant manufacturer and having a minimum of 5 years proven experience.

1.5 **SITE CONDITIONS**

- .1 Do not install materials when ambient air temperature is less than 5°C, when recesses are wet or damp, or to manufacturer's recommendations.

1.6 **DELIVERY, STORAGE AND HANDLING**

- .1 Arrange delivery of materials in original, unopened packages with labels intact, including batch number, and ensure that on-site storage is kept to a minimum. Do not store materials on site where there exists any danger of damage from moisture, direct sunlight, freezing and other contaminants.

1.7 EXTENDED WARRANTY

- .1 Submit an extended warranty for Sealant Work in accordance with General Conditions, except that warranty period is extended to 2 years from date of Substantial Performance of the Work.
 - .1 Warrant against leakage, cracking, crumbling, melting, shrinkage, running, loss of adhesion and staining adjacent surfaces.
 - .2 Coverage: Complete replacement including affected adjacent Work.

2 Products

2.1 MATERIALS

- .1 General:
 - .1 All materials under Work of this Section, including but not limited to, primers and sealants are to have low VOC content limits.
 - .2 Use materials as received from manufacturers, without additives or adulterations. Use one manufacturer's Product for each kind of Product specified.
- .2 Sealant **Type A**: ASTM C920, Type S, Grade NS, Class 25; One-part, non-sag type, silicone sealant, in standard colours selected.
 - .1 'DC CWS' by Dow Corning Inc.
 - .2 'Sikasil 305CN' by Sika.
 - .3 'Tremsil 400' by Tremco.

2.2 ACCESSORIES

- .1 Primers: Type recommended by material manufacturers for various substrates, primers to prevent staining of adjacent surfaces encountered on project.
- .2 Joint backing: ASTM C1330; Round, solid section, closed cell, skinned surface, soft polyethylene foam gasket stock, compatible with primer and sealant materials, 30 to 50% oversized, Shore A hardness of 20, tensile strength 140 to 200 kPa. Bond breaker type surface.
- .3 Bond breaker: Type recommended by material manufacturers.
- .4 Void filler around the window frames to be one part expanding polyurethane foam.
- .5 Cleaning agents: As recommended by material manufacturer, non-staining, harmless to substrates and adjacent finished surfaces.

2.3 MIXING

- .1 Follow manufacturer's instructions on mixing, shelf and pot life.

3 Execution

3.1 **EXAMINATION**

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

3.2 **INSPECTION**

- .1 Verify that joint sealants, backing, and other materials containing hazardous materials have been removed.
- .2 Verify that joint substrates and adjoining materials are structurally sound.
- .3 Verify that joints to be renovated can be satisfactorily repaired with the specified methods and materials.

3.3 **PREPARATION**

- .1 Protect adjacent exposed surfaces to prevent smearing, staining or other damage, by masking or other means, prior to performing Work. Make good any damage caused by sealant application. Remove protection upon completion and clean adjacent, exposed surfaces of any compound deposited upon such surfaces.
- .2 Remove all existing sealant, loose rust and mill scale by hand cutting, power grinding or wire brushing. Completely remove sealant build up in all joints. Remove any loose particles by blowing joint out with compressed air.
- .3 Clean substrate surfaces so that they are free from caulking, dust, grease, soiling, or extraneous matter, which are detrimental to the adhesion of the sealant.
- .4 Chemically clean all non-porous surfaces, such as aluminum and glass, by solvent wipe and drying with a clean cloth.
- .5 Patch, repair, and smooth minor substrate defects and deficiencies. Clean porous surfaces such as masonry and concrete by mechanical abrading.
- .6 Where existing fasteners are loose, tighten or replace as required.
- .7 Substrate moisture tests:
 - .1 Test for moisture content over areas where sealant is to be applied.
 - .2 If any test registers above 10% allow entire substrate surfaces, within the plane, to dry further before sealant system application. Install temporary drying fans if necessary.
 - .3 After drying of the substrate, re-test employing same criteria.

- .8 Mildew removal: Scrub with solution of TSP and rinse with water, and allow to dry completely.
- .9 Erect scaffolding and rigging required to perform sealant Work in accordance with reviewed Shop Drawings.
- .10 Ensure that all materials in contact with sealant are compatible. Test substrate for adhesion.
- .11 Depth of recess: Maintain depth to ½ joint width up to a maximum of 13 mm and not less than 6 mm at centre of joint. For greater depth, use joint backing under. Where recess is less than specified depth, cut back surface of recess to specified recess depth.
- .12 Install polyethylene backing rod in joints 6 mm or more in width. Roll backing rod into joint. Do not stretch or bend backing rod. Install bond breaker to back of recess.
- .13 Prime sides of recess, in accordance with sealant manufacturer's instructions.
- .14 Condition products for use in accordance with manufacturer's recommendations.

3.4 **INSTALLATION**

- .1 Apply sealant immediately after adjoining Work is in condition to receive such Work. Apply sealant in continuous bead using gun with correctly sized nozzle. Use sufficient pressure to evenly fill joint.
- .2 Ensure sealant has full uniform contact with, and adhesion to, side surfaces of recess. Superficial painting with skin bead is not acceptable. Tool sealant to smooth surface, free from ridges, wrinkles, sags, air pockets, embedded impurities, dirt, stains or other defects.
 - .1 At recesses in angular surfaces, finish sealant with flat profile, flush with face of material at each side.
 - .2 At recesses in flush surfaces, finish compound with concave face, flush with face of material at each side.
- .3 Make sealant bead uniform in colour.
- .4 Cure sealants in accordance with sealant manufacturer's instructions. Do not cover up sealants until proper curing has taken place.
- .5 Immediately remove excess compound or droppings which would set up or become difficult to remove from adjacent finished surfaces, using recommended cleaners, as work progresses. Do not use scrapers, chemicals or other tools which could damage finished surfaces. Remove defective sealant.
- .6 Clean recesses and re-apply sealant.
- .7 Remove masking tape immediately after joints have been sealed and tooled.

3.5 **CLEANING**

- .1 Clean surfaces adjacent to joints, remove sealant smears or other soiling resulting from application of sealants. At metal surfaces, remove residue. Do not mar or damage finishes on materials adjacent to joints. Repair or replace marred or damaged materials.

3.6 **SCHEDULE OF LOCATIONS**

- .1 Following sealant location schedule is included for convenience and may not be complete. Examine Contract Drawings and other specification sections and determine entire extent of Work of this Section. Generally seal following locations:
 - .1 Concrete, masonry, wood and stone to metal.
 - .2 Wood to masonry, concrete and stone.
 - .3 Metal to metal.
 - .4 All dissimilar materials.
 - .5 Where 'sealant' or 'caulking' is indicated on drawings.
- .2 Sealant **Type A**:
 - .1 Exterior joints between masonry and steel or aluminum.
 - .2 Exterior joints between masonry and shelf angle.
 - .3 Exterior joints between steel or aluminum and concrete or masonry.
 - .4 Interior and exterior control joints, except in floors.
 - .5 Door frames, interior and exterior side.
 - .6 Protrusions through interior and exterior walls and floors, interior and exterior side, except where fire rated seals are required.
 - .7 Seal thresholds.

END OF SECTION

- 1 General
- 1.1 **SECTION INCLUDES**
 - .1 Labour, Products, equipment and services necessary for the metal doors and frames
Work in accordance with the Contract Documents.
- 1.2 **REFERENCES**
 - .1 ASTM A653/A653M, Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvanealed) by the Hot-Dip Process.
 - .2 ASTM A568/A568M, Specification for General Requirements for Steel, Carbon and High-Strength Low-Alloy, Hot-Rolled Sheet and Cold-Rolled Sheet.
 - .3 ASTM E90, Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements
 - .4 CAN4-S104M, Standard Method for Fire Test of Door Assemblies.
 - .5 CAN4-S105M, Standard Specification for Fire Door Frames, Meeting the Performance Required by CAN4-S104M.
 - .6 CAN/CGSB-1.198, Cementitious Primer, (for Galvanized Surfaces).
 - .7 CGSB 41-GP-19Ma, Rigid Vinyl Extrusions for Windows and Doors.
 - .8 CAN/ULC-S702, Thermal Insulation, Mineral Fibre for Buildings.
 - .9 CSA W47.1, Certification of Companies for Fusion Welding of Steel Structures.
 - .10 CSA W59-M, Welded Steel Construction (Metal Arc Welding).
 - .11 NFPA 80, Standard for Fire Doors and Other Opening Protectives.
 - .12 NFPA 252, Standard Methods of Fire Tests of Door Assemblies.
- 1.3 **DESIGN REQUIREMENTS**
 - .1 Design exterior frame assemblies to accommodate expansion and contraction when subjected to minimum and maximum surface temperature of -35EC to 35EC.
- 1.4 **SUBMITTALS**
 - .1 Product data: Submit manufacturer's Product data in accordance with the Conditions of the Contract indicating door and frame construction.

- .2 Shop drawings:
 - .1 Submit shop drawings in accordance with the Conditions of the Contract for each type of door and frame indicating:
 - .1 Thickness and type of steel.
 - .2 Thickness and type of core.
 - .3 Thickness and type of steel stiffeners and location of them within the door.
 - .4 Thickness and type of metal facing on edges of door and method of fastening.
 - .5 Location of mortises, reinforcement, anchorages, joining, welding, sleeving, exposed fasteners, openings and arrangement for hardware.
 - .2 Include schedule identifying each unit with door marks and numbers relating to numbering on Contract Drawings and in door schedule. Indicate doors and frames to be fire rated.

1.5 **QUALITY ASSURANCE**

- .1 Perform Work in accordance with requirements by a member of the Canadian Steel Door and Frame Manufacturers Association.
- .2 Label and list fire rated doors and frames by an organization acceptable to authorities having jurisdiction and accredited by the Standards Council of Canada in conformance with CAN4-S104M and CAN4-S105M for ratings indicated, Labelling shall be in accordance with NFPA 80.
- .3 Retain a Professional Engineer, licensed in Province of Ontario, with experience in Hollow metal work of comparable complexity and scope to perform the following services as part of the Work of this Section:
 - .1 Design of Hollow Metal door and screens work.
 - .2 Review, stamp, and sign shop drawings.
 - .3 Conduct on-Site inspections and prepare and submit inspection reports.
 - .4 Design of anchors, supports and accessories.

2 Products

2.1 **ACCEPTABLE MANUFACTURERS**

Member of The Canadian Steel Door & Frame Manufacturers' Association or approved by the Construction Manager prior to Tender closing.

- .1 All Steel Doors 2000 Ltd.
- .2 Daybar Industries Limited.
- .3 Fleming-Baron Door Products.

2.2 MATERIALS

- .1 General: All materials under Work of this Section, including but not limited to, primers are to have low VOC content limits.
- .2 Steel: ASTM A568/A568M, Class 1; Commercial grade steel, hot dip galvanized to ASTM A653/A653M, ZF120 galvanized coating.
- .3 Minimum base steel thickness:

.1	Frames	1.6 mm
.2	Exterior doors	1.5 mm
.2	Interior doors	1.2 mm
.3	Lock/strike reinforcements	1.6 mm
.4	Hinge reinforcements	2.7 mm
.5	All other reinforcement	1.6 mm
.6	Top and bottom channels	1.2 mm
.7	Glazing stops	0.9 mm
.8	Guard boxes	0.9 mm
.9	Jamb spreaders	0.9 mm
- .4 Top caps and thermal breaks: CGSB 41-GP-19Ma; Rigid PVC extrusions. Provide factory installed flush steel top caps.
- .5 Primer: CAN/CGSB 1.198.
- .6 Core material:
 1. Interior doors: Mineral fibre insulation with minimum face density of 24kg/m³.
 2. Exterior doors: Rigid poly/isocyanurate, closed cell insulation, 32 kg/m³, thermal value: RSI 1.9.
 3. Fire rated doors: Mineral fibre insulation to CAN/ULC S702, Type 1A, 24 kg/m³.
- .7 Screws: Stainless steel screws with countersunk flat head.
- .8 Door silencers: Type 6-180, black neoprene.
- .9 Frame anchors:
 - .1 Frames in existing masonry: 0.9 mm minimum frame anchors to suit design.
 - .2 Labeled frames: In accordance with ULC requirements.
- .10 Floor anchors: 1.6 mm minimum adjustable floor clip angles with 2 holes for anchorage to floor.
- .11 Labels for fire doors and door frame: Brass plate, riveted to door and door frame.

2.3 FABRICATION

.1 General

- .1 Fabricate doors and frames in accordance with reviewed shop drawings.
- .2 Welding: CSA W59-M to produce a finished unit with no visible seams or joints, square, true and free of distortion.
- .3 Welding: Continuous unless specified otherwise. Execute welding by a firm fully acceptable to the Canadian Welding Bureau to requirements of CSA W47.1.
- .4 Form profiles accurately to details shown on Contract Drawings.
- .5 Ream and remove burrs from drilled and punched holes.
- .6 Grind welded corners and joints to a flat plane and fill with metallic filler and sand to a uniform smooth finish. Apply one coat of primer.

.2 Frames:

- .1 Fabricate frames of welded construction. Cut mitres and joints accurately and weld continuously on inside of frame profile. Exterior frames to be thermally broken.
- .2 Construct large frame sections with provision for on Site assembly to suit Site conditions.
- .3 Blank, reinforce, drill and tap frames for mortised, templated hardware. Protect mortised cut-outs with guard boxes.
- .4 Reinforce frames where required for surface mounted hardware.
- .5 Reinforce frames over 1200 mm wide with roll formed steel channels or hollow structural sections specified in Section 05500 and as indicated on drawings.
- .6 Furnish exterior door frames with a continuously welded integral steel weather drip at head of frame.
- .7 Prepare each door opening for single stud rubber door silencers, 3 for single door openings located in strike jamb, and 2 for double door openings located in head.
- .8 Install 2 channel or angle spreaders per frame, to ensure correct frame alignment. Install stiffener plates or spreaders between frame trim where required, to prevent bending of trim and to maintain alignment when setting in place.
- .9 Form channel glazing stops minimum 16 mm height, accurately cut, mitred, fitted and fastened to frame sections with stainless steel counter-sunk, flat head screws spaced at maximum 450 mm throughout and 50 mm from each end.

.3 Anchorage:

- .1 Anchor units to floor and wall construction. Locate each wall anchor immediately above or below each hinge reinforcement on hinge jamb and directly opposite on strike jamb, minimum number of anchors for each jamb:
 - .1 Frames up to 2285 mm 3 anchors.
 - .2 Frames from 2285 mm to 2440 mm 4 anchors.
- .2 Where frames are to be set in masonry or concrete, supply adjustable anchors to trade installing frame.

- .3 Fabricate frames for installation in steel stud partitions with steel anchors of suitable design, minimum number of anchors for each jamb:
 - .1 Frames up to 2285 mm height 4 anchors.
 - .2 Frames 2285 mm to 2440 mm 5 anchors.
- .4 Frames in previously placed masonry or structural steel: Anchors located at 150 mm maximum from top and bottom of each jamb, and intermediate anchors at maximum 660 mm o.c.

- .4 General Door Requirements:
 - .1 Hollow steel construction, flush swing type, of sizes to conform to details, schedules and reviewed shop drawings with provisions for cut-outs for glass and grilles and reinforced to receive hardware fastenings.
 - .2 Blank, reinforce, drill and tap doors for mortised, templated hardware. Where required, reinforce doors for surface mounted hardware and door closers.
 - .3 Reinforce oversized doors with steel channels and plates specified in Section 05500 and as indicated on drawings.
 - .4 Where openings are required, form integral cut-outs with framing, glass stop moldings and division bars.
 - .5 Install grilles to fit tight and secure into openings.
 - .6 Bevel both stiles of single doors 1 in 16.

- .5 Interior Doors:
 - .1 Supply and install inverted, recessed, mechanically interlocked with tack welded channels at top and bottom of doors.
 - .2 Fabricate doors with joints between front and back panels meeting on stile edges. Make joints continuously welded for entire height of door. After welding has been completed, grind joints smooth to match metal. Ensure that no filler is used in joints.
 - .3 Fill hollow space within door and vertical stiffeners from top to bottom with mineral fibre batt insulation.

- .6 Exterior Doors:
 - 1. Supply and install inverted, recessed, fully welded channels at top and bottom of doors. Supply and install PVC top caps.
 - 2. Fabricate doors with joints between front and back panels meeting on stile edges. Make joints continuously welded for entire height of door. After welding has been completed, grind joints smooth to match metal ensure that no filler is used in joints. Include steel stiffeners at 150mm o.c.
 - 3. Fill hollow space within door from top to bottom with rigid polyisocyanurate insulation.

- .7 Fire Rated Doors:
 - 1. Supply and install inverted, recessed, spot welded channels at top and bottom of doors.
 - 2. Fabricate doors with joints between front and back panels meeting on stile edges. Make joints continuously welded for entire height of door. After welding has been completed, grind joints smooth to match metal. No filler to be used in joints.
 - 3. Fabricate doors to achieve fire rating as indicated on drawings and in accordance with ULC. Provide ULC label on door at hinged edge midway between top hinge and header of door.

4. Fabricate fire rated door from specified core material.

3 Execution

3.1 **EXAMINATION**

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

3.2 **HOLLOW METAL DOOR AND FRAME INSTALLATION**

- .1 Install hollow metal doors and frames plumb, square, level, secure, and at correct elevation.
- .2 Install doors clear of floor finishes, and with the correct rebate opening for the door installation. Install door silencers.
- .3 Secure anchorages and connections to adjacent construction. Brace frames rigidly in position while building-in. Remove temporary steel shipping jamb spreaders. Install wood spreaders at third points of frame rebate height to maintain frame width. Supply and install vertical supports as indicated on drawings for openings over 1200 mm in width. Remove wood spreaders after frames have been built-in.
- .4 Allow for structural deflection and prevent structural loads from being transmitted to hollow metal frames.
- .5 Touch-up areas where galvanized coating has been removed or damaged with primer.
- .6 Install fire rated doors and frames in accordance with requirements of NFPA 80.

3.3 **ADJUSTING AND CLEANING**

- .1 Adjust doors for smooth and balanced door movement.
- .2 Clean doors and frames.

END OF SECTION

1 General

1.1 SECTION INCLUDES

- .1 Design, labour, Products, tool, equipment and services necessary for aluminum work in accordance with the Contract Documents.

1.2 REFERENCES

- .1 AAMA 611, Voluntary Standards for Anodized Architectural Aluminum.
- .2 AAMA CW-10, Care and Handling of Architectural Aluminum from Shop to Site.
- .3 AAMA CW I-9, Aluminum Curtain Wall Design Guide Manual.
- .4 CAN/CSA-A440-M/A440.1-M, Windows / User Selection Guide to CSA Standard CAN/CSA A440-M Windows.
- .5 ANSI H35.1M, Alloy and Temper Designation Systems for Aluminum (Metric).
- .6 ASTM A167, Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet and Strip.
- .7 ASTM B209M, Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- .8 ASTM B221M, Specification for Aluminum-Alloy Extruded Bars, Rods, Wires, Profiles and Tubes.
- .9 ASTM E283, Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.
- .10 ASTM E330, Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference.
- .11 .11 ASTM E331, Standard Test Method for Water Penetration of Exterior Windows, Curtain Walls and Doors by Uniform Static Air Pressure Difference.
- .12 .12 ASTM F738M, Specification for Stainless Steel Metric Bolts, Screws, and Studs.
- .13 .13 CAN/CGSB 1.108-M, Bituminous Solvent Type Paint.
- .14 .14 CAN/CGSB-19.13-M, Sealing Compound, One-Component, Elastomeric, Chemical Curing.
- .15 .15 CAN/CSA-S136, Cold Formed Steel Structural Members.
- .16 .16 CAN/ULC S702, Thermal Insulation, Mineral Fibre, for Buildings.
- .17 CSA W59-M, Welded Steel Construction (Metal Arc Welding).
- .18 CAN/ULC S702, Thermal Insulation, Mineral Fibre, for Buildings.

1.3 DEFINITION(S)

- .1 Aluminum work: Shall mean aluminum curtainwall, entrance, windows and doors mentioned in Part 2 of this Specification Section.

1.4 DESIGN REQUIREMENTS

- .1 Design aluminum work in accordance with following Climatic Design Data for Toronto contained in the Ontario Building Code:
 - .1 Design temperature: January 1%, July 2 1/2%.
 - .2 Hourly wind pressures: 1 in 50-year occurrence.
- .2 Design aluminum work to accommodate following without producing detrimental effect:
 - .1 Cyclic 40°C daily thermal swing of components.
 - .2 Cyclic, dynamic loading and release of loads such as wind loads.
 - .3 13 mm vertical deflection in supporting structure and movement of supporting structure due to live, dead load, and creep or deflections, seismic load, sway displacement and similar items.
- .3 Design to prevent accumulation of condensate on interior side of aluminum work framing under the following service conditions:
 - .1 Interior temperature: 25°C.
 - .2 Exterior temperature: -20°C.
 - .3 Interior RH: 35%.
- .4 Design windows in accordance with following CAN/CSA-A440-M/A440.1-M classification ratings:
 - .1 Air tightness: A3.
 - .2 Water tightness: B7.
 - .3 Wind load resistance: C5.
 - .4 Temperature Index: I57.
 - .5 Forced Entry: F2.
 - .6 Insect Screens: S2.
- .5 Restrict air infiltration/exfiltration, through aluminum work in accordance with ASTM E283 at pressure differential as indicated:
 - .1 Curtainwalls and entrance assemblies: 0.0003 m³/s m² at differential of 300 Pa.
 - .2 Doors (per door): 2.78 m³/h m per linear metre of crack at differential of 75 Pa.
- .6 Design and detail-controlled drainage path to actively discharge water, which enters into or forms within aluminum work, to exterior; prevent accumulation or storage of water within aluminum work. Prevent water from entering interior when tested in accordance with ASTM E331.
- .7 Design and detail air barrier, vapour retarder, and rainscreen products and assemblies into continuous and integrated aluminum work envelope. Optimize aluminum work design to align envelope layers and to minimize thermal bridges.
- .8 Prevent deflection and permanent or progressive glazing displacement. Restrict horizontal and vertical mullion deflection to less than L/175 (under uniformly

distributed positive design wind load), and 10 mm maximum regardless of span.

- .9 Design anchorage inserts for installation as part of other Sections of Work.
Design anchorage assemblies to accommodate construction and installation tolerances.
- .10 Design aluminum work and connections to substrate where the bottom of the aluminum work extends to a point below 1070 mm above finished floor level and separates a floor level from an adjacent interconnected space or exterior to withstand the required guard and handrail loads in accordance with the OBC and applicable local regulations. When requested by Consultant, provide a letter signed and sealed by a Professional Engineer certifying that the aluminum work conforms to the OBC requirements. Provide restrictors to OBC requirement for all vents with sill height less than 1070 mm.
- .11 Design window assemblies with an overall thermal transmittance of fenestration of $2.2 \text{ W/m}^2\text{-K}$ or better using ASHRAE 90.1 calculation procedures and shall include the effect of sash, frame, edge effect, and spacer for multiple-glazed units. Window manufacturer must be prepared to submit computer simulations to prove equivalent thermal transmittance performance meeting or exceeding the design requirements. Requests for alternatives or substitutions to the products specified must be accompanied by a computer simulation report in a recognized thermal simulation software (Therm 6/Window 6) proving compliance to design requirements no later than five days prior to close of tender.

1.5 **SUBMITTALS**

- .1 Shop drawings:
 - .1 Submit shop drawings in accordance with Section 01 33 00 indicating:
 - .1 Plans, sections, details, type of extrusions, profiles, finishes, panels, operating components, doors, related flashings, closures, fillers, and end caps, and sealants.
 - .2 Products and glazing types.
 - .3 Anchorage inserts, system installation tolerances.
 - .4 Section and hardware reinforcement, anchorage, assembly fixings.
 - .5 Detailing, locations, and allowances for movement, expansion, contraction
 - .6 Path of cavity drainage and air pressure equalization.

- .2 Samples:
 - .1 Submit two samples of following in accordance with Section 01 33 00.
 - .1 250 mm long samples of each type of extrusion and finish.
 - .2 250 x 200 mm samples of insulating glass unit.
 - .3 One complete corner detail of door frame, glazing, and finish for each door type.
 - .4 Each door hardware item for Consultant's approval.
- .3 Reports:
 - .1 Submit substantiating engineering data, and independent test results of pre-tested, aluminum work to substantiate compliance with the design criteria.
 - .2 Submit documentation to substantiate ten years of experience in aluminum window and door manufacture and installation.
- .4 Close-out submittals: Submit window data for incorporation into the Operations and Maintenance Manual as part of Section 01 78 23.

1.6 **QUALITY ASSURANCE**

- .1 Retain a Professional Engineer, licensed in Province of Ontario, with experience in aluminum work of comparable complexity and scope to perform the following services as part of the Work of this Section:
 - .1 Design of aluminum work.
 - .2 Review, stamp, and sign shop drawings.
 - .3 Conduct on-Site inspections and prepare and submit inspection reports.
- .2 Independent inspection:
 - .1 Inspection and testing of windows may be performed by an inspection and testing firm designated and paid for by the Owner.
 - .2 Inspection and testing by the independent inspection company may be performed on or off site. Inspection and testing will be performed to ensure that windows meet specified design criteria. Coordinate with inspection and testing company.
 - .3 Windows not meeting design criteria will be replaced at no cost to Owner.
- .3 Mock-up:
 - .1 Fabricate, deliver, and erect one, full scale mock-up of each type of aluminum work, in location acceptable to Consultant.
 - .2 Demonstrate full range of Products, finishes, textures, quality of fabrication, and workmanship.
 - .3 Mock-up may form part of final Work, if acceptable to Consultant. Remove and dispose of mock-ups which do not form part of Work.

1.7 **DELIVERY, STORAGE, AND HANDLING**

- .1 Handle aluminum work in accordance with AAMA CW-10.
- .2 Protect aluminum surfaces with strippable coating. Do not use adhesive papers or sprayed coatings which bond when exposed to sunlight or

weather. Do not remove before final cleaning of building.

1.8 EXTENDED WARRANTY

- .1 Submit a warranty for aluminum work in accordance with General Conditions, except that warranty period is extended to 5 years. Insulating glass unit warranty is 10 years.
 - .1 Warrant against failure to meet the design criteria and requirements such as interior leakage, insulating glass unit failure, finish degradation, frame condensation.
 - .2 Coverage: Complete replacement including affected adjacent Work.

2 Products

2.1 ACCEPTABLE MANUFACTURER(S) AND SYSTEM(S)

- .1 Curtainwall: 'ThermaWall TW 2200 Series' by Alumicor Limited or approved alternative by Kawneer or Oldcastle Building Envelope.
 - .1.1 Back section depth: 70mm (2 ¾")
- .2 Windows: Window profile to be 'RainBlade 1970 Series' 133 mm depth by Alumicor or approved equivalent by Kawneer or Oldcastle Building.
- .3 Operable Windows: "UniVent 1350 series" by Alumicor Limited, or equivalent by Kawneer or Oldcastle Building Envelope.
- 4. Doors: Therma Porte 7700- T600B by Alumicor Limited or approved alternative by Kawneer or Oldcastle Building envelope.

2.2 MATERIALS

- .1 All materials under Work of this Section, including but not limited to, sealants are to have low VOC content limits.
- .2 Aluminum extrusions and channels: ASTM B221 and ANSI H35.1 AA6063 alloy, T6 temper.
 - .1 Profile and dimensions: Refer to Contract Drawings.
 - .2 Thermal breaks in frame members: Vertically aligned with glazing.
- .3 Aluminum sheet: ASTM B209 and ANSI H35.1 AA1100 aluminum alloy, H14 temper, minimum 1.29 mm for sheets less than 610 mm wide and minimum 2.05 mm for sheets of a greater dimension.
- .4 Reinforcements and anchors: ASTM A167, Type 304 to AISI No. 2B finish. Size as shown.
- .5 Glass and glazing materials and glass spandrels: As specified in Section 08 80 00.

- .6 Airseal and aluminum work sealant: ASTM C920, Type S, Grade NS, Class 100/50; One-part, low-modulus, moisture-curing, silicone. 'Dow Corning 790' by Dow Corning; 'Spectrem 1' by Tremco. Verify compatibility with insulating glass unit manufacturer's secondary sealant. Colour as selected by Consultant. Primer as recommended by manufacturer.
- .7 Frame sealant: Type as recommended by the aluminum work manufacturer.
- .8 Joint backing: Closed cell foam polyethylene rod, outsized minimum 30-50% larger than joint width and compatible with joint sealant. Product as recommended by sealant manufacturer.
- .9 Airseal transition membrane: 'Sopraseal Stick 1100' by Soprema Inc., 'Exoair 110' by Tremco or 'Air-Shield' by W.R. Meadows. Membrane to come complete with applicable primer.
- .10 Anchors, clips, and angles: Extruded aluminum or stainless steel.
- .11 Shims and blocking for frame: Rigid plastic, wood is not permitted.
- .12 Flashings, closures and trim: 1.0 mm minimum aluminum sheet, finish to match curtain wall extrusion finish.
- .13 Screws, bolts and other fasteners: ASTM F738M; Stainless Steel Type 304.
- .14 Isolation coating: CAN/CGSB-1.108-M; Bitumastic coating, acid and alkali resistant material.
- .15 Spray Foam Insulation: CFC free, polyurethane foam in place, closed cell low expansion, one component, minimum density 15 kg/m3.
 - .1 'ENERFOAM' by Dow Chemical Canada.
 - .2 'IPF All Weather Pro' by Rivenco Industries.
- .16 Window hardware: Manufacturer's standard heavy-duty hardware including multi-point locks, pin hinges, roto operators, Teleflex and flyscreens.
- .17 Door hardware: Supplied by finish hardware supplier under Section 08 70 00 for installation by door manufacturer.
- .18 Insect screen: Extruded aluminum frames containing 14 x 18 heavy duty aluminum mesh in accordance with CSA A440. Screen to be retained in place with turn clip type fixings.
Provide insect screen in offices.
- .19 Weatherstripping: Durable, non-absorbing material resistant to deterioration by aging and weathering.

2.3

FABRICATION

- .1 Fabricate sections true to detail, free from defects impairing appearance, strength and durability. Fabricate extrusions with sharp, well defined corners.
- .2 Fabricate panel system in accordance with reviewed shop drawings.
- .3 Fabricate, fit, and secure framing joints and corners accurately, with flush surfaces, and hairline joints. Apply frame sealant at joints for weatherproof seams.
- .4 Conceal anchors, reinforcement and attachments from view. Fabricate reinforcement in accordance with design requirements.
- .5 Do not expose manufacturer's identification labels on aluminum assemblies.
- .6 Fabricate continuous sill flashings with intermediate anchor clips, and joint reinforcing, form to profile shown. Fabricate filler and closure pieces as necessary for a complete and weather tight installation.
- .7 Certify aluminum windows as complying with the CAN/CSA-A440-M/A440.1-M design criteria and requirements using an easily removable label located on the inside face of glazing.
- .8 Position operable windows on main frame to provide direction of opening specified, free and smooth operation, without binding or sticking against main frame members. Provide all operable windows with restrictors to ensure windows cannot be opened more than 100 mm.
- .9 Fabricate aluminum work closures and trim from aluminum sheet. Form to profile shown. Make weathertight.
- .10 Double weather-strip windows and doors. Install weather-stripping in specially extruded ports and secure to prevent shrinkage or movement.
- .11 Fabricate glazing recess with drainage to exterior.

2.4 **FINISH**

- .1 Exterior finish:
Clear anodized to AAMA 611 per Aluminum Association Designation System for Aluminum Finishes AA-M12C22A41.

- .2 Interior finish: Clear anodized to AAMA 611 per Aluminum Association Designation System for Aluminum Finishes AA-M12C22A41.
- .3 Panel and sheet finish: As indicated on drawings to match adjacent extrusion finish at A/C and other mechanical penetration locations.

3 Execution

3.1 **INSTALLATION**

- .1 Install aluminum work in accordance with reviewed shop drawings, manufacturer's written instructions, and CAN/CSA-A440-M/A440.1-M.
- .2 Install Work of this Section securely, in correct location, level, square, plumb, at proper elevations, free of warp or twist.
- .3 Apply isolation coating at 0.8 mm dry film thickness to prevent corrosive or electrolytic action between dissimilar materials such as aluminum to concrete, masonry, galvanized steel and similar conditions.
- .4 Install flashings, closures, and trim pieces.
- .5 Fill voids between aluminum framing and adjacent construction with foam insulation.
- .6 Install sills in maximum lengths possible. For sills over 1200 mm in length, maintain 3 mm to 6 mm space at each end.
- .7 Refer to Contract Drawings for glazing type locations. Install glazing in accordance with Section 08 80 00.
- .8 Automatic door operators to be supplied and installed by Section 08 71 13. Install doors and hardware to manufacturers' written instructions. Clean and adjust hardware for correct performance.
- .9 Adjust operable parts for correct function.
- .10 Remove damaged or unacceptable Products and assemblies from Site and replace to Consultant's acceptance.
- .11 Install glass presence markers, in two cross stripes extending from diagonal corners. Maintain markers until final clean-up.

3.2 **ERECTION TOLERANCES**

- .1 Tolerances: Non-cumulative.
 - .1 Maximum variation from plumb: 1.5 mm/3 m non-cumulative or 12 mm/30 m, whichever is less.
 - .2 Maximum misalignment of two adjoining members abutting in plane: 0.8 mm.
 - .3 Vertical and horizontal positions: +/- 3 mm.
 - .4 Racking of face: 6 mm, nil in elevation.
 - .5 Operable components: Consistent with smooth operation and weatherproof performance.
 - .6 Maximum perimeter sealant joint between aluminum and adjacent construction: 13 mm.

3.3 **GLAZING PERIMETER AIRSEAL**

- .1 Install glazing perimeter airseal at entire perimeter of each insulating glass unit to achieve an airseal from insulating glass unit to curtain wall frame. Do not obstruct path of cavity drainage and air pressure equalization.

3.4 **AIRSEAL TRANSITION MEMBRANE**

- .1 Install primer and airseal transition membrane in accordance with manufacturer's instructions. Install airseal transition membrane into extrusion reglet as indicated on drawings. If there is no extrusion reglet, mechanically fasten airseal transition membrane to frame with batten bar fastened at 150 mm o.c.
- .2 Overlap airseal transition membrane 75 mm minimum and lap in direction of waterflow.
- .3 Coordinate airseal transition to adjacent parts of Work.

3.5 **JOINT BACKING AND ALUMINUM WORK SEALANT**

- .1 Prepare substrate surface and mask as recommended by sealant manufacturer.
- .2 Install joint backing and sealant at aluminum work and perimeter joints for weather tight installation in accordance with sealant manufacturer's instructions. Tool sealant. Remove excess sealant.

3.6 **CLEANING**

- .1 Maintain aluminum work, inside and outside, in clean condition throughout construction period.
- .2 Remove labels, protective material, and glass presence markers from prefinished surfaces.
- .3 Remove CAN/CSA-A440-M/A440.1-M certification labelling when

directed by Consultant, in writing.

- .4 Wash aluminum work with solution of mild detergent in warm water, with particular attention to recesses and corners. Wipe surfaces clean and dry.

END OF SECTION

1 General

1.1 **SECTION INCLUDES**

- .1 Labour, Products, equipment and services necessary for finish hardware Work in accordance with the Contract Documents.

1.2 **REFERENCES**

- .1 BHMA, Builders Hardware Manufacturing Association.

1.3 **SUBMITTALS**

- .1 Product data: Submit manufacturer's Product data in accordance with the Conditions of the Contract indicating compliance with reference standards, transportation, storage, handling and installation requirements.

- .2 Shop drawings:

- .1 Submit shop drawings and 3 complete hardware lists in accordance with the Conditions of the Contract indicating:
 - .1 Door locations, sizes, hardware manufacturer's catalogue numbers, finish symbols and quantities required.
 - .2 Locations and mounting heights of each type of hardware.
- .2 Supply templates and required information to door and frame manufacturer to enable accurate sizes, locations of cut-outs and reinforcement for hardware.
- .3 Submit templates to required trade to arrange for provisions for accurate setting and fitting of hardware.

- .3 Samples:

- .1 Submit 2 samples in accordance with the Conditions of the Contract of each item that is different from hardware specified and include manufacturer's parts lists and installation instructions.
- .2 Submit hardware component samples illustrating style, colour and finish. Tag samples identifying applicable Specification article number, brand name and number, finish, building location, date and catalogue number.
- .3 Do not order hardware until samples have been accepted. Submit new samples to replace rejected samples. Supply hardware and finishes identical to each accepted sample.

- .4 Closeout submittals:

- .1 Submit the following in accordance with the Conditions of the Contract for each Product for incorporation into Operation and Maintenance Manual:
 - .1 Maintenance data.
 - .2 Operating instructions and safety precautions.
 - .3 Parts list with name and address of supplier.
 - .4 Lubrication schedule and type of lubricant recommended.
 - .5 Keys, tools and special devices.
 - .6 Inspection procedures related to preventive maintenance.

1.4 **QUALITY ASSURANCE**

- .1 General:
 - .1 Manufacturers: Companies specializing in manufacturing door hardware and registered with BHMA.
 - .2 Hardware supplier: Company specializing in supplying commercial door hardware and acceptable to manufacturer.
- .2 Certifications:
 - .1 Employ an Architectural Hardware Consultant to inspect completed installation and certify that hardware has been supplied and installed in accordance with manufacturer's printed instructions and as specified.
 - .2 Submit manufacturer's certificate that finish hardware meets specified requirements.

1.5 **DELIVERY, STORAGE, AND HANDLING**

- .1 Be responsible for packaging of hardware, on a set by set basis. As material is received from various manufacturers identify it to correspond to Hardware List symbols.
- .2 Label packages legibly, indicating manufacturer's number, types, sizes, opening number and Hardware List reference number. Wrap hardware and include in package, screws, bolts and fastening necessary for correct installation. If hardware package is not complete, pay additional charges incurred by installer.
- .3 Deliver hardware to Site packaged, labelled and cross-referenced to hardware list for each item and it's scheduled installation location.
- .4 Accept Products of this Section on Site and that each item is undamaged.
- .5 Catalogue and store hardware in secure area.

2 Products

2.1 **GENERAL**

- .1 Carefully check and verify Hardware List against Contract Drawings to ensure that hardware listed can be used as specified. Inform Consultant of concerns regarding quality, quantity, operation or function of hardware selected:
 - .1 Verify hand of doors, examine details on Contract Drawings and at Site to ensure hardware supplied can be correctly installed and is correct for Work as constructed.
 - .2 Select hardware in accordance with applicable codes and regulations and to approval of local Fire Marshall.
 - .3 Replace and pay for defective hardware including hardware which was incorrectly selected, and remedial and installation costs.
- .2 Ensure that hardware selected will function correctly, meets Contract requirements and Ontario Building Code and authorities having jurisdiction.

- .3 Ensure that each hardware item is of same type, design and by same manufacturer.
- .4 Manufacturer's names or trade marks are not permitted on exposed surfaces of hardware.
- .5 Include in packing slip a list of parts, name of supplier and door number in which lock is to be installed.

2.2 **ACCESSORIES**

- .1 Items to be attached to masonry or concrete with expandable shields, lag screws, bolts or other fastening devices as required. Exposed screws: Stainless steel, Phillips or Robertson heads.

2.3 **FINISHES**

- .1 Metal finishes: Free from defects, clean, unstained and of a uniform colour for each type of finish required. Exposed surfaces and anchors: Specified finish symbol of item.

3 Execution

3.1 **INSTALLATION**

- .1 Install hardware in accordance with manufacturer's installation instructions and applicable codes and regulations.
- .2 Remove existing mortise hardware on reused doors and install new lever mortise hardware.
- .3 Install hardware in accordance with hardware templates.
- .4 Adjust fixed and operable hardware for correct clearances and function.
- .5 Mount hardware measured from finished floor to centre of hardware, unless indicated otherwise:
 - .1 Top hinge: 250 mm from head of door to top.
 - .2 Bottom hinge: 265 mm from finished floor to bottom of hinge.
 - .3 Intermediate hinge: Equal distance between top and bottom hinge.
 - .4 Locksets, latchsets: 1000 mm
 - .5 Push plates: 1000 mm to centre of plates.
 - .6 Guard bars: 1100 mm
 - .7 Door pulls: 1000 mm to centre of pulls.
 - .8 Blank strike: 1450 mm
 - .9 Blank fronts: 1450 mm

3.2 **FIELD QUALITY CONTROL**

- .1 Have hardware inspected after installation by hardware supplier's representative, obtain certification in writing that hardware has been supplied and installed in accordance with Specifications and hardware manufacturer's instructions and is functioning correctly.

3.3 **HARDWARE SCHEDULE**

- .1 Finish Hardware Schedule will be provided at a later date.

END OF SECTION

-
- 1 General
- 1.1 **SECTION INCLUDES**
- .1 Design, labour, Products, equipment, tools, and services necessary for glass and glazing Work in accordance with the Contract Documents.
- 1.2 **REFERENCES**
- .1 ASTM D2240, Test Method for Rubber Property - Durometer Hardness.
- .2 CAN/CGSB-1.108-M, Bituminous Solvent Type Paint.
- .3 CAN/CGSB-12.1-M, Tempered or Laminated Safety Glass.
- .4 CAN/CGSB-12.3-M, Flat, Clear Float Glass.
- .5 CAN/CGSB-12.8, Insulating Glass Units.
- .6 CAN/CGSB-12.9-M, Glass, Spandrel.
- .7 CAN/CGSB-12.20-M, Structural Design of Glass for Buildings.
- .8 Glass Association of North America (GANA) Glazing Manual.
- 1.3 **DESIGN REQUIREMENTS**
- .1 Design glass to CAN/CGSB-12.20-M. Perform stress analysis. Design units to accommodate live, dead, lateral, wind, seismic, handling, transportation, and erection loads.
- .2 Limit glass deflection to flexural limit of glass with full recovery of glazing materials.
- .3 Utilize inner light of multiple light sealed units for continuity of air and vapour seal.
- .4 Perform a thermal stress analysis on each insulating unit and provide heat strengthening and/or tempered units as necessary to prevent thermal breakage.
- 1.4 **SUBMITTALS**
- .1 Shop drawings: Submit shop drawings in accordance Section 01 33 00 for fabrication and erection of glazing elements indicating materials, thicknesses, finishes, connections, joints, method of anchorage, number of anchors, supports, reinforcement, details, and accessories.
- .2 Samples:
- .1 Submit following samples in accordance with Section 01 33 00.
- .2 Submit one sample of each type of glass.

.1 200 x 200 mm of each type of insulating glass unit.

- .3 Certificates: Submit manufacturer's certification that glass and glazing materials are compatible.
- .4 IGMA Compliance Audit: Submit in accordance with Section 01 78 23, a written certification of successful completion of a Compliance Audit within the last six months.

1.5 **QUALITY ASSURANCE**

- .1 Insulating glass unit fabricators shall be a certified member of the Insulating Glass Manufacturer's Alliance (IGMA). IGMA members must participate in the certification program and shall have successfully passed a Compliance Audit within the last six months.

1.6 **SITE CONDITIONS**

- .1 Glaze with compounds, sealants, or tapes only when glazing surfaces are at temperatures over 4°C, and when positive that no moisture is accumulating on them from rain, mist, or condensation.
- .2 When temperature of glazing surfaces is below 4°C, obtain from Consultant approval of glazing methods and protective measures which will be used during glazing operations.

1.7 **EXTENDED WARRANTY**

- .1 Submit a warranty for Glazing work in accordance with General Conditions, except that warranty period for insulating glass unit is 10 years.

2 **Products**

2.1 **ACCEPTABLE MANUFACTURERS**

- .1 Glass manufacturers:
 - .1 AGC Flat Glass.
 - .2 Guardian Industries.
 - .3 PPG Industries Ltd.
 - .4 Viracon Inc.
 - .5 Cardinal Glass Industries.

2.2 **MATERIALS**

- .1 All materials under Work of this Section, including but not limited to, primers, coatings, sealers, sealants, adhesives and cleaners are to have low VOC content limits.

- .2 Tempered glass (**TGL**): CAN/CGSB-12.1-M, Type 2, Class B, Category II, clear or tinted as indicated, minimum 6 mm thick.
- .3 Insulating glass units: Factory sealed to CAN/CGSB-12.8-M and IGMA requirements utilizing approved metallic stainless-steel edge spacer. Dual seal with a PIB primary seal and silicone secondary seal.
- .4 Argon gas: 90% pure. Argon gas to be used to fill air space at all insulated glass units.
- .5 Low-E coating (Soft coat): High performance sputtered low-E coating. Provide insulating glass units with low-E coating edge deletion and low-E coating. Apply low-E coating to second surface unless otherwise indicated. 'Comfort Ti-AC 36' by AGC Flat Glass, 'Solarban 90' clear by PPG Industries Inc. or approved alternative.
- .6 Glazing schedule:
 - .1 Exterior curtain wall and window glazing: 6 mm TGL outside, argon filled air space, 6 mm TGL inside, 25 mm overall thickness, complete with low-e film, and etched tempered glass designation shall be visible.
 - .2 Exterior Doors: 6 mm TGL outside, argon filled air space, 6 mm TGL inside, 25 mm overall thickness, complete with low-e film, and etched tempered glass designation shall be visible.
- .8 Glazing and rebate primers, sealants, sealers, and cleaners: Compatible with each other. Type as recommended by glass manufacturer.
- .9 Glazing sealant: Silicone sealant as recommended by glazing manufacturer. Verify compatibility with insulating glass unit secondary sealant.
- .10 Heel & toe bead: Silicone sealant as recommended by glazing manufacturer.
- .11 Glazing gasket: 'Visionstrip' by Tremco Ltd., extruded composite glazing seal, size as recommended by manufacturer.
- .12 Glazing tape: 'Polyshim II' glazing tape EPDM shim.
- .13 Glazing splines: EPDM or neoprene, extruded shape to suit glazing channel retaining slot, colour as selected.
- .14 Setting blocks (regular): EPDM, 80 - 90 Shore A durometer hardness to ASTM D2240, 100 mm long x 6 mm high x rebate width minimum, size designed for glass size and weight of glass unit.
- .15 Edge blocks: EPDM, 60-70 Shore A Durometer hardness, sized with 3 mm clearance from glass edge and spanning glass thickness(es). Capable of withstanding weight of glass unit, self adhesive on face.

- .16 Glass presence markers: Easily removable, non-residue depositing.
- .17 Isolation coating: CAN/CGSB 1.108-M; Bitumastic paint.
- .18 Screws, bolts and fasteners: Type 304 stainless steel.

2.3 **FABRICATION**

- .1 Verify glazing dimensions on Site.
- .2 Clearly label each glass lite with maker's name and glass type. Ensure labels are easily removable, non-residue depositing type. Do not remove labels until after Work is accepted by Consultant.
- .3 Fabricate glazing not less than 3 mm smaller than rebate size in either dimension; allow for edge spacers, shims, and setting blocks as necessary.
- .4 Work shall have smooth finished surfaces free from distortion and defects detrimental to appearance and performance.
- .5 Carefully make and fit details. Take special care with exposed finished Work to produce a neat and correct appearance to the Consultant's acceptance.
- .6 Fabricate argon filled thermal units with air space filled minimum 90% filled with argon gas.
- .7 Provide 6 mm thick inner and outer glass lites where required to maintain mullion spacing and glass areas as indicated on drawings.

3 Execution

3.1 **EXAMINATION**

- .1 Verify that openings for glazing are correctly sized and within tolerance.
- .2 Verify that surfaces of glazing channels or recesses are clean, free of obstructions, and ready to receive glazing.

3.2 **PREPARATION**

- .1 Clean contact surfaces with solvent and wipe dry.
- .2 Seal porous glazing channels or recesses with substrate compatible primer or sealer.
- .3 Prime surfaces scheduled to receive sealant.

3.3 **INSTALLATION**

- .1 Provide glazing in accordance with IGMA recommendations. Provide continuous contact between glazing tapes to the glazing.
- .2 Install glazing to the Work of Sections 08 11 13 and 08 51 13.
- .3 Provide neat, straight sight lines. Trim excess glazing material flush with top of stops and fixed leg of frames.
- .4 Remove protective coatings, glazing stops, clean rebate and glass contact surfaces with solvent, wipe dry.
- .5 Apply primer/sealer to contact surfaces, prior to glazing.
- .6 Apply glazing tape as per manufacturer's instructions including recommended corner sealant.
- .7 Use setting blocks at 1/4 points and spacers to centre glass unit in frame.
- .8 Install glazing in accordance with reviewed shop drawings and manufacturer's written instructions. Install glazing with full contact and adhesion at perimeter. Maintain edge clearance recommended by glass manufacturer.
- .9 Re-install glazing stops ensuring continuous contact and rattle-free installation. Do not distort glass. Trim tape protruding more than 2 mm above stop.
- .10 Apply a continuous heel bead of sealant around perimeter of inboard lite of the sealed unit and the metal framing.
- .11 Install glazing gasket in accordance with manufacturer's recommendations.
- .12 Do not cut or abrade tempered, heat treated, or coated glass.
- .13 Install glass presence markers in two cross stripes extending from diagonal corners. Maintain markers until final clean-up.
- .14 Remove, dispose of, and replace broken, cut and abraded glass.
- .15 Exterior glass: Glaze units with gasket on exterior side and glazing tape on interior side. Seal gap between glazing and stop with sealant to depth equal to bite of frame. Apply cap head of sealant along void between stop and glazing, to uniform line, flush with sight line. Tool or wipe sealant surface smooth.
- .16 Interior glass: Glaze interior glass using glazing gasket glazing tape.

3.4

CLEANING

- .1 Immediately remove sealant and compound droppings from finished surfaces.

- .2 Remove labels, protective material, and glass presence markers from prefinished surfaces.

END OF SECTION

1. General
- 1.1 **SECTION INCLUDES**
 - .1 Labour, Products, equipment and services necessary for terrazzo restoration Work in accordance with the Contract Documents.
- 1.2 **REFERENCES**
 - .1 CSA A23.1, Concrete Materials and Methods of Concrete Construction/Methods of Test for Concrete.
 - .2 CAN/CSA A3000, Cementitious Materials Compendium.
 - .3 TTMAC, Terrazzo, Tile and Marble Association of Canada
- 1.3 **SUBMITTALS**
 - .1 Product data:
 - .1 Submit duplicate copies of manufacturer's Product data in accordance with Section 01 33 00 indicating:
 - .1 Performance criteria, compliance with appropriate reference standard(s), characteristics, limitations, and trouble-shooting protocol.
 - .2 Product transportation, storage, handling and installation requirements.
 - .2 Shop drawings:
 - .1 Submit shop drawings in accordance with Section 01 33 00 indicating:
 - .1 Terrazzo layout.
 - .2 Perimeter conditions, junctions with dissimilar materials.
 - .3 Setting details.
 - .3 Certificates: Submit manufacturer's certificates stating that materials supplied are in accordance with this specification.
 - .4 Closeout submittals: Submit recommended maintenance instructions and listing of recommended maintenance Products for incorporation into Operations and Maintenance Manuals in accordance with Section 01 78 23.
- 1.4 **QUALITY ASSURANCE**
 - .1 Installers qualifications: Perform Work of this Section by a company that has a minimum of five years proven experience in the installation of terrazzo units of a similar size and nature and that is approved by manufacturer. Submit to Consultant, applicator's current certificate of approval by the material manufacturer as proof of compliance.

1.5 **SITE CONDITIONS**

- .1 Do not install Work of this Section outside of the following environmental ranges without the Consultant's and Product manufacturer's written acceptance:
 - .1 Ambient air and surface temperature: 15°C to 45°C.
 - .2 Precipitation: None.
- .2 Install temporary protection and facilities to maintain the Product manufacturer's, and specified, environmental requirements for 7 Days before, during, and 7 Days after installation.

2 Products

2.1 **MATERIALS**

- .1 Cement: Portland cement to meet specified requirements of CAN/CSA A3000, Normal or High-Early strength. Use white portland cement in white matrix.
- .2 Sand: To meet specified requirements of CSA A23.1, sharp, screened, washed. Use white sand in white matrix.
- .3 Water: Potable, free from acids, alkalies, oil, or organic materials.
- .4 Divider Strips: To match existing material and size.
- .5 Topping:
 - .1 Marble Chips: To meet specified requirements of Terrazzo, Tile and Marble Association of Canada, match existing size gradation and colour.
 - .2 Colour pigments: Pure mineral, alkali-resistant, non-fading, colour to match existing.
- .6 Cleaner: To meet specified requirements of #1000 Series of Terrazzo, Tile and Marble Association of Canada.
- .7 Sealer: To meet specified requirements of #2000 Series of Terrazzo, Tile and Marble Association of Canada.
- .8 Floor Finish: To meet specified requirements of Type #3001 of Terrazzo, Tile and Marble Association of Canada.
- .9 Curing Agent: Non-staining, maximum moisture retention 0.015 grams, to meet specified requirements of Terrazzo, Tile and Marble Association of Canada.

2.2 MIXES

- .1 Underbed:
 - .1 One part cement to four parts sand by volume.
 - .2 Add water to product stiff mix, but use no more than four gals/80 lb. bag of cement to make workable.

- .2 Topping:
 - .1 Marble chip aggregate and cement mixed dry with colour pigments to match existing. Grind a small area to determine the true colours of existing terrazzo and chip gradation.
 - .2 Water shall not exceed 18 L /bag of cement.
 - .3 Prepare topping by mechanical mixing with materials added in the following order: one-half of aggregate, total of cement, water, remaining aggregate.

3 Execution

3.1 EXAMINATION

- .1 Ensure that environmental conditions and backing surfaces have been provided according to specified requirements. Do not proceed with work until satisfied that installation will meet specified standard.

3.2 PREPARATION

- .1 Take extreme care that surfaces adjacent to terrazzo work are protected from staining by terrazzo materials, and that slurry is not tracked into other building areas any time during installation.
- .2 Verify condition and dimensions of previously installed Work upon which this Section depends. Report defects to Consultant. Commencement of Work means acceptance of existing conditions.
- .3 Sweep backing surfaces clean of all loose materials, and remove the debris. Clean off contaminants which would cause a defective installation.
- .4 Locate and prepare for equipment or accessories recessed in finished terrazzo work.

3.3 INSTALLATION

- .1 General:
 - .1 Installation shall match existing type. Profile of base shall match existing. Where bases are of different profiles, install new base of profile to match finished installation.

- .2 When patching terrazzo, extend area to nearest divider strip in all directions.

.2 Underbed for Bonded Installation:

- .1 Wet backing surfaces with water, remove excess, and when surface water has dried, slush into soaked backing a neat portland cement grout.
- .2 Immediately following application of grout, place underbed, spread evenly, and screed to true levels to receive specified topping.

.3 Divider Strips:

- .1 Install divider strips in underbed while it is still semi-plastic.
- .2 Locate divider strips accurately. Set them straight, aligned, to line up with existing and at correct level; make junctions tight; and firmly trowel them along edges into underbed to ensure anchorage.
- .3 Set edging strips at junctions with other floor finishes to provide precisely for their thicknesses and finished levels after grinding. At openings set edging strips under doors.
- .4 Extend divider strips at right angles across borders.

.4 Placing of Topping:

- .1 Let underbed cure for at least 24 hours.
- .2 Wet top of underbed with water, remove excess, and when surface water had dried slush into soaked underbed a neat Portland cement grout of same colour cement and pigment as for matrix.
- .3 Apply topping to slurry or underbed while it is still wet.

3.4 **TOPPING**

.1 Standard Finish:

- .1 Into wet topping surface of floors, sprinkle wet aggregate of same materials in same proportions as specified for topping.
- .2 Apply so that finish surfaces match existing.

.2 Surface Preparation:

- .1 After finish aggregates are added, immediately roll floor topping with a heavy roller to compact and to remove excess water and cement. Pack bases.
- .2 Hand trowel all terrazzo surfaces to expose divider strips level with topping.

.3 Curing:

- .1 Cure topping for a minimum of six days following placing.
- .2 Cure to ensure that topping is kept damp until cement is hydrated.
- .3 Use wet mats or sand, paper or plastic sheets, or liquid curing compound.

3.5 **FINISHING**

- .1 Grind terrazzo surfaces by machine. Hand rub places inaccessible to grinding machines.

- .2 Constantly flood surfaces with water during grinding.
- .3 For initial grinding, use 24 to 60 grit carborundum stones.
- .4 After initial grinding, wash surfaces clean, remove all residue from holes and voids, and thoroughly rinse with only water.
- .5 Trowel plastic grout, of same mix and colour as matrix, into holes and voids of wetted surface, and remove excess. When grout begins to set, work it into holes and voids with burlap or excelsior pads, and remove excess.
- .6 Cure grout for a minimum of 48 hours as specified above for curing.
- .7 Give final grinding with 120 grit stones and water.
- .8 Wash off surfaces thoroughly after grinding.

3.6 **SITE TOLERANCES**

- .1 Finish surfaces shall be level or straight within a tolerance of 1.6 mm between division strips.

3.7 **REPAIR**

- .1 Before Project completion, remove and replace defective, off-colour, and damaged work. Defective work shall include areas where distribution of surface aggregate is visually different from surrounding area. Removed areas shall be completely bounded by divider strips or edges. Regrout and regrind surfaces left with open fissures and holes.

3.8 **CLEANING**

- .1 Scrub terrazzo surfaces with an abundance of clean water. Use machine scrubbers where possible for floors.
- .2 Rinse with clean water and allow to dry.
- .3 Remove dust with heavy-duty vacuum cleaner.
- .4 If further cleaning is required, use Terrazzo, Tile and Marble Association of Canada #1001 cleaner in accordance with their specifications.

.5 Sealing:

- .1 As soon as possible after final cleaning, apply a coat of sealer. Wipe off excess before it dries.
- .2 Just before completion of Project, clean terrazzo, as specified above, and apply a second coat of sealer as before.
- .3 Apply two coats of floor finish.

3.9 **PROTECTION**

- .1 Prevent all traffic and work on newly laid floors by barricading areas for at least 24 hours following installation.

END OF SECTION

1 General

1.1 **SECTION INCLUDES**

.1 Design, labour, Products, equipment and services necessary for gypsum board Work.

1.2 **REFERENCES**

- .1 ASTM A653/A653M, Specification for Steel Sheet, Zinc-coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvanealed) by the Hot-Dip Process.
- .2 ASTM C475, Specification for Joint Compound and Joint Tape for Finishing Gypsum Board.
- .3 ASTM C645, Specification for Non-Load Bearing (Axial) Steel Studs, Runners (Tracks), and Rigid Furring Channels for Screw Application of Gypsum Board.
- .4 ASTM C754, Specification for Steel Framing Members to Receive Screw-Attached Gypsum Board.
- .5 ASTM C840, Specification for Application and Finishing of Gypsum Board.
- .6 ASTM C1002, Specification for Steel Drill Screws for the Application of Gypsum Board or Metal Plaster Bases.
- .7 ASTM C1396, Specification for Gypsum Board.
- .8 ASTM F1267, Standard Specification for Metal, Expanded, Steel.
- .9 CGSB 19-GP-21M, Sealing and Bedding Compound, Acoustical.

1.3 **DESIGN REQUIREMENTS**

- .1 Design ceiling suspension system in accordance with manufacturer's printed directions and ASTM C754.
- .2 Design ceiling system for adequate support of electrical fixtures as required by the current bulletin of the Electrical Safety Authority.
- .3 Design hanger anchor and entire suspension system static loading not to exceed 25% of their ultimate capacity including lighting fixture dead loads.
- .4 Design suspension system to support weight of mechanical and electrical items such as air handling boots and lighting fixtures, and with adequate support to allow rotation/relocation of light fixtures.
- .5 Design subframing as necessary to accommodate, and to circumvent, conflicts and interferences where ducts or other equipment prevent the regular spacing of hangers.

1.4 **REGULATORY REQUIREMENTS**

- .1 Provide fire separations and fire protection exactly as specified in test design specification that validates the specified rating. Verify that work specified in other Sections, as a part of the entire assembly, meets applicable validating test design specification.

1.5 **SUBMITTALS**

- .1 Product data:
 - .1 Submit copies of manufacturer's Product data in accordance with the Conditions of the Contract indicating:
 - .1 Performance criteria, compliance with appropriate reference standard, characteristics, and limitations.
 - .2 Product transportation, storage, handling and installation requirements.
 - .2 Shop drawings: Submit shop drawings in accordance with the Conditions of the Contract indicating adjacent construction, elevations, sections and details, dimensions, thickness, finishes and relationship to adjacent construction.
 - .3 Certifications: Submit written certification stating that suspended ceiling system is designed for adequate support of electrical fixtures as required by the current bulletin of the Electrical Safety Authority.

1.6 **QUALITY ASSURANCE**

- .1 Qualifications: Execute the Work of this Section by skilled, qualified, and experienced workers trained in the installation of the Work of this Section.

1.7 **SITE CONDITIONS**

- .1 Do not begin Work of this Section until:
 - .1 Mechanical and electrical Work above the ceiling is complete.
 - .2 Substrate and ambient temperature is above 15°C.
 - .3 Relative humidity is below 80 %.
 - .4 Ventilation is adequate to remove excess moisture.
- .2 Install temporary protection and facilities to maintain Product manufacturer's, and above specification, environmental requirements 24 h before, during, and 24 h after installation.

2 Products

2.1 **MATERIALS**

- .1 Steel framing: ASTM C754; ASTM A653/A653-M, Z275; cold rolled, galvanized steel sheet.
 - .1 Bailey Metal Products Limited
 - .2 Corus Metal Profiles

- .2 Steel studs and track runners: ASTM C645; Formed from galvanized steel sheet, minimum 0.018" thick or as indicated on the contract drawings, galvanized steel studs and runners, 1-1/4" wide x depth as indicated on Contract Drawings.
- .3 Main carrying channels: ASTM C645; Formed from galvanized steel sheet, 1-1/2" x 3/4" mm cold rolled, channels.
- .4 Resilient channel: ASTM C645; 0.02" thick galvanized metal, 2-1/4" wide x 1/2" deep for walls and ceiling to reduce sound transmission.
- .5 Furring channels: ASTM C645; Formed from galvanized steel sheet, 7/8" winged flange type, cold rolled.
- .6 Furring channels (hat type): ASTM C645; 0.02" base steel thickness, galvanized. 2-3/4" wide x 7/8" deep hat shaped channel.
- .7 Heavy duty furring channels: ASTM C645; 0.04" (20 ga.) steel thickness, galvanized hat shaped channel with a wider and deeper size as required by manufacturers.
- .8 Hanger wires: 0.16" minimum diameter galvanized pencil rod.
- .9 Tie wire: 1/16" thick minimum diameter, soft annealed, galvanized steel wire.
- .10 Corner bead, casing bead, and special shapes: Formed from 0.6 mm thick minimum, galvanized steel sheet, designed to be concealed by joint compound.
- .11 Control joint strip: Roll formed from galvanized steel sheet, with a tape protected recess, 1/4" wide x 7/16" deep.
- .12 Screw fasteners: ASTM C1002 Type S; Corrosion resistant.
- .13 Concrete anchors: tie wire sleeve anchors, 'Redi-Drive TW' by Red Head or approved alternative.
- .14 Acoustic/Fire insulation: Paperless, semi-rigid, spun mineral fibre mats, of thickness as indicated on Contract Drawings, Thermafibre by CGC Inc., or Roxul AFB or Flexibatt by Roxul Inc., or Quiet Zone Batts by Owens Corning Inc.
- .15 Acoustical sealant: CGSB 19-GP-21M; Single component, non-skinning synthetic rubber sealant. Acoustical Sealant by Tremco.
- .16 Mould, water, and abuse resistant gypsum board: ASTM C1396; Abuse resistant gypsum board 5/8" thick of maximum practical lengths to minimize end joints. "USG SHEETROCK® BRAND GLASS-MAT PANELS MOLD TOUGH® VHI FIRECODE® X"
- .17 Exterior sheathing: 3/4" thick, "Dens-Glass Gold" by G-P Products.
- .18 Sheathing screws: to ASTM C1002, Type S, corrosion resistant, 1/2" penetration into steel, complete with 1-1/2" diameter washers.

- .19 Joint reinforcing tape: ASTM C475; 2" wide x 0.01" thick, perforated paper, with chamfered edges.
- .20 Bonding adhesive: Type for purpose intended and as recommended and approved by manufacturer.
- .21 Joint and patching compound: ASTM C475; Asbestos-free, supplied by manufacturer of gypsum board used.
- .22 Fast setting patching compound: ASTM C475; Asbestos-free, Sheetrock or Durabond by CGC Inc or approved alternative.
- .23 Access doors: Supplied by other Sections for installation as part of the Work of this Section.

3 Execution

3.1 **SUSPENSION FRAMING**

- .1 Install ceiling systems in accordance with manufacturer's written instructions and reviewed shop drawings.
- .2 Install hanger wires plumb and securely anchored to the building structural framing, independent of walls, pipes, ducts, and metal deck; install additional framing and hangers to bridge interference items.
- .3 Install hanger wires at 4'-0" maximum centres along carrying channels, not less than 1", and not more than 6" from channel ends.
- .4 Install additional hangers at lighting fixture and ductwork locations. Do not attach hanger wires to mechanical or electrical equipment. Do not support mechanical and electrical fixtures and fitting on ceiling without the ceiling manufacturer's written acceptance.
- .5 Install main carrying channels transverse to structural framing members. Lap main carrying channels 8" minimum at splices and wire each end with two loops and prevent clustering or lining-up of splices.
- .6 Install furring channels at 16" o.c., not less than 1", and not more than 6" from perimeter walls, at openings, at interruptions in ceiling continuity, and at change in plane. Install furring channels to a tolerance of 1/8" maximum in 12'-0"
- .7 Install additional main carrying and furring channels to frame and to reinforce openings such as recessed lighting fixtures, access hatches, ceiling grilles, outlet boxes, ventilating outlets and similar items.

3.2 **STEEL STUDS AND FURRING**

- .1 Install steel stud partitions to underside of structure unless indicated otherwise.
- .2 Install track runners at floors, ceilings, and underside of structure; align track runners accurately and secure to structure at 24" centres maximum.

- .3 Install double top track runner assembly to prevent the transmission of structural loads to steel studs.
- .4 Install steel studs vertically at 16" and not more than 2" from abutting walls, at openings, and at each side of corners. Install studs securely to track runners.
- .5 Schedule and coordinate steel framing installation with mechanical and electrical services installation.
- .6 Install full height, double studs at door and service openings, fastened together and stiffened back to the structure to prevent vibration when doors close.
- .7 Provide double studs boxed together at all openings, sill, head and jambs and at door jambs, fastened together and stiffened back to the structure to prevent vibration. At each opening exceeding 3'-0" in width, double studs shall be 20 ga. extending to structure above, and adequately anchored at each end. Provide steel studs above and below openings spaced at 1'-4" maximum. All metal stud partitions above doors and screens over 4'-0" wide shall be secured to structure over and reinforced with sway bracing to stabilize walls to prevent lateral movement.
- .8 Erect three studs at corner and intermediate intersections of partitions. Space 2" apart and brace together with wired 3/4" channels.
- .9 Stiffen partitions over 8'-0" high or 10'-0" long, or both, with horizontal bracing extended for full length of partitions. Provide one line of bracing in partitions. Space lines to provide equal unbraced panels. Provide bracing for portions of partitions over door openings in partitions over 10'-0" high, and bracing both above and below openings in partitions located no greater than 6" from top and bottom of opening, and extending two stud spaces beyond each edge of opening for both doors and windows. Wire tie or weld bracing to studs.
- .10 Frame control joints using back to back double studs at abutting structural elements, at dissimilar backup interface, at dissimilar walls and ceilings, at structural expansion and control joints, at door and other openings, and at 30'-0" maximum spacing in continuous runs. Install control joint strips and secure in place.
- .11 Install additional support framing at openings and cutouts for built-in equipment, upper cabinet support, access panels and similar items.
- .12 Attach to framing adequate steel reinforcing members or an 18 ga. steel stud mounted horizontally and notched around furring members to support the load of, and to withstand the withdrawal and shear forces imposed by, items installed upon the work of this Section. Such items include, but are not restricted to, coat hooks, wall-hung cabinets and fitments, shelving, curtain and drape tracks; Owner supplied equipment; and minor mechanical and electrical work. Heavy mechanical and electrical equipment shall be self-supporting in Divisions 15 and 16.
- .13 Provide for support and incorporation of flush-mounted and recessed mechanical and electrical equipment and fixtures only after consultation and verification of methods with those performing the work of Divisions 15 and 16.

- .14 Install cross bracing in accordance with the steel stud manufacturer's recommendations.

3.3 FIRE RATED ASSEMBLIES

- .1 Install fire rated assemblies in accordance with applicable ULC tested and approved designs.
- .2 Stiffen fire rated walls over 12'-0" high, where linear length of wall is greater than 8'-0" between perpendicular wall supports, with diagonal bracing above the ceiling extending perpendicular to wall at a 45° angle to structure above. Locate diagonal bracing at maximum 8'-0" o.c.
- .3 Where double layers of gypsum board are shown, and required for fire rating, screw first layer to studs and furring and laminate the second layer to the first using joint filler as an adhesive. Stagger joints between first and second layers.

3.4 ACOUSTICAL INSULATION

- .1 Install acoustic insulation in partitions, between steel studs of exterior insulation and finish system, and as indicated on Contract Drawings and in accordance with the manufacturer's instructions. Fill stud cavities to full height of partitions and carefully cut and fit acoustic insulation around services and protrusions.

3.5 ACOUSTICAL SEALANT

- .1 Install acoustical sealant to acoustically insulated partitions in accordance with the manufacturer's instructions and Contract Drawings.
- .2 Install acoustical sealant under floor runner track, at partition perimeter both sides and at openings, cut-outs, and penetrations, concealed from view in the final installation.

3.6 GYPSUM BOARD

- .1 Comply with ASTM C840. Install gypsum board in accordance with manufacturer's written instructions.
- .2 Install gypsum board vertically or horizontally, whichever results in fewer end joints. Locate end joints over supporting members.
- .3 Install gypsum board in lightly butted contact at edges and ends and with 1.6 mm maximum open space between boards; do not force gypsum board into place. Do not install imperfect, damaged or damp boards.
- .4 Install gypsum board butting paired tapered edge joints, and mill-cut or field-cut end joints; do not place tapered edges against cut edges or ends.

- .5 Install vertical joints minimum 12" from the jamb lines of openings and stagger vertical joints over different studs on opposite sides of partitions.
- .6 Do not locate joints within 8" of corners or openings, except where control joints occur at jamb lines or where openings occur adjacent to corners. Where necessary, place a single vertical joint over the centre of wide openings.
- .7 Install gypsum board over concrete and concrete masonry units with adhesive as recommended by gypsum board manufacturer where indicated on Drawings.
- .8 Cut, drill and patch gypsum board as may be necessary to accommodate the Work of other trades.
- .9 Fire Separations:
 - .1 Construct gypsum board assemblies, where located, in accordance with tested assemblies to obtain required or indicated fire rated assemblies. As a minimum fire separations shall consist of metal framing covered on both sides by fire-rated gypsum board.
 - .2 Install assemblies tightly to enclosing constructions to maintain integrity of the separations. Install casing beads at all perimeter edges.

3.7 **SHEATHING INSTALLATION**

- .1 Install sheathing and sheathing materials in accordance with manufacturer's written instructions.
- .2 Install sheathing with long dimension perpendicular to metal studs, offset joints and butt tight, centre edges of sheathing over metal studs, mechanically fasten with specified fasteners and washers in accordance with manufacturer's instructions.
- .3 Lap self adhesive membrane ends 2" minimum. Roll adhesive membrane and laps for continuous adhesion over entire substrate area.
- .4 Seal screw holes with mortar/adhesive.

3.8 **CORNER, CASING BEADS AND TRIM**

- .1 Corner reinforcing bead: Install along all external angles, erect plumb, level and with a minimum of joints. Secure with screws at 9" o.c. apply filler over flanges flush with nose of the bead and extending at least 3" onto surface of board each side of corner. When filler dries, apply a thin coat of topping cement and blend onto adjoining surfaces.
- .2 Casing bead: Install where wallboard butts against a surface having no trim concealing the juncture and where shown on drawings. Erect casing beads plumb or level, with minimum joints, and secure with screws at 12" o.c. apply filler over flange flush with bead and extending at least 3" onto surface of board. When dry, apply a thin coat of topping cement and blend onto adjoining surfaces.

- .3 Recess channels and trim: Install recess channels and special metal trim where shown. Secure to substrate. Provide casing beads full height on wallboard edges at recess channels and metal trim.

3.9 **JOINT TAPING AND FINISHING**

- .1 Install reinforcing tape and a minimum of 3 coats of joint compound over gypsum board joints, metal trim and accessories, and screw fasteners in accordance with the gypsum board manufacturer's instructions.
- .2 Fill gaps between, and any imperfections in, gypsum boards with joint compound, allow to dry, and sand smooth ready for painting.
- .3 Install finished gypsum board Work smooth, seamless, plumb, true, flush, and with square, plumb, and neat corners.
- .4 Finish gypsum board in accordance with ASTM C840 to the following grades:
 - .1 Level 0: No taping, finishing, or accessories required. Use above suspended ceilings and within other concealed spaces, unless the assembly is fire rated, sound rated, sound or smoke controlled, or unless the space serves as an air plenum.
 - .2 Level 1: At joints and interior angles embed tape in joint compound. Leave surface free of excess joint compound. Tool marks and ridges are acceptable. Use above suspended ceilings and within other concealed spaces if the gypsum board assembly is fire rated, sound rated, sound or smoke controlled, or the space serves as an air plenum.
 - .3 Level 2: At joints and interior angles embed tape in joint compound with one separate coat of joint compound applied over joints, angles, fastener heads, and accessories.
 - .4 Level 3: At joints and interior angles embed tape in joint compound with two separate coats of joint compound applied over all joints, angles, fastener heads, and accessories. Apply joint compound smooth and free of tool marks and ridges. Use where heavy grade wall coverings are the final decoration.
 - .5 Level 4: At joints and interior angles embed tape in joint compound with three separate coats of joint compound applied over all joints, angles, fastener heads, and accessories. Apply joint compound smooth and free of tool marks and ridges. Use for all locations except those indicated for other finish levels.
 - .6 Level 5: At joints and interior angles embed tape in joint compound with three separate coats of joint compound applied over all joints, angles, fastener heads, and accessories. Apply a thin skim coat of joint compound, or a material manufactured especially for this purpose, to the entire surface. Leave surface smooth and free of tool marks and ridges. Use where semi-gloss or gloss finish coatings are the final decoration.

3.10 **ACCESS DOORS**

- .1 Install access doors supplied as part of other parts of the Work.

3.11 SITE TOLERANCES

- .1 Install metal support systems to ensure that, within a tolerance of +1/8" and -1/16" for plaster thickness, finish surfaces will be flat within 1/8" under a 10'-0" straightedge, and with no variation greater than 1/16" in any running 1'-0", and that surface planes shall be within 1/8" of dimensioned location.

3.12 WORK IN EXISTING AREAS

- .1 In existing areas, where existing gypsum board work has been demolished and/or damaged and repair work is required, provide new gypsum board finish.
- .2 Thoroughly prepare areas to be repaired. Provide neat, clean and straight cuts.
- .3 Finish all repair work as specified for new work.
- .4 In existing areas where existing openings are to be filled in with gypsum board, provide new gypsum board wall and ceiling construction. Ensure new board faces are flush with faces of abutting existing walls and ceilings.

3.13 REPAIR

- .1 Make good cut-outs for services and other work, fill in defective joints, holes and other depressions with joint compound.
- .2 Make good defective work, and ensure that surfaces are smooth, evenly textured and within specified tolerances to receive finish treatments.

END OF SECTION

1 General

1.1 **SECTION INCLUDES**

.1 Design, labour, Products, equipment and services necessary for acoustical ceilings Work in accordance with the Contract Documents.

1.2 **REFERENCES**

.1 ASTM A653/A653M, Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvanealed) by the Hot-Dip Process.

.2 ASTM C423, Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.

.3 ASTM E580, Specification for the Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings.

.4 ASTM C636, Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels.

.5 ASTM C645, Specification for Non-Load Bearing (Axial) Steel Studs, Runners (Tracks), and Rigid Furring Channels for Screw Application of Gypsum Board.

.6 ASTM E1264, Classification for Acoustical Ceiling Products.

.7 CAN/CGSB-92.1-M, Sound Absorptive Prefabricated Acoustical Units.

1.3 **DESIGN REQUIREMENTS**

.1 Design ceiling suspension systems in accordance with ASTM E580 and manufacturer's printed directions.

.2 Design tile ceiling system for adequate support of electrical fixtures as required by the current bulletin of the Electrical Safety Authority. Acoustic panel system is not designed to carry the weight of electrical equipment.

.3 Design hanger anchor and entire suspension system static loading not to exceed 25% of their ultimate capacity including lighting fixture dead loads.

.4 Design tile suspension system to support weight of mechanical and electrical items such as air handling boots and lighting fixtures, and with adequate support to allow rotation/relocation of light fixtures. Acoustic panel system is not designed to carry the weight of mechanical and electrical equipment.

.5 Design subframing as necessary to accommodate, to avoid conflicts and interferences where ducts or equipment prevent regular spacing of hangers.

1.4 SUBMITTALS

- .1 Shop drawings:
 - .1 Submit shop drawings in accordance with the Conditions of the Contract indicating:
 - .1 Suspension system layout including hangers and supports for acoustic tile system.
 - .2 Acoustic panel system including suspension system, hangers, supports and panel sizes and locations.
 - .3 Conditions at abutting, intersecting, and penetrating construction.
 - .4 Dimensioned locations of lighting fixtures, diffusers, sprinkler heads and other items that pierce the ceiling plane.
- .2 Samples:
 - .1 Submit following samples in accordance with the Conditions of the Contract:
 - .1 One full-size sample of each type of tile panels to be used.
 - .2 One of each type of suspension system members.
- .3 Certificates: Submit written certification stating that suspended ceiling system is designed for adequate support of electrical fixtures as required by the current bulletin of the Electrical Safety Authority.

1.5 QUALITY ASSURANCE

- .1 Mock-up:
 - .1 Construct one 100 ft² mock-up for each type of ceiling system incorporating typical light fixture and other typical mechanical and electrical fixtures.
 - .2 Test the adequacy of the suspension system to support the fixtures without deflection of ceiling or failure of hanging wire anchorage. Supply copy of Test Results to Consultant.
 - .3 Change materials and installation methods if tests indicate proposed system is inadequate and re-test as necessary until system approved.
 - .4 Give early notice to Consultant and Mechanical and Electrical Trades and cooperate with them in selecting suitable location for sample ceiling and timing of installation and test.
 - .5 Do not commence general installation work until sample ceiling approved, then install ceiling to conform with approved samples.
 - .6 Mock-up may form part of final Work, if acceptable to Consultant. Remove and dispose of mock-ups which do not form part of Work.

1.6 SITE CONDITIONS

- .1 Do not install the Work of this Section until:
 - .1 Mechanical and electrical Work above the ceiling is complete.
 - .2 Relative humidity is below 80 %.
 - .3 Ventilation is adequate to remove excess moisture.
 - .4 Areas are closed and protected against weather, and maintained at no less than 10°C.

- .2 Install temporary protection and facilities to maintain Product manufacturer's, and above specification, environmental requirements 24 h before, during, and after installation.

1.7 **MAINTENANCE**

- .1 Submit extra acoustic ceilings amounting to 2% of gross ceiling area, allowing proportionately for each pattern and type specified to nearest full carton. Submit Products which are part of same production run as installed Products. Store maintenance Products as directed by Consultant.

1.8 **DELIVERY, STORAGE AND HANDLING**

- .1 Transport, handle and store material in manner to prevent warp, twist, damage to panel edges and surfaces in accordance with Manufacturer's recommendations.
- .2 Any warped and/or damaged panels and trim shall be rejected and be replaced by new, straight, undamaged and acceptable material at no cost to Owner.
- .3 Bent, twisted or otherwise damaged Tee grid suspension components shall not be used under any circumstances. Replace such damaged items with new undamaged material at no additional cost to Owner.
- .4 Store material in warm, dry place away from water and the elements. Protect against undue loading stresses and shock.
- .5 All packaged material shall be delivered in original manufacturers wrappers and containers with labels and seals intact. All cartons shall bear U.L. label.

2 Products

2.1 **MATERIALS**

- .1 Galvanized steel sheet: ASTM A653/A653-M, Z275; cold rolled, galvanized steel sheet.
- .2 Main carrying channels: ASTM C645; Channels formed from galvanized steel sheet, 38 x 19 mm cold rolled.
- .3 Subframing: ASTM C645; Channels formed from galvanized steel sheet, dimensions and spans as required.
- .4 Hangers: 2.6 mm minimum diameter, galvanized steel wire.
- .5 Tie wire: 1.6 mm minimum diameter, soft annealed galvanized steel wire.
- .6 Wall mouldings and accessories, including but not limited to, corner caps, edge mouldings, panel hold over clip, metal closures, and trim. Finish and colour: same as main tees.
- .7 Exposed main, cross tees, and relocatable cross tees: ASTM E580, 38 mm high steel, bulb tee design double steel web, rectangular single spans without exceeding a deflection of

1/360 of the span. Splices to be integral and reversible; cross tee interlocking into main tee.

Colour and finish: White

- .1 Suspension system:
 - .1 'Prelude XL' by Armstrong World Industries Inc.
 - .2 'Donn DX Fast-Loc' by CGC Inc.
 - .3 '15/16 Classic Stab System' by CertainTeed Ceilings Canada.
- .2 Fire Rated ceilings:
 - .1 DONN "DXL" Firecode Fire Rated suspension system by CGC
 - .2 15/16" FireSecure Stab by CertainTeed Ceilings Canada

- .8 Acoustic tile: To match the existing ceiling tiles in area of work.
- .9 Wall mouldings: To match acoustical ceiling suspension system.
- .10 Suspension system: To match existing where modifications are required.

3 Execution

3.1 **SUSPENSION SYSTEM**

- .1 Coordinate locations and openings of mechanical and electrical services support, and penetration through the acoustical ceilings. Coordinate field conditions, clearances, measurements, and mechanical and electrical services testing and commissioning, above the acoustical ceilings.
- .2 Install hanger wires plumb and securely anchored to the building structural framing, independent of walls, pipes, ducts, and metal deck; install additional framing and hangers to bridge interference items.
- .3 Install acoustical ceiling systems in accordance with manufacturer's written instructions, reviewed shop drawings, and ASTM C636, listed in order of precedence.
- .4 Install hanger wires at 4'-0" maximum centres along carrying channels, not less than 1", and not more than 6" from channel ends.
- .5 Install additional hangers at lighting fixture and air distribution ductwork locations. Do not attach hanger wires to mechanical or electrical equipment. Do not support mechanical and electrical fixtures and fitting on ceiling without the ceiling manufacturer's written acceptance.
- .6 Install acoustical ceiling suspension system to a tolerance of 1:1200 of span and 0.015" maximum between adjacent metal members. Tolerances are not cumulative. Refer to Electrical Contract Drawings for fixture layout.

- .7 Do not bend or twist hangers as a means of levelling. Form double loops tightly and lock to prevent vertical movement or rotation within the loop.
- .8 Install edge moulding at intersection of ceiling and vertical surfaces.
- .9 Centre acoustical ceiling suspension systems on room axis; install equal border pieces. Install hangers onto the ends of main tee runners at not more than 6" from ends of runners, adjacent and perpendicular to walls.
- .10 Support the suspension system independently of walls, columns, ducts, pipes and conduits.
- .11 Install main runners in maximum available lengths. Layout joints in suspension members to avoid the perimeters of recessed fixtures. Lock grid members to form a rigid assembly. Install additional tee, suspension system framing around recessed fixtures, diffusers, grilles and other items for a complete assembly.

3.2 ACOUSTIC LAY-IN TILES

- .1 Install acoustic tile in grid system openings supported by bottom flanges of members. Provide special shapes and sizes to provide a complete installation by cutting tile to fit into openings. Fit tile moderately tight between upright legs of members.
- .2 Carefully cut and trim acoustic tiles to accommodate items piercing the finished ceiling plane.
- .3 Remove and replace acoustic tiles with broken edges, or damaged, marked, discoloured, soiled, or stained faces.

3.3 ADJUSTMENTS AND CLEANING

- .1 Clean soiled or discoloured surfaces of exposed work on completion of work.
- .2 Replace components which are visibly damaged, marred or un-cleanable.

END OF SECTION

1 General

1.1 **SECTION INCLUDES**

- .1 Labour, Products, equipment and services necessary for painting Work in accordance with the Contract Documents.
- .2 Work included:
 - .1 Paint exposed steel lintels, beams and columns, hollow metal doors and frames and interior finishes as required. All to be exterior grade.
 - .2 Removal of existing paint, prepare substrate and apply painting. This will be mainly exterior painting on various substrates.

1.2 **REFERENCES**

- .1 CAN/CGSB 85.10, Protective Coatings for Metals.
- .2 CAN/CGSB-85.100, Painting.
- .3 Master Painters Institute (MPI), Painting Specification Manual.
- .4 SSPC Steel Structures Painting Council, Standards.

1.3 **SUBMITTALS**

- .1 Product data:
 - .1 Submit copies of manufacturer's Product data in accordance with the Conditions of the Contract indicating:
 - .1 Performance criteria, compliance with appropriate reference standard, characteristics, limitations.
 - .2 Product transportation, storage, handling and installation requirements.
 - .2 Submit listing of manufacturer's Product types, Product codes, and Product names, number of coats, and dry film thicknesses, corresponding to each Painting Schedule code; submit listing minimum of 8 weeks before materials are required.
- .2 Samples:
 - .1 Submit following samples in accordance with the Conditions of the Contract.
 - .1 Three 300 x 150 mm drawdowns of each colour minimum 4 weeks before paints are required.
 - .2 Identify each sample with Contract number and title, colour reference, sheen, date, and name of applicator.
- .3 Certificates:
 - .1 Submit certification from paint manufacturer, on company letterhead, indicating each product proposed for use is Manufacturer's premium grade, first line Product and primers are compatible with paint.
 - .2 Submit certified documentation to confirm each airless spray painter has minimum of 5 years' experience on applications of similar complexity and scope.

- .3 Submit certified documentation to confirm each worker has Provincial Tradesman Qualification certificate of proficiency.
- .4 Reports:
 - .1 Submit written field inspection and test report results after each inspection.
 - .2 Submit Field Quality Control test result reports for alkali content, substrate moisture, and dry film thickness.
 - .3 Submit electronic moisture meter manufacturer's specifications including tolerances. Submit record of latest meter calibration to meet manufacturer's recommendations.

1.4 **QUALITY ASSURANCE**

- .1 Finishing Work: Perform work to MPI requirements for premium grade.
- .2 Supervision: Have Work supervised by a full-time qualified foreperson who has 10 years minimum experience on Contracts of similar complexity and scope.
- .3 Mock-up:
 - .1 Construct three 10 m² mock-ups of different Paint Schedule code systems, selected by Consultant, in locations acceptable to Consultant to demonstrate installation workmanship, colour, and hiding power of Products.
 - .2 Obtain Consultant's acceptance in writing before proceeding with the Work of this Section.
 - .3 Mock-ups may remain as part of the Work if acceptable to Consultant and will serve as a standard for similar code systems.
- .4 Repaint over mock-ups which do not form part of the Work.

1.5 **DELIVERY, STORAGE, AND HANDLING**

- .1 Install correct, safe temporary storage for paint, thinner, solvents, and other volatile, corrosive, hazardous, and explosive materials in accordance with requirements of authorities having jurisdiction.
- .2 Post hazard warning signage in areas of storage and mixing. Install and maintain sufficient CO₂ fire extinguishers of minimum 9 kg capacity, accessible in each storage mixing and storage areas.
- .3 Maintain storage enclosures at minimum 10°C ambient temperature and to manufacturer's instructions.

1.6 **SITE CONDITIONS**

- .1 Apply coatings under the following conditions:
 - .1 Exterior coatings (except Latex): 5° C minimum.
 - .2 Exterior latex coatings: 10°C minimum.
 - .3 24 hours minimum after rain, frost, condensation, or dew.
 - .4 When no condensation is possible (unless specifically formulated against condensation).
 - .5 Interior coatings: 7°C minimum.

- .6 Relative humidity: 85% maximum.
- .7 Not in direct exposure to sun light.

- .2 Maintain temperature conditions indicated above for 24 hours before, during and 24 hours after painting.

- .3 Install clean plywood sheets to protect floors and walls in storage and mixing areas, from paint drips, spatters, and spills.

- .4 Apply sufficient masking, clean drop cloths, and protective coverings for full protection of Work not being painted including, but not limited to, the following:
 - .1 Light fixtures, fire and smoke detectors.
 - .2 Sprinkler heads.
 - .3 Prepainted diffusers and registers.
 - .4 Prepainted equipment.
 - .5 Fire rating labels and equipment specification plates.
 - .6 Finished surfaces.

1.7 **ENVIRONMENTAL PERFORMANCE REQUIREMENTS**

- .1 Provide paint products meeting MPI "Green Performance Standard GPS-1-05".

1.8 **MAINTENANCE**

- .1 Deliver to Owner's place of storage on completion of work, sealed containers of each finish painting material applied, and in each colour. Label each container as for original, including mixing formula. Provide the following:
 - .1 1 L of extra materials when less than 50 L are used for Project;
 - .2 3.78 L of extra stock when 50 to 200 L are used;
 - .3 7.57 L of extra stock when over 200 L are used.

1.9 **EXTENDED WARRANTY**

Submit a warranty for paint work in accordance with General Conditions, except that warranty period is extended to 2 years.

- (1) Warrant against peeling, cracking, blistering and any other defect.
- (2) Coverage: Complete repaint of affected Work.

2 Products

2.1 **MATERIALS**

- .1 Paint:
 - .1 All materials under Work of this Section, including but not limited to, primers, stains, and paints are to have low VOC content limits. All material used for one surface to be from the same manufacturer.
- .2 Products in accordance with the MPI Painting Specification Manual, Exterior and Interior Systems;
 - .1 For each MPI paint code, manufacture's premium grade, first line Products is to be use.
 - .2 Uniform dispersion of pigment in a homogeneous mixture.

- .3 Ready-mixed and tinted whenever possible.
- .3 Products within each MPI paint system code: From single manufacturer.
 - .1 Primer for Galvanized steel: One coat "Pro-Cryl Universal Primer" by Sherwin Williams or approved equal.
 - .2 Paint for steel: Minimum Two coats, "Waterbased Acrolon 100" by Sherwin Williams or approved equal.
- .4 Acceptable manufacturers:
 - .1 Benjamin Moore.
 - .2 Dulux Paints/PPG.
 - .3 Para Painting & Coatings.
 - .4 Sherwin Williams.

2.2 COLOUR SCHEDULE

- .1 Consultant will select choice of colours and gloss when compiling a Colour Schedule after award of Contract; allow for colour selection beyond paint manufacturer's standard colour range.
- .2 Refer to Colour Schedule for selected colour references.
- .3 Conform to gloss reflectance definitions listed in MPI Specification Manual.

.3 PAINTING AND FINISHING SCHEDULE

- .1 Refer to Table 1, MPI Painting and Finishing Schedule coded systems, comply with MPI Painting Specification Manual.

Table 1: Painting and Finishing Schedule

EXTERIOR SUBSTRATES	Typical substrates (Including but not limited to)	MPI Manual Ref.	MPI Finish System Code	Topcoat
Cementitious Composition board	Cementitious siding	EXT 3.3	Ext 3.3A	Latex
Concrete (clear water repellent)		EXT 4.2	EXT 4.2H	Water repellent
Structural steel and metal fabrications		EXT 5.1	EXT 5.1D	Acrylic Urethane
Steel (High heat)	Boilers, pipes, flues, heat exchangers)	EXT 5.2	EXT 5.2C	Inorganic Zinc
Galvanized steel	HM doors & frames, handrails, steel deck	EXT 5.3	EXT 5.3B	Acrylic Urethane w/ Acrylic Primer
Wood paneling	Wood soffits	EXT 6.4	EXT 6.4A	WB solid colour stain

3 Execution

3.1 **EXAMINATION**

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

3.2 **PREPARATION**

- .1 General:
 - .1 Clean substrate surfaces free from, dust, grease, soiling, or extraneous matter, which are detrimental to finish.
 - .2 Clean substrate surfaces as per SSPC and NACE standards.
 - .3 Remove old paint to expose substrate.
 - .4 Patch, repair, and smoothen substrate defects and deficiencies e.g. machine, tool and sand paper marks, shallow gouges, marks, and nibs.
 - .5 Clean, sweep, and vacuum floors and surfaces to be painted, debris and dust-free prior to painting.
 - .6 Refer to MPI Painting Specification Manual for surface preparation requirements of substrates not listed here.
- .2 Where finish hardware has been installed remove, store, re-install finish hardware, to accommodate painting. Do not clean hardware with solvent that will remove permanent lacquer finishes.
- .3 Test for Presence of Passivating Treatments on Galvanized surfaces:
 - .1 Test galvanized surfaces for passivating as per SSPC-SP16 standards. Follow procedures for cleaning as specified in the standard.
- .3 Alkali Content tests and neutralization:
 - .1 Test for ph level using litmus paper on dampened substrate.
 - .2 Neutralize surfaces over 8.5 ph with 4% solution of Zinc Sulphate for solvent based systems and tetrapotassium pyrophosphate for latex based systems, to below 8.0 ph, and allow to dry.
 - .3 Brush-off any residual Zinc Sulphate crystals.
 - .4 Coordinate paint system primer / sealer to be alkali-resistant.
- .4 Substrate moisture tests:
 - .1 Test for moisture content over entire surface to be painted, minimum one test/ 2 m² in field areas and one test/600 mm along inside corners including at ceiling to wall juncture.
 - .2 If any test registers above 10% allow entire substrate surfaces, within the plane, to dry further before paint system application. Install temporary drying fans if necessary.
 - .3 Re-test employing same criteria.
- .5 Cementitious and masonry (existing): Clean existing surfaces by pressure washing where indicated on drawings with a TSP solution and pressure range of 1500 - 4000 PSI at 6 - 12". Rinse areas with clean water and allow to thoroughly dry. Provide for collection and disposal of water.

- .6 Cementitious and masonry (Concrete, block):
 - .1 Allow 28 days cure before painting.
 - .2 Coordinate repair of protrusion-chipping and grinding, and honeycomb filling with responsible trades.
 - .3 Remove dirt, loose mortar, scale, powder, efflorescence, and other foreign matter.
 - .4 Remove form oil and grease with trisodium phosphate, rinse, and allow to dry thoroughly.
 - .5 Prepare surfaces in accordance with CAN/CGSB-85.100.
 - .6 Remove rust stains with solution of sodium metasilicate after thorough wetting; allow to dry thoroughly.

- .7 Metal Fabrications (existing): Scrape and either hand or power wire brush surfaces to remove mill and scale and old paint to expose substrate.

- .8 Aluminum (mill finish): Wash with Xylene solvent, apply etching primer, then paint immediately.

- .9 Galvanized steel sheet:
 - .1 Z275 (Satin & Spangled Sheet): SSPC SP16 brush-off blast.
 - .2 ZF075 (Wiped Coat): Remove contamination, wash with Xylene solvent.
 - .3 Touch-up damaged galvanized areas with organic zinc rich primer.

- .10 Galvanized iron and steel: Prepare galvanized and ungalvanized metal surfaces according to CAN/CGSB-85.10.
 - .1 Unpassivated, unweathered and weathered: Remove contamination, wash with Xylene or Toluol solvent, allow to dry thoroughly. Make paint system primer/sealer an etching type primer.
 - .2 Manufacturer pre-treated (including passivated): SSPC SP16.
 - .3 Touch-up damaged galvanized areas with organic zinc rich primer.

- .11 Structural steel and miscellaneous metal fabrications:
 - .1 Coordinate the following with the responsible trades:
 - .1 Rust, mars, mill scale, and weld-burn touch-ups.
 - .2 Oil, grease, weld flux and other residue removal.
 - .3 Clean surfaces as per SSPC-SP3 Power Tool cleaning requirements.
 - .2 Prime paint items, not otherwise indicated to be primed as part of another Section.
 - .3 Touch-up damaged galvanized areas with organic zinc rich primer. Apply primer as recommended by paint manufacturer to entire area.

- .12 Wood (existing):
 - .1 Rough woods: brush surface free of all dirt, dust and foreign matter with a wire brush.
 - .2 Smooth woods: brush surfaces with a stiff fibre brush to remove dirt, dust etc.

- .13 Wood and Millwork:
 - .1 Wood surfaces to be clean and dry with a moisture content of less than 15%.
 - .2 Remove foreign matter prior to prime coat; spot coat knots, pitch streaks and sappy sections with sealer.

- .3 Fill nail holes and fine cracks after primer has dried.
- .4 Back prime interior and exterior woodwork.

- .14 Factory primed surfaces:
 - .1 Touch up damaged areas.
 - .2 Clean as required for top coat.

- .15 Coordinate with other trades to prevent:
 - .1 Damage, and inadvertent activation of fire and smoke detectors.
 - .2 Odour and dust distribution by permanent HVAC systems including fouling of ducts and filters.

- .16 Field-mix Products in accordance with manufacturer's written instructions.

3.3 APPLICATION

- .1 Apply painting systems in accordance with the MPI Painting Specification Manual. Apply each Product to manufacturer's recommended dry film thickness.

- .2 Painting systems listed are required minimum, apply additional coats if necessary, to obtain substrate hiding acceptable to the Consultant.

- .3 Tint intermediate coats lighter than final top coats for identification of each succeeding coat and to facilitate inspections. Include only manufacturers recommended reducing and tinting accessories. Do not add adulterants.

- .4 Primer to be specialized primer coating system as required by manufacturer for selected colour. Standard primer being tinted shall be tinted to a maximum of 1.5% by volume.

- .5 Sand lightly between coats to achieve a tooth or anchor for subsequent coats.

- .6 Apply paint uniformly in thickness, colour, texture, and gloss, as determined by the Consultant under adequate illumination and viewed at a distance of 1500 mm. Apply finishes free of defects in materials and application which, in the opinion of the Consultant, affect appearance and performance. Defects include, but are not limited to:
 - .1 Improper cleaning and preparation of surfaces.
 - .2 Entrapped dust, dirt, rust.
 - .3 Alligatoring, blisters, peeling.
 - .4 Scratches, blemishes.
 - .5 Uneven coverage, misses, drips, runs, and poor cutting in.

- .7 Do not apply coatings on substrates which are not sufficiently dry. Unless indicated otherwise, allow each painting system coat to cure dry and hard before following coats are applied.

- .8 Repaint entire areas of damaged or incompletely covered surfaces, to the nearest inside or outside corner; patching will not be permitted.

- .9 Miscellaneous painting requirements:
 - .1 Paint projecting ledges, and tops, bottoms and sides of doors both above and below sight lines to match adjacent surfaces.

- .2 Paint door frames, access doors and frames, door grilles, prime coated butts, and prime coated door closers to match surface in which they occur.
- .10 Mechanical, electrical and other painting coordination:
 - .1 Paint mechanical services in accordance with Mechanical Identification Division 21, 22 and 23.
 - .2 Coordinate painting of pipes, ducts, and coverings with the Work of Division 21, 22 and 23 to precede pipe colour banding, flow arrows, and other pipe identification labeling installation.
 - .3 Paint exposed conduit, pipes, hangers, ductwork, grilles, gratings, louvres, access panels, fire hose cabinets, registers, convector and radiator covers, enclosures, and other mechanical and electrical equipment including services concealed inside cupboard and cabinet Work; apply colour and sheen to match adjacent surfaces, except as noted otherwise.
 - .4 Paint portions of surfaces such as duct interiors, piping, ductwork, hangers, insulation, walls, and similar items, visible through grilles, louvres, convector covers etc., matte black in colour.
 - .5 Remove the following to accommodate painting, carefully store, clean, then re-install on completion of each area and when dry:
 - .1 Switch and receptacle plates, fittings and fastenings, grilles, gratings, louvres, access panels, convector covers, and enclosures.

3.4 FIELD QUALITY CONTROL

- .1 Dry film thickness tests:
 - .1 Test for film thickness over entire surface to be painted, minimum one test/2 m² in field areas and one test/600 mm along inside corners including at ceiling to wall juncture.
 - .2 If any test registers below specified thickness, re-apply paint to entire surface to nearest inside and outside corners.
 - .3 If test registers more than 50% above specified thickness, consult with paint manufacturer, determine if problem exists, offer solutions to Consultant, and repair as directed.
 - .4 Re-test employing same criteria after repair.

3.5 CLEANING

- .1 Remove spilled, splashed, and spattered paint promptly as Work proceeds and on completion of Work. Clean surfaces soiled by paint spillage and paint spatters. Repair or replace damaged Work, as directed by Consultant.

3.6 PROTECTION

- .1 Post Wet Paint signs during drying and restrict or prevent traffic where necessary.
- .2 Post sign, after Consultant's inspection and acceptance of each room, reading: PAINTING COMPLETE - NO ADMITTANCE WITHOUT CONTRACTOR'S PERMISSION.

END OF SECTION

CONTENT

<u>SECTION</u>	<u>TITLE</u>
15000	Mechanical Specifications Content
15005	Demolition
15010	Mechanical General Requirements
15015	Testing, Adjusting, and Balancing
15060	Pipe Hangers and Supports
15075	Access Doors
15090	Identification
15260	Piping Insulation
15702	Hot Water Piping and Accessories
15753	Forced Flow Heater

END OF SECTION

PART 1 GENERAL

1.1 WORK INCLUDING IN THIS SECTION

- .1 Refer to drawings for detailed demolition scope of work.
- .2 All existing building services not affected by this work shall be maintained in operation during and after the demolition work is complete. Any accidental interruption of existing building services not required by this project will be promptly repaired at no additional cost to the Board.
- .3 Prior to removing any piping, ensure the system is completely isolated and is not live.

1.2 QUALIFICATIONS

- .1 Work of this section shall be executed by trades personnel having a minimum of five years of experience in the demolition field and capable to deploy adequate equipment to complete the work in an efficient and orderly manner.

1.3 EXAMINATION

- .1 Examine existing property. Determine the nature of materials to be removed.

1.4 SALVAGE

- .1 The Board Representative will review the Site prior to commencement of demolition and instruct the Contractor, in writing, as to the items to be retained for re-use or be turned over to the Board. In the absence of such specific instructions, materials from demolition shall become property of Mechanical Contractor who shall promptly remove all salvageable material and debris from Site.
- .2 Remove and store indicated items for future use by the Board. Remove, handle and transport such items to storage area designated by the Board Representative. Perform such work carefully and with diligence to prevent any damage to the items during removal and in storage. Store material to be salvaged, neatly on wooden pallets, where directed by Board.

1.5 MAINTAINING TRAFFIC

- .1 Maintain and preserve Board's access requirements within, to and from existing building in areas where demolition and removal work is being carried out.
- .2 Do not close, obstruct, place or store material in Board's driveways and passageways. Conduct operations with minimum interference with roads, streets, driveways, user traffic and passageways.

1.6 HAULING OPERATIONS

- .1 Maintain roadways and paving in the hauling areas clean on a daily basis and as required by Municipal Authorities.

1.7 INTERRUPTIONS TO BOARD'S OPERATIONS

- .1 There will be absolutely no interruptions to the School schedule during demolition work. Therefore, it is imperative that operations and machine and equipment movements, deliveries and removals are executed at time or times that will permit uninterrupted Board's operations in and around the school, including parking, receiving areas, deliveries and site and access and egress.
- .2 Where interruptions of domestic cold and hot water are necessary, coordinate with the School Representatives the timing and duration of such interruptions.

1.8 SAFETY REQUIREMENTS

- .1 Coordinate posting of danger signs conspicuously around property. Close doorways and thoroughfares giving access to area of demolition with barricades.
- .2 Provide a competent, experienced supervisor in charge of the Work and on Site while work is in progress.
- .3 Should any suspect designated substance not already identified, be encountered, cease work in the immediate area and immediately report, to the Board. Board is responsible for removal of designated substances.

1.9 PROTECTION

- .1 Prevent movement, settlement or damage of adjacent structures, services, walks, paving, and parts of existing building to remain. Make good any collateral damage caused by demolition.
- .2 Take precautions to support affected structures and, if safety of building being demolished or adjacent structures or services appears to be endangered, cease operations and notify the Board.
- .3 Prevent debris from blocking drainage systems (floor drains) or other mechanical and electrical systems that must remain in operation.
- .4 Protect building floors against damage from demolition work. Use ½" plywood covers over floor where lifting, moving, rolling of removed equipment is anticipated. Be responsible for repairing any damage to flooring caused by the work defined in this section. Execute repairs to the satisfaction of the Board at no cost to the Board.

PART 2 PRODUCTS

Not Applicable.

PART 3 EXECUTION

3.1 DEMOLITION

- .1 At the end of each day's work, leave site in a safe condition and erect safety barriers and lights as required. Ensure that no parts of the existing building are in danger of collapsing.
- .2 Review the requirements of new equipment to be installed. Perform all demolition work required to allow for the new equipment to be installed, whether shown on the drawings or not.
- .3 Control dust and dirt produced during demolition.
- .4 Provide any additional labour, materials and services not specifically indicated on the drawings but required to complete the work.
- .5 Dispose of demolished materials in accordance with the requirements of authorities having jurisdiction.
- .6 At the end of demolition work, leave site in broom-clean condition. Clean existing surfaces specified to receive new applied finishes to ensure proper adherence.
- .7 Do not disturb adjacent structures or equipment designated to remain in place.
- .8 Confine operations and workers to those parts of the building which are defined on the drawings and exercise great care not to damage existing construction beyond that necessary for the carrying out of new work. Make good any such damage in every respect, to the satisfaction of the Board.

END OF SECTION

PART 1 GENERAL

1.1 GENERAL

- .1 This section of the specification is an integral part of the Contract Documents and shall be read accordingly.
- .2 Where applicable, all portions of the Mechanical Supplementary Tender Form shall be submitted by bidders.

1.2 DUTIES OF MECHANICAL CONTRACTOR

- .1 The mechanical contractor shall assume the responsibilities and duties including, but not limited to, the ones described below.
- .2 Superintendence
 1. Provide full time on-site superintendent personnel and supporting staff with proven experience in project of similar value and complexity.
 2. Site superintendent shall have over-all authority to speak for and represent the mechanical contractor.
- .3 Coordination
 1. Coordinate the work with all the sub-trades involved to ensure that the work will be carried out on schedule and in proper sequence.
 2. Take complete responsibility for all remedial work that results from failure to coordinate any aspect of the mechanical work prior to its fabrication and/or installation.
 3. Take responsibility for the delivery of equipment necessary to complete the work in accordance with the approved schedule.
- .4 Staffing and Scheduling
 1. Within seven days after the award of the contract, the Mechanical Contractor shall provide to the Owner's representative the following information:
 - a. Appointment of official representatives in the project.
 - b. Schedule of work.
 - c. Delivery schedule for specified equipment.
 - d. Requirements for temporary facilities, site signs, storage, etc.
- .5 Work Completion Meeting
 1. Prior to application for Substantial Performance of the Work, the mechanical contractor shall participate in the take-over meeting. Agenda to include the following:

- a. Review of outstanding deficiencies.
- b. Submission of maintenance manuals, warranties and as-built drawings.
- c. Results of performance tests and described further in this section.
- d. Scheduling of training to Owner's personnel.

1.3 INTENT

- .1 Bidders for this work shall include for all labor, material, equipment and all other related cost including all applicable taxes (except HST) and fees to provide the work as indicated on the drawings.
- .2 Misinterpretation of any requirement of the drawings and specifications will not relieve the Mechanical Contractor of responsibility. If in any doubt, the Mechanical Contractor shall contact the Consultant for written clarification prior to submitting a bid for the Work.

1.4 INTERFERENCE

- .1 The mechanical drawings do not show all the architectural and structural details, and any information involving accurate measuring of the building shall be taken from the building drawings or at the building. Make without additional charge, any necessary changes or additions to the runs of drains, pipes, ducts, etc., to accommodate the above conditions. The location of equipment may be altered without charge providing the change is made before installation and does not necessitate major additional material.
- .2 Wherever differences occur between specifications, riser diagrams or schematics and drawings, the maximum conditions shall govern and the bid shall be based on whichever information indicates the greater cost.
- .3 Field verifications of dimensions on plans shall be made since actual locations, distances, and levels will be governed by actual field conditions.
- .4 Discrepancies between different plans, or between plans and actual field conditions, or between plans and specifications shall promptly be brought to the attention of the Consultant for a decision.
- .5 Install all mechanical services including but not exclusive to drains, pipes, and ducts, to conserve headroom and interfere as little as possible with the free use of the space through which they pass. All drains, pipes, ducts, etc., particularly those which may interfere with the inside treatment of the building, or conflicting with other trades, shall be installed only after the locations have been approved by the Consultant. Special care shall be taken in the installation of all mechanical services including, but not exclusive to drains, pipes, and ducts, which are to be concealed, to see that they come within the finished lines of floors, walls, and ceilings. Where such drains, pipes, ducts, etc., have been installed in such a manner as to cause interference, they shall be removed and re-installed in suitable locations without extra cost to the Owner.
- .6 Before commencing work, check and verify all grade and invert elevations, stacks, levels, and dimensions, to ensure proper and correct installation of the work.

- .7 In every place where there is space indicated as reserved for future or other equipment, leave such space clear, install blank offs, shut off valves with blind flanges and other work so that the necessary connections can be made without any stoppages to the system. Consult with the Consultant whenever necessary for this purpose.
- .8 In addition to the work specifically mentioned in the Specifications and shown on the drawings, provide all other items that are obviously necessary to make a complete working installation, including those required by the Authorities Having Jurisdiction over the work.
- .9 The mechanical plans show approximate locations for wall mounted devices. Obtain Consultant's approval of mounting heights and locations before commencement of work.

1.5 EXAMINE SITE

- .1 Examine the site and the local conditions affecting the work. Examine carefully all drawings and the complete specifications to ensure that the work can be satisfactorily carried out as shown. No allowance will be made later for any expenses incurred through the failure to make these examinations or to report any such discrepancies in writing to the Consultant.

1.6 SUBCONTRACTOR'S SHOP

- .1 Provide Job site office, work-shop, tools, scaffolds, material storage, etc., as required to complete the work.

1.7 CLEANING

- .1 During the performance of the work and on the completion, remove from the place of the work all debris, rubbish and waste materials caused by the performance of the work. Remove all tools and surplus materials after completion and acceptance of the work.
- .2 All equipment shall be thoroughly vacuumed out at the time of final acceptance of the work.

1.8 DELIVERY, STORAGE, AND HANDLING

- .1 Protection of Equipment:
 1. Equipment and material placed on the job site shall remain in the custody of the Contractor until phased acceptance, whether or not the Owner has reimbursed the Contractor for the equipment and material. The Contractor is solely responsible for the protection of such equipment and material against any damage.
 2. Place damaged equipment in first class, new operating condition; or, replace same as determined and directed by the Consultant. Such repair or replacement shall be at no additional cost to the Owner.

3. Protect interiors of new equipment and piping systems against entry of foreign matter. Clean both inside and outside before painting or placing equipment in operation.
 4. Existing equipment and piping being worked on by the Contractor shall be under the custody and responsibility of the Contractor and shall be protected as required for new work.
- .2 Cleanliness of Piping and Equipment Systems
1. Exercise care in storage and handling of equipment and piping material to be incorporated in the work. Remove debris arising from cutting, threading and welding of piping.
 2. Piping systems shall be flushed, blown or pigged as necessary to deliver clean systems.
 3. Clean interior of all tanks prior to delivery for beneficial use by the Owner.
 4. Contractor shall be fully responsible for all costs, damage, and delay arising from failure to provide clean systems.

1.9 INSTALLATION OF WORK

- .1 Be responsible for:
 1. The layout of the work shown on the drawings and specified herein, and for any damage caused to the Owner by improper location or carrying out of this work.
 2. The prompt installation of the work in advance of concrete pouring or similar work.
 3. The condition of all material and equipment supplied and for the protection and maintenance of work completed.
- .2 Coordinate with other trades and schedule all work to suit the date for the substantial performance established in the construction contract.
- .3 Furnish items to be "built-up" in ample time and give necessary information and assistance in connection with the building in of the same.
- .4 Proceed with the work as quickly as practical so that construction may be completed in as short a time as possible and in accordance with the building schedule.
- .5 Ensure that all equipment and material is ordered in time to meet the building schedule. Provide a schedule of equipment deliveries to the Owner within the time limit stipulated.
- .6 Furnish promptly information required for the construction schedule.
- .7 Manufactured products supplied with instructions for their installation shall be installed in strict accordance with those instructions.

1.10 CODES, PERMITS, FEES, AND CONNECTIONS

- .1 Conform to Federal, Provincial and Municipal regulations and perform work in accordance with requirements of By-Laws and Regulations in force in area where the building is to be erected.
- .2 Apply for, obtain, and pay for all permits, fees and service connections for the work and the inspections required by Authorities Having Jurisdiction in the area where the building is to be erected.
- .3 In particular, coordinate with and pay for the local gas supply company to adjust/modify/replace the existing gas meter assembly and PRV as required to ensure that the available gas pressure is adequate for all gas fired equipment to operate simultaneously at maximum capacity. The minimum gas pressure at the boiler shall not be less than 8" w.g. under simultaneous maximum operating condition of all gas-fired equipment.
- .4 For information, a specific code or standard might be mentioned. This information must not be taken as the only code or standard applicable.
- .5 When part of equipment does not bear the required CSA label, the contractor shall obtain from CSA or Hydro Electric Power Commission, when that part of the equipment is an electric component, a special approval and pay the applicable fees.
- .6 Furnish necessary certificates as evidence that the work installed conforms to laws and regulations of Authorities having jurisdiction. Changes in work requested by an Authority having jurisdiction shall be carried out without charge.

1.11 MATERIALS

- .1 Where materials, equipment, apparatus, or other products are specified by the manufacturer, brand name, type or catalogue number, such designation is to establish standards of desired quality style or dimensions and shall be the basis of the Bid. Materials so specified shall be furnished under this Contract, unless changed by mutual agreement. Where two or more designations are listed, the contractor shall choose one of those listed and state the choice made on the Bid Form or Supplementary Tender Form (where applicable).

1.12 EQUIVALENTS AND ALTERNATIVES

- .1 Unless requests for changes in base bid specifications are received and approved min. 5 days prior to the opening of the bids, the Contractors will be held to furnish specified items under the base bid. After the Contract is awarded changes in specifications will be made only as defined in this section (see Material Substitutions below).
- .2 Equipment of the Contractors' choice may be offered as alternates to the items named in the specifications. Alternate proposals must be accompanied by full descriptive and technical data on the article proposed, together with a statement of the amount of addition or deduction from the base bid if the alternate is accepted. Prior approval from the Consultant

is not required on submitting alternative items, but the decision on acceptance of the alternate(s) will rest with the Consultant and the Owner Representative.

- .3 Unspecified materials and/or rejected alternates built into the work shall be replaced with specified or accepted materials at no additional cost to the Owner.

1.13 MATERIAL SUBSTITUTIONS

- .1 After execution of the Contract, requests for substitution of materials of makes other than those specifically named in the Contract Documents may be approved by the Consultant, subject to Owner's review and acceptance of the financial credits involved.
- .2 In the absence of such express approval by the Consultant, the Mechanical Contractor will be held to furnish specified items under the base bid.

1.14 SHOP DRAWINGS AND SAMPLES

- .1 Submit to the Consultant detailed dimension shop drawings and installation wiring diagrams for all mechanical equipment. Further details and special requirements called for in these specifications shall be shown on the shop drawings.
- .2 Ensure that copies of all reviewed shop drawings are available on the job site for reference.
- .3 Provide samples of mechanical equipment as requested in the specification at the same time as the shop drawing submission.

1.15 AS-BUILT DRAWINGS

- .1 Maintain up to date "as built" drawings on site.
- .2 At the conclusion of the project, the Consultant will forward to the Contractor a set of electronic files of the project. The Contractor shall modify the files as required, to reflect the as-built conditions, mark them conspicuously in the title block as "as-built drawings" and submit the modified files to the Consultant for review.
- .3 Upon certifications by the Consultant that the as-built files are correct, the files shall be transferred on a CD and handed over to the Owner as part of the Operations and Maintenance manuals.
- .4 Any subsequent changes found by the Consultant shall remain the responsibility of the Contractor at no charge to the Owner.

1.16 TEMPORARY AND TRAIL USAGE

- .1 After any part of the work has been completed, the Consultant will make an inspection, and performance tests of such parts shall be carried out under the direction of the Consultant. If deficiencies are found, they shall be immediately rectified to the satisfaction of the Consultant. After such deficiencies have been rectified, the work shall be placed in service

at such time and in such order as the Consultant may direct. If, in placing a portion of the equipment in service, it is necessary to make temporary connections in the wiring in order to obtain proper operation, such connections shall be provided to the extent and in the manner required by the Consultant.

- .2 Temporary or trial usage of any mechanical devices, machinery, apparatus, equipment or materials shall not be construed as evidence of the acceptance of same.
- .3 No claims for damage will be considered for injury to, or the breaking of any parts of such work which may be used.

1.17 CONSULTANT'S INSTRUCTIONS

- .1 During construction the Consultant will issue such instructions as may be necessary for verification and corrections of the work. These instructions shall be binding as part of the specification.

1.18 ADDITIONAL WORK AND CHANGES

- .1 Unless a written order, reviewed by the Consultant and countersigned or otherwise approved by the Owner Representative, no additional work shall be undertaken by the Contractor.

1.19 WARRANTY

- .1 The Mechanical Contractor shall guarantee all work and apparatus installed under his contract against all defects of workmanship and material for a period of one (1) year after the Substantial Performance of the Work, unless otherwise mentioned in the Specifications, and shall make good any and all defects developing during such time without expense to the Owner. Any materials shall be further guaranteed as may be called for in these specifications. Where warranties on equipment extend beyond one (1) year the Mechanical Contractor shall honor the extended warranty.

1.20 SCHEDULING OF WORK

- .1 For all work to be performed under this contract, adhere to Construction Schedule agreed upon with the Owner Representative.

1.21 EQUIPMENT REQUIREMENTS AND INSTALLATION

- .1 Permit equipment maintenance and disassembly by use of unions or flanges to minimize disturbance to connecting piping and duct systems and without interference from building structure or other equipment.
- .2 Provide accessible means for lubricating equipment including permanent lubricated bearings.

- .3 For all base mounted boilers, pumps, compressors, air handling units, fans and other rotating equipment, provide chamfered edge housekeeping pads a minimum of 4" high and 4" larger than equipment dimensions all around. Work shall be performed by the trades specializing in this work.
- .4 Pipe drain lines, overflows and safety relief vents to drains. If the horizontal drains present a tripping hazard, use aluminum checkered plate covers.
- .5 Line-up equipment, rectangular cleanouts and similar items with building walls wherever possible.

1.22 LIFTING ATTACHMENTS

- .1 Provide equipment with suitable lifting attachments to enable equipment to be lifted in its normal position. Lifting attachments shall withstand any handling conditions that might be encountered, without bending or distortion of shape, such as rapid lowering and braking of load.

1.23 PIPE HANGERS AND SUPPORTS

- .1 General
 1. Pipe Supports: Comply with MSS SP 58. Type Numbers specified refer to this standard. For selection and application comply with MSS SP 69.
- .2 Attachment to Concrete Building Construction
 1. Concrete insert: MSS SP-58, Type 18.
 2. Self-drilling expansion shields and machine bolt expansion anchors: Permitted in concrete not less than 102 mm (four inches) thick when approved by the Consultant for each job condition.
 3. Power driven fasteners: Permitted in existing concrete or masonry not less than 102 mm (four inches) thick when approved by the Resident Engineer for each job condition.
- .3 Attachment to Steel Building Construction
 1. Welded attachment: MSS SP 58, Type 22.
 2. Beam clamps: MSS SP-58, Types 20, 21, 28 or 29. Type 23 C clamp may be used for individual copper tubing up to 23mm (7/8 inch) outside diameter.
- .4 Attachment to Metal Pan or Deck
 1. As required for materials specified Steel Decking section of the specification.

- .5 Attachment to Wood Construction
 1. Wood screws or lag bolts.
- .6 Hanger Rods
 1. Hot rolled steel, ASTM A36 or A575 for allowable load listed in MSS SP 58. For piping, provide adjustment means for controlling level or slope. Types 13 or 15 turn buckles shall provide 38 mm (1 1/2 inches) minimum of adjustment and incorporate locknuts. All thread rods are acceptable.
- .7 Hangers Supporting Multiple Pipes (Trapeze Hangers)
 1. Galvanized, cold formed, lipped steel channel horizontal member, not less than 41 mm by 41 mm (1 5/8 inches by 1 5/8 inches), 2.7 mm (No. 12 gage), designed to accept special spring held, hardened steel nuts. Not permitted for steam supply and condensate piping.
 2. Allowable hanger load: Manufacturers rating less 91kg (200 pounds).
 3. Guide individual pipes on the horizontal member of every other trapeze hanger with 6 mm (1/4 inch) U bolt fabricated from steel rod. Provide Type 40 insulation shield, secured by two 13mm (1/2 inch) galvanized steel bands, or preinsulated calcium silicate shield for insulated piping at each hanger.
- .8 Supports for Piping Systems
 1. Select hangers sized to encircle insulation on insulated piping. To protect insulation, provide Type 39 saddles for roller type supports or preinsulated calcium silicate shields. Provide Type 40 insulation shield or preinsulated calcium silicate shield at all other types of supports and hangers including those for preinsulated piping.
- .9 Piping Systems (MSS SP 58)
 1. Standard clevis hanger: Type 1; provide locknut.
 2. Riser clamps: Type 8.
 3. Wall brackets: Types 31, 32 or 33.
 4. Roller supports: Type 41, 43, 44 and 46.
 5. Saddle support: Type 36, 37 or 38.
 6. Turnbuckle: Types 13 or 15. Preinsulate.
 7. U bolt clamp: Type 24.
 8. Copper Tube:
 - a. Hangers, clamps and other support material in contact with tubing shall be painted with copper colored epoxy paint, plastic coated or taped with non-adhesive isolation tape to prevent electrolysis.

- b. For vertical runs use epoxy painted or plastic coated riser clamps.
 - c. For supporting tube to strut: Provide epoxy painted pipe straps for copper tube or plastic inserted vibration isolation clamps.
9. Insulated Lines:
- a. Provide pre-insulated calcium silicate shields sized for copper tube.
10. Supports for plastic or glass piping: As recommended by the pipe manufacturer with black rubber tape extending one inch beyond steel support or clamp.
- .10 Piping with Vertical Expansion and Contraction
- 1. Movement up to 20 mm (3/4 inch): Type 51 or 52 variable spring unit with integral turn buckle and load indicator.
 - 2. Movement more than 20 mm (3/4 inch): Type 54 or 55 constant support unit with integral adjusting nut, turn buckle and travel position indicator.
- .11 Heat Exchanger and Expansion Tank Hangers
- 1. May be Type 1 sized for the shell diameter. Insulation where required will cover the hangers.

1.24 PIPE PENETRATIONS

- .1 Install sleeves during construction for other than blocked out floor openings for risers in mechanical bays.
- .2 To prevent accidental liquid spills from passing to a lower level, provide the following:
 - 1. For sleeves: Extend sleeve 25 mm (one inch) above finished floor and provide sealant for watertight joint.
 - 2. For blocked out floor openings: Provide 40 mm (1 1/2 inch) angle set in silicone adhesive around opening.
 - 3. For drilled penetrations: Provide 40 mm (1 1/2 inch) angle ring or square set in silicone adhesive around penetration.
- .3 Penetrations are not allowed through beams or ribs, but may be installed in concrete beam flanges. Any deviation from these requirements must receive prior approval of Consultant.
- .4 Sheet Metal: Provide for pipe passing through floors, interior walls, and partitions, unless brass or steel pipe sleeves are specifically called for below.

- .5 Cast Iron or Zinc Coated Pipe Sleeves: Provide for pipe passing through exterior walls below grade. Make space between sleeve and pipe watertight with a modular or link rubber seal. Seal shall be applied at both ends of sleeve.
- .6 Galvanized Steel or an alternate Black Iron Pipe with asphalt coating Sleeves: Provide for pipe passing through concrete beam flanges, except where brass pipe sleeves are called for. Provide sleeve for pipe passing through floor of mechanical rooms. Except in mechanical rooms, connect sleeve with floor plate.
- .7 Brass Pipe Sleeves: Provide for pipe passing through quarry tile, terrazzo or ceramic tile floors. Connect sleeve with floor plate.
- .8 Sleeves are not required for wall hydrants for fire department connections or in drywall construction.
- .9 Sleeve Clearance: Sleeve through floors, walls, partitions, and beam flanges shall be one inch greater in diameter than external diameter of pipe. Sleeve for pipe with insulation shall be large enough to accommodate the insulation. Interior openings shall be caulked tight with fire stopping material and sealant to prevent the spread of fire, smoke, and gases.

1.25 SPECIAL TOOLS AND LUBRICANTS

- .1 Furnish, and turn over to the Owner, special tools not readily available commercially, that are required for disassembly or adjustment of equipment and machinery furnished.
- .2 Grease Guns with Attachments for Applicable Fittings: One for each type of grease required for each motor or other equipment.
- .3 Tool Containers: Hardwood or metal, permanently identified for intended service and mounted, or located, where directed by the Owner.
- .4 Lubricants: A minimum of 0.95 L (one quart) of oil, and 0.45 kg (one pound) of grease, of equipment manufacturer's recommended grade and type, in unopened containers and properly identified as to use for each different application.

1.26 WALL, FLOOR, AND CEILING PLATES

- .1 Material and Type: Chrome plated brass or chrome plated steel, one piece or split type with concealed hinge, with set screw for fastening to pipe, or sleeve. Use plates that fit tight around pipes, cover openings around pipes and cover the entire pipe sleeve projection.
- .2 Thickness: Not less than 2.4 mm (3/32 inch) for floor plates. For wall and ceiling plates, not less than 0.64 mm (0.025-inch) for up to 80 mm (3 inch pipe), 0.89 mm (0.035-inch) for larger pipe.

- .3 Locations: Use where pipe penetrates floors, walls and ceilings in exposed locations, in finished areas only. Use also where insulation ends on exposed water supply pipe drop from overhead. Provide a watertight joint in spaces where brass or steel pipe sleeves are specified.

1.27 EXCAVATION AND BACKFILL

- .1 Grade the bottom of the pipe trench excavation as required.
- .2 In firm, undisturbed soil, lay pipes directly on the soil, and shape soil to fit the lower one-third segment of all pipes and pipe bells. Ensure even bearing along the barrels. Backfill excess excavation with 25 mPa concrete.
- .3 Where rock or shale is encountered, arrange to have this excavated and removed. After excavation, backfill with a bedding of 10 mm crushed stone.
- .4 Prepare new bedding under the pipe in unstable soil, in fill, and in all cases where pipe bedding has been removed in earlier excavation, particularly near perimeter walls of buildings, at manholes and catch basins. Compact to maximum possible density and support the pipe by 200 mm (8 inches) thick firm supports. Install reinforcing steel in cradle or construct piers every eight feet or closer, down to solid load bearing strata. Provide a minimum of one pier per length of pipe. Use same method where pipes cross.
- .5 Where excavation is necessary in proximity to and below the level of any footing, backfill with 25 mPa concrete to the level of the highest adjacent footing. Proximity is determined by the angle of repose as established by the Consultant.
- .6 Provide support over at least the bottom one third segment of the pipe in all bedding methods.
- .7 Do not open trench ahead of pipe laying and backfilling more than weather will permit. Keep walls of trenches straight to at least 450 mm (18") above the top of the pipe to keep the diameter load within the pipe design limits. Have excavations inspected at least once a week by authorities.
- .8 Before backfilling, obtain approval. Remove all shoring during backfill.
- .9 Backfill trenches within building, with clean sharp sand or gravel in individual layers of maximum 150 mm (6") thickness, compacted to a density of 100% Standard Proctor. Hand compact the first layers up to a compacted level of minimum 300 mm (12") above the top of pipe. Hand or machine compact the balance up to grade, using approved equipment.
- .10 Backfill trenches outside buildings, not under roads, parking lots, or traffic areas, up to a compacted level of 450 mm (18") above the pipes with individual layers of material 150 mm (6") thick, hand compacted to a density of 95% Standard Proctor, using approved 10 mm (3/8") crushed stone. Backfill the balance with 150 mm (6") layers of approved excavated material, compacted to 95% Standard Proctor, using approved equipment.

- .11 Backfill all other trenches outside buildings with 150 mm (3/8") crushed stone in layers not exceeding 6" thickness, compacted to 100% Standard Proctor density up to grade level. Manual compaction up to 450 mm (18") above the pipe with approved equipment for the balance.
- .12 Fill all depressions to a correct grade level with appropriate material. After a period has passed adequate to reveal any settlement, use maximum possible compaction. Pay all costs required to make good all damages caused by settlement.
- .13 Dispose of excavated materials in accordance with the requirements of the Authorities having Jurisdiction.

1.28 TESTS

- .1 Do not insulate or conceal work until tested and approved. Follow construction schedule and arrange for tests.
- .2 Conduct tests in presence of Consultant.
- .3 Bear costs including retesting and making good.
- .4 Pipe pressure:
 1. Hydraulically test piping systems at 1.5 times system operating pressure or minimum 125 psi, whichever is greater.
 2. Maintain test pressures without loss for 4 hours unless otherwise specified.
 3. Test natural gas systems to requirements of authorities having jurisdiction and as per Ontario Gas Utilization Code O.Reg. 452/89.
 4. Test drainage, waste and vent piping to code.
- .5 Prior to tests, isolate all equipment or other parts which are not designed to withstand test pressures.

1.29 PAINTING

- .1 Apply at least one coat of corrosion resistant primer paint to supports, and equipment fabricated from ferrous metals.
- .2 Touch-up paint all damaged equipment with products matching original finish in quality and appearance.
- .3 Paint the entire gas line where with two coats of yellow paint.

1.30 SPECIAL TOOLS AND SPARE PARTS

- .1 Furnish spare parts as follows:
 1. One set of packing for each pump.
 2. One glass for each gauge glass installed.
 3. One set of v-belts/bolts for each piece of machinery.
 4. One spare set of filters for each filter bank installed.
- .2 Upon completion of project and immediately before hand-over, replace all filters.

1.31 DIELECTRIC COUPLINGS

- .1 Provide wherever pipes of dissimilar metals are joined.
- .2 Provide insulating unions for pipe sizes larger than 2" diameter and under; same for flanges of pipe sizes over 2" diameter.
- .3 Cast brass adapters may be used on domestic water systems and where approved by the Consultant.
- .4 Provide rubber gaskets to prevent dissimilar metals contact.

1.32 INSTRUCTION OF OPERATING STAFF

- .1 Supply certified personnel to instruct Owner operating staff on operation of new mechanical equipment. Supply maintenance specialist personnel to instruct operating staff on maintenance and adjustment of mechanical equipment and any changes or modification in equipment made under terms of guarantee.
- .2 Provide minimum 6 hrs of instruction time during regular work hours prior to acceptance and turn-over to operating staff for regular operation.
- .3 Use operation and maintenance data manual for instruction purposes. On completion of instruction, turn manuals over to the Consultant.
- .4 Scheduling of the timing for the training of the operating staff shall be arranged 10 days prior to the completion of the project.
- .5 For training on controls, refer to Section 15900.

1.33 MAINTENANCE MANUALS

- .1 Provide minimum of three (3) copies of Mechanical Maintenance Manuals, in accordance to the following:
 1. Mechanical Maintenance Manuals to be delivered to the Consultant's office 10 days prior to the substantial completion of the Contract.

- .2 Manuals to be bound in a hard cover neatly labeled: "OPERATING AND MAINTENANCE INSTRUCTIONS".
- .3 The Maintenance Manuals shall be divided into sections with neatly labeled and tabbed dividers between each section. The sections to be included in the manual are:
 1. Section I - General
 2. Section II - Piping and Pump Systems, Plumbing Fixtures and Accessories
 3. Section III - Boilers, Heat Exchangers, Pool Filters and Accessories
 4. Section IV - Automatic Controls
 5. Section V - Air and Water Balancing
- .4 The following information shall be contained within the sections:
 1. SECTION I: A list giving name, address and telephone number of the Consultant, Engineers, General Contractor, Mechanical Trade and Controls Trade. Written guarantees for the Mechanical Systems. A copy of the Valve directory giving number, valve location, normal valve position, and purpose of valve (a framed copy of Valve Directory to be hung in Boiler Room). Equipment lists and certificates shall be provided - certificates shall be signed and sealed by the appropriate suppliers.
 2. SECTION II, III: A copy of all pressure tests and operational tests. A copy of Gas Operational Tests for gas fired equipment. A list giving name, address and telephone number of all suppliers. Details of chemical treatment equipment and substances. A copy of all reviewed Shop Drawings for all mechanical equipment and ancillary devices (valves, expansion tanks, pumps, strainers, plumbing, etc.). Copies of warranties.
 3. SECTION IV: Complete Control Diagrams, Wiring Diagrams and description of Control system and the functioning sequence of the system. Also refer to section 15900.
 4. SECTION V: For balancing reports and formats, refer to section 15015 of these specifications.

1.34 CONCRETE

- .1 All concrete work required to complete this project, whether shown on the drawings or not, shall be the Contractor's responsibility.
- .2 Refer to this specification section for requirements for housekeeping pad.

1.35 METALS

- .1 All steel construction required for the completion of this project, whether shown on the drawings or not, shall be the Contractor's responsibility.

1.36 CUTTING, PATCHING, ROOFING, AND X-RAY

- .1 All cutting, patching, roofing and X-Rays required for the completion of this project whether shown on the drawings or not, shall be the Contractor's responsibility. The cutting and patching work shall be performed in accordance with the following:
 1. All cutting and patching shall be done by the trades specializing in the materials to be cut.
 2. All flashing and equipment supports on the roof shall be done in strict accordance with the Owner standards by Owner-approved roofing contractors only.
- .2 Should any cutting, roofing and/or repairing of finished surfaces be required, the Sub-trade contractor for the Contractor shall employ the particular trades engaged on the site for this type of work to do such cutting and/or repairing. Obtain the approval of the Consultant before doing any cutting. In the event that tradesmen required for particular cutting and/or repairing are not already on the site, bring to the site tradesmen to do this work.
- .3 Supporting members of any floor, wall or the building structure shall be cut only in such a location and manner as approved by the Consultant.
- .4 Where slabs in the portions of the building which are existing must be saw-cut or core drilled, all locations shall be x-rayed prior to saw-cutting or core-drilling. All x-raying shall be done by personnel qualified in the use of the type of equipment required to x-ray the saw-cuts shall be permitted to perform this work on the site. No allowance will be made later for expenses incurred through the failure of performing these x-rays.

1.37 MECHANICAL PROJECT COMPLETION

- .1 Ten (10) days prior to substantial performance of work obtain documentation and/or prepare certification of the following items and submit them to the Owner's representative:
 1. All inspection certificates including drainage, Plumbing, and refrigeration.
 2. Guarantee certificates as called for under "Warranty".
 3. Record drawings.
 4. Operating and Maintenance Manuals.
 5. Test certifications as called for under "Testing".
 6. Provide a signed statement to the effect that all tests for mechanical systems and equipment have been completely carried out in the Trade Sections of these Specifications and to the manufacturer's recommendations, and in accordance with the requirements of all authorities having jurisdiction.

1.38 PERFORMANCE TESTS AND EQUIPMENT START-UP

- .1 After all equipment has been installed, adjusted, balanced and started up, subject equipment to a series of performance tests, as soon as conditions permit.

- .2 The timing of the tests shall be arranged to suit the convenience of the Consultant, and the manner and duration shall be as the Consultant deems necessary. Record the daily start and stop times, operating hours and functions performed. Ensure that the performance tests are witnessed by the Consultant.
- .3 All major equipment including but not limited to boilers, pumps, sand filters are to be inspected by the manufacturer to ensure that the equipment has been installed in accordance with their recommendations.
- .4 Operate equipment under varying load conditions, demonstrate start-up sequence, normal shutdown, simulated emergency shutdown, operation of temperature, etc., and safety controls. Operate switches and electrical devices for correct wiring sequences. Adjust components to achieve a proper functional relationship among all the components of all the systems. Repeat these functions as many times as deemed necessary by the Consultant to achieve reliable operation.
- .5 Repair defects and repeat tests as necessary. During test maintain lubrication schedule, set, align and tension drives.
- .6 At the successful completion of Performance Tests and all testing and balancing, make the systems ready for final inspection and subsequent acceptance of the Owner. Replace and clean filters, flush out lines and equipment, remove and clean strainers, fill liquid systems and purge air. Provide water treatment to pipes and report in accordance to Section 15602. Disinfect all domestic water as required by current by-laws and Authorities Having Jurisdiction.
- .7 Conduct tests to demonstrate operation and ability to meet requirements of all equipment and freedom from undue noise and vibration at the time of final inspection, having ensured that it has previously been subjected to Performance Tests.

PART 2 PRODUCTS

Not Applicable.

PART 3 EXECUTION

Not Applicable.

END OF SECTION

PART 1 GENERAL

1.1 DESCRIPTION

- .1 Testing, adjusting, and balancing (TAB) of heating and ventilating systems. TAB includes the following:
 1. Systems Inspection Report.
 2. Duct Air Leakage Test Report.
 3. Balancing air and water distribution systems; adjustment of total system to provide design performance.
 4. Recording and reporting results.

1.2 DEFINITIONS

- .1 TAB: Testing, Adjusting and Balancing; the process of checking and adjusting HVAC systems to meet design objectives.
- .2 AABC: Associated Air Balance Council.
- .3 Hydronic Systems: Includes heating hot water, domestic hot water recirculation, chilled water, condenser water, and glycol water systems, as applicable to the project.
- .3 Air Handling Systems: Includes all central and distributed air handling equipment that provide outside air, supply air, return air, exhaust air, and relief air to and from the building, as applicable to the project.
- .4 Air distribution systems: Includes all grilles, diffusers, terminal units (bypass/VAV).
- .5 Flow rate tolerance: The allowable percentage variation, minus to plus, of actual flow rate from values (design) in the contract documents.

1.3 QUALITY ASSURANCE

- .1 Qualifications:
 1. TAB Agency: The TAB agency shall be a subcontractor of the General Contractor and shall report to and be paid by the General Contractor.
 2. The TAB agency shall be either a certified member of AABC to perform TAB service for HVAC and water balancing equipment. The certification shall be maintained for the entire duration of duties specified herein. If, for any reason, the agency loses subject certification during this period, the General Contractor shall immediately notify the Consultant and the Owner and submit another TAB firm for approval.

3. TAB Specialist: The TAB specialist shall be either a member of AABC or an experienced technician of the Agency.
- .2 TAB Agency shall be identified by the General Contractor within 60 days after the award of the contract.
- .3 The TAB specialist will be coordinating, scheduling and reporting all TAB work and related activities and will provide necessary information as required by the Consultant. The responsibilities would specifically include:
 1. Shall directly supervise all TAB work.
 2. Shall sign the TAB reports that bear the seal of the TAB Agency. The reports shall be accompanied by report forms and schematic drawings required by the TAB standard, AABC.
 3. Would follow all TAB work through its satisfactory completion.
 4. Shall provide final markings of settings of all HVAC adjustment devices.
 5. Permanently mark location of duct test ports.
- .4 Test Equipment Criteria: The instrumentation shall meet the accuracy/calibration requirements established by AABC National Standards and or by the instrument manufacturer.
- .5 Tab Criteria:
 - (a) Air Filter resistance during tests, artificially imposed if necessary, shall be at least 90 percent of final values for pre-filters and after-filters.
 - (b) Flow rate tolerance:
 - a. Air handling unit and all other fans, cubic meters/min (cubic feet per minute): Minus 5% to plus 10%.
 - b. Grilles, diffusers and air terminal units (maximum values): -5% to +10%.
 - c. Exhaust hoods/cabinets: 0 % to + 10 %.
 - d. Minimum outside air: 0 % to +10 %.
 - e. Individual room air outlets and inlets, and air flow rates not mentioned above: - 5 % to +10 % except if the air to a space is 100 CFM or less the tolerance would be 0 to plus 5 %.

1.4 SUBMITTALS

- .1 Submit the following for review to the Consultant:
 1. Systems inspection report on equipment and installation for conformance with design.

2. Duct Air Leakage Test Report.
3. Final TAB reports covering flow balance and adjustments, performance tests.
4. Include in final reports uncorrected installation deficiencies noted during TAB and applicable explanatory comments on test results that differ from design requirements.

1.5 APPLICABLE PUBLICATIONS

- .1 The following publications form a part of this specification to the extent indicated by the reference thereto. In text the publications are referenced to by the acronym of the organization.
- .2 American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc. (ASHRAE): HVAC Applications ASHRAE Handbook, Testing, Adjusting, and Balancing.
- .3 Associated Air Balance Council (AABC): AABC National Standards for Total System Balance.
- .4 Sheet Metal and Air Conditioning Contractors National Association (SMACNA): HVAC Systems Testing, Adjusting and Balancing.

PART 2 PRODUCTS

2.1 PLUGS

- .1 Provide plastic plugs to seal holes drilled in ductwork for test purposes.

2.2 INSULATION REPAIR MATERIAL

- .1 Coordinate with the mechanical Contractor the TAB activity such that it does take place before the insulation is installed on ductwork and piping.
- .2 In the absence of such coordination, the mechanical contractor shall be responsible for the repair to the ductwork and or piping insulation removed for TAB purposes, including the integrity of the vapor barrier material and the insulation jacket.

PART 3 EXECUTION

3.1 GENERAL

- .1 Obtain applicable contract documents and copies of approved submittals for HVAC equipment and automatic control systems.

3.2 SYSTEMS INSPECTION REPORT

- .1 Inspect equipment and installation for conformance with design.

- .2 The inspection and report is to be done after air distribution equipment is on site and duct installation has begun, but well in advance of performance testing and balancing work. The purpose of the inspection is to identify and report deviations from design and ensure that systems will be ready for TAB at the appropriate time.
- .3 Verify that all items such as ductwork piping, ports, terminals, connectors, etc., that is required for TAB is installed. Provide a report to the Consultant.
- .4 Reports: Follow check list format developed by AABC or SMACNA, supplemented by narrative comments, with emphasis on air handling units and fans. Check for conformance with submittals. Verify that diffuser and register sizes are correct. Check air terminal unit installation including their duct sizes and routing.

3.3 TAB REPORT

- .1 Format to be in accordance with referenced standard listed above, but using design drawing units.
- .2 Produce "as-built" full system schematics. Use as-built drawings for reference.
- .3 Submit 1 copy of preliminary TAB reports, each in "D" ring binders, complete with index tabs for verification and approval of Consultant.
- .4 Submit copies of final TAB reports after approval by the Consultant, to be incorporated into the Maintenance and Operations Manual, as indicated in section 15010.

3.4 PROCEDURES

- .1 Tab shall be performed in accordance with the requirement of the Standard under which TAB agency is certified.
- .2 Start final TAB only when building is essentially completed, including:
 1. Installation of ceilings, doors, windows and other construction affecting TAB.
 2. Application of sealing, caulking and weather-stripping.
 3. Normal operation of mechanical systems affecting TAB.
- .3 General: During TAB all related system components shall be in full operation. Fan and pump rotation, motor loads and equipment vibration shall be checked and corrected as necessary before proceeding with TAB. Set controls and/or block off parts of distribution systems to simulate design operation of variable volume air or water systems for test and balance work.

3.5 AIR BALANCE AND EQUIPMENT TEST

- .1 Include all air handling units, fans, terminal units, fan coil units, room diffusers/outlets/inlets, as applicable to this project.
- .2 Adjust fan speeds to provide design air flow.
- .3 Test and balance systems in all specified modes of operation, including variable volume, economizer, and fire emergency modes. Verify that dampers and other controls function properly.
- .4 Parameters to be measured:
 1. Air flow.
 2. Air velocity.
 3. Static pressure.
 4. Velocity pressure.
 5. Temperature.
 - a. Wet bulb.
 - b. Dry bulb.
 6. Cross-sectional area.
 7. Fan's RPM.
 8. Electrical power.
 - a. Voltage.
 - b. Current draw.
- .5 Locations of measurements:
 1. Inlet and outlet of each:
 - a. Fan.
 - b. Coil.
 - c. Filter.
 - d. Balancing damper.
 - e. Other auxiliary equipment.
 2. Main ducts.
 3. Main branch ducts.
 4. Sub-branch ducts.
 5. Each supply, exhaust, and return air inlet and outlet.
 6. Before and after the silencers.

3.6 WATER BALANCE AND EQUIPMENT TEST:

- .1 Include all circulating pumps, heat exchangers, boilers, coils, as applicable to this project.
- .2 Adjust flow rates for equipment to the values indicated on the drawings and schedules. Set balancing valves and circuit setters to the values on indicated on the equipment schedules

- .3 Record final measurements for hydronic equipment on performance data sheets. Include entering and leaving water temperatures for heating and cooling coils, and for heat exchangers. Include entering and leaving air temperatures (DB/WB for cooling coils) for air handling units and reheat coils. Make air and water temperature measurements at the same time.
- .4 Parameters to be measured
 - .1 Water/Glycol Flow (as applicable to the project)
 - .2 Pressure.
 - .3 Temperature.
 - .4 Specific gravity.
 - .5 Pumps RPM
 - .6 Electrical power:
 - .1 Voltage
 - .2 Current draw.
- .5 Locations of Measurements
 - .1 Inlet and outlet of each
 - .1 Balancing valve.
 - .2 Automatic control valves

3.7 VERIFICATION

- .1 Reported measurements shall be subject to verification by Consultant. Provide instrumentation and manpower to verify results of up to 30 % of all reported measurements. Number and location of verified measurements to be at discretion of Consultant.
- .2 Bear costs to repeat TAB, as required, to satisfaction of Consultant.

3.8 MARKING OF SETTINGS

- .1 Following approval of TAB final Report, the setting of all HVAC adjustment devices including balancing valves, splitters and dampers shall be permanently marked by the TAB Specialist so that adjustment can be restored if disturbed at any time. Style and colors used for markings shall be coordinated with the Consultant.

3.9 IDENTIFICATION OF TEST PORTS

- .1 The TAB Specialist shall permanently and legibly identify the location points of duct test ports. If the ductwork has exterior insulation, the identification shall be made on the exterior side of the insulation. All penetrations through ductwork and ductwork insulation shall be sealed to prevent air leaks and maintain integrity of vapor barrier.

END OF SECTION

PART 1 GENERAL

1.1 GENERAL

- .1 Conform to Sections of Division 1 as applicable.
- .2 Conform to Section 15010, Mechanical General Requirements, as applicable.

1.2 RELATED SECTIONS

- .1 Conform to Section 16010 - Electrical General Requirements.
- .2 Installation of inserts, sleeves and anchors supplied by this Section: Section 04200, Masonry.

1.3 REFERENCES

ANSI B31.1 to B31.9 (inclusive)	Piping
CAN/CGSB-1.40-97	Primer, Structural Steel, Oil Alkyd Type
CSA B51-03	Boiler, Pressure Vessel, and Pressure Piping Code
CSA B52-99	Mechanical Refrigeration Code
CAN/CSA-G40.20/G40.21-98	General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel
CAN/CSA-S16-01	Limit States Design of Steel Structures
CSA W47.1-92(R2001)	Certification of Companies for Fusion Welding of Steel Structures
CAN/CSA W48-01	Filler Metals and Allied Materials for Metal Arc Welding.
CSA W59-M1989 (R2001)	Welded Steel Construction (Metal Arc Welding)
CAN/CSA W117.2-01	Safety in Welding, Cutting and Allied Processes

1.4 SUBMITTALS

- .1 **Shop Drawings:** Prepare and submit shop drawings for equipment covered by this Section including upper, middle and pipe attachments, riser clamps, shields and saddles, and sway braces.

PART 2 PRODUCTS

2.1 MATERIALS

- .1 **Welding Studs:**
 - Graham
 - Omark
 - Nelson
- .2 **Concrete Inserts and Anchors:**

- Readhead by ITW
- SSS by Star
- Parabolt by USM
- Kwik-Bolt by Hilti

.3 Beam Clamps:

- Grinnell
- Myatt
- Hilti

.4 Concrete Grout:

- Sikagrout 212 by Sika Canada Inc.
- Embeco 636 Grout by Master Builders
- Sealtight V-3 Grout by W.R. Meadows

.5 Pipe Hangers:

- Grinnell
- Myatt
- Hilti

.6 Zinc-Rich Paint:

- Galvafruid by W.R. Meadows

.7 Primer:

- CAN/CGSB-1.40-M

PART 3 EXECUTION

3.1 GENERAL CONSTRUCTION REQUIREMENTS

.1 Attachment to Building Construction

1. Use welding studs of size not larger than 10 mm (3/8") for attaching miscellaneous materials and equipment to building steel. If weight of materials or equipment require bolts or studs larger than 10 mm (3/8") diameter use steel clips or brackets, secured to building steel by welding or bolting method of attachment as approved by Consultant.
2. Use self-drilling expansion type concrete inserts for securing miscellaneous equipment and materials to masonry or concrete construction already in place, of sufficient number and size to prevent concrete from breaking away. Use of powder or power

actuated fasteners will not be allowed unless prior written approval is obtained from Consultant.

3. Support rods for any suspended item must not be attached to or extended through steel pan type roofs or through concrete slab roofs.
4. Provide beam clamps of 2-bolt design and of such type that rod load is transmitted only concentrically to beam web centreline. Use of "C" and "I" beam side clamps and other similar items will not be allowed without written consent of Consultant.
5. Where roof or floor framing consists of open web or long span steel joists, ensure that hangers are located at or within 150 mm (6") of joist top or bottom chord panel points, otherwise provide additional structural steel as required where hanger spacing does not coincide with joist spacing. Design suspension assembly such that hanger load is transmitted only concentrically to supporting joist. Do not use "C" and "I" beam side clamps, brackets and other similar, without written consent of Consultant.
6. Locate secondary structural steel members between joists at or within 150 mm (6") of top or bottom chord panel points. Where secondary structural steel member cannot be located at or near joist panel point, provide additional diagonal structural steel web member(s) designed for applicable load to nearest panel point in opposite chord member. This condition may be waived if load to be suspended between panel points is not in excess of 45 kg (100 lbs). Diagonal hangers which will induce lateral stresses in chord member of joist will not be permitted. Submit shop drawings of suspension assembly indicating location of suspension or support points, max load at each suspension point, location and size of hangers, brackets and intermediate framing members when required, and also details of connection to building structure.

3.2 PIPING CONSTRUCTION METHODS

- .1 Unless specified otherwise herein, construct and install piping in accordance with ANSI Sections B31.1 to B31.9 as applicable to service, except that soldered joints will not be permitted in compressed air piping.
- .2 To avoid unnecessary cutting of masonry, provide inserts, sleeves and anchors to other trades for building in as Work proceeds. Arrange with other trades to leave openings, slots and chases to accommodate later installation of mechanical work.

3.3 PIPE HANGERS AND SUPPORTS

- .1 General
 1. Support or suspend piping with necessary hangers, structural supports and/or brackets as indicated on Drawings and/or as required, to prevent sagging, warping and vibration and to allow for movement due to expansion and contraction. Place hangers and supports close to fittings, valves and/or other heavy parts.

2. Do not allow loads of any nature to be transmitted through piping connections to equipment not specifically designed for such loads. Where flexible connections are not called for at connections to equipment, support pipe by stands attached to both pipe and supporting structure so that force in any direction is not transmitted to equipment.
 3. Provide suitably dampened spring hangers for first 3 supports from equipment connection on piping subject to excessive movement or shock from any source, thermal expansion and contraction, selected in accordance with ANSI B31.1. Where it is evident that no undue loads will be transmitted to equipment by system concerned, i.e. small bore connections to comparatively large equipment, cold service piping not subject to shock, etc., then spring hangers may be omitted and standard hangers used.
 4. Use trapeze type hangers where pipes are grouped together, unless specifically indicated otherwise on Drawings. Suspend horizontal member by adjustable rods with locking feature for maintaining level and slope. Space trapeze type hangers based on closest interval required by any pipe supported thereon. Provide any auxiliary steel required to support trapeze between building steel.
 5. Do not hang any pipe from another pipe unless specifically indicated on Drawings.
- .2 Saddles and Roller Supports
1. Provide saddles at roller supports for piping carrying liquids at 10.5°C (51°F) or higher. Weld saddles to black or galvanized steel piping. Refinish galvanized surfaces destroyed by welding with zinc rich paint.
- .3 Hangers
1. For insulated piping up to NPS 4 carrying liquids at temperatures 10.5°C (51°F) and higher, use standard weight clevis hangers with level adjustment and locknut.
 2. For insulated lines of NPS 4 diameter and larger carrying liquids at temperatures 10.5°C (51°F) or higher, use adjustable roller type hangers with locknuts, and rollers of sufficient width to clear outside diameter of insulation on piping. Support rollers at both ends, either by yoke, swivel type hanger or by 2 adjustable rods with locknuts.
 3. For insulated piping carrying liquids at temperature of 10°C (50°F) or less, use elongated clevis type hangers, with clevis of sufficient width to fit over insulation bearing plate.
 4. Provide insulation protection bearing plates at hangers and supports for piping carrying liquids at temperature of 10°C (50°F) or less. Install temporary spacers between plate and pipe equal to thickness of insulation specified. (Refer to Section 15081, Piping Insulation).
 5. Bearing plates may be either shop fabricated, or manufactured plates of size required to properly fit outside diameter of pipe insulation.

6. Fabricate bearing plates conforming to following table for various pipe sizes:

Pipe Size (NPS)	Length of Thickness of:	
	Plate - mm (in)	Plate - mm (ga)
1/2 thr. 1-1/2	130 (5)	1.2 (18)
2	150 (6)	0.52 (16)
2-1/2	200 (8)	1.52 (16)
3	230 (9)	1.52 (16)
4 and up	250 (10)	1.52 (16)

7. Form bearing plates to outside diameter of adjoining pipe insulation and extend plate up to horizontal centre line of pipe.
8. For non-insulated piping use clevis type of wrought steel construction with adjustable rod, level locking feature and backnuts.
9. For copper tubing provide copper coated hangers. Regulations of some municipalities require that copper tubing be taped with plastic tape at hanger location, or hanger be provided with plastic insert. Meet these requirements when required, in which case copper coating may be omitted on hanger.
10. Attach hanger rods to building structure by means of malleable iron beam clamps, concrete inserts, and/or approved anchors as hereinbefore specified.

.4 Hanger Spacing

1. For horizontal runs of plumbing and drainage piping comply with hanger spacing requirements of OBC.
2. For horizontal runs of black or galvanized steel pipe, other than for plumbing service, do not exceed max distances between supports and with minimum diameter rods as follows:

Pipe Size (NPS)	Distance - m (ft)	Diameter of Rod - mm (in)
Up thru 1-1/4	1.8 (6)	10 (3/8)
1-1/2	1.8 (6)	10 (3/8)
2	3.05 (10)	10 (3/8)
2-1/2 & 3	3.66 (12)	12 (1/2)
4	4.27 (14)	16 (5/8)
6	5.18 (17)	19 (3/4)
8	5.79 (19)	22 (7/8)
10 & 12	6.71 (22)	22 (7/8)

3. Provide additional hangers in locations where there are concentrated loads such as valves, specialties and other such items.
4. For horizontal runs of copper tubing for services other than plumbing, do not exceed 1.8 m (6 ft) between hangers for lines up to and including NPS 3/4 and 2.4 m (8 ft) for lines of NPS 1 and larger.

5. For horizontal runs of piping fabricated of PVC, use hanger spacing as recommended by the manufacturer.

.5 Vertical Piping Supports

1. Support vertical plumbing and drainage piping as required by OBC, unless more stringent requirements are specified herein.
2. Support cast iron soil pipe at every floor and other piping at every other floor unless otherwise required by expansion conditions or otherwise specified.
3. Support bottom of riser with base fitting set on concrete pier or by hanger located at top of riser pipe as close to riser as possible.
4. For supports at intermediate floors, use Grinnell Fig. 261 or approved equal steel extension pipe clamp, bolted securely to pipe. Rest ends of clamp on pipe sleeve or on floor.
5. Provide lateral stability of vertical piping by fabricated brackets or malleable iron, extension type split hangers. Run vertical piping at columns in column webs, on either or both sides of column, unless otherwise directed.

.6 Anchors and Guides

1. Supply and install anchors where indicated on Drawings and/or as required to maintain permanent location of pipe lines. Construct anchors for steel or galvanized pipe of approved steel straps and/or rods and for anchoring copper lines use copper plated anchors or provide insulation bands between tubing and clamps if steel straps or rods are used. Install anchors and guides in approved manner.
2. Acceptable Materials: Grinnell #256 or Myatt.

3.4 MISCELLANEOUS STEEL

.1 General

1. Supply and install miscellaneous structural supports, platforms and braces as may be required to hang or support piping unless Drawings or other Sections of Specifications state otherwise.
2. Submit detailed shop drawings to structural engineer for review before commencing fabrication.

.2 Materials and Fabrication

1. Conform to CAN/CSA-S16 for materials, design of details, and execution of work.

2. Conform to CAN/CSA-G40.20/G40.21, grade 300W for structural shapes, plates, and other similar items.
 3. Use welded construction wherever practicable, with bolted joints allowed for field assembly using high strength steel bolts. Chip welds to remove slag, and grind smooth.
 4. Conform to the latest issue of the following CSA Specifications:
 - a. CSA W47.1, for qualification of welders
 - b. CSA W48.1-M, for electrodes (only coated rods allowed)
 - c. CSA W59-M, for design of connections and workmanship
 - d. CSA W117.2, for safety
- .3 Painting & Cleaning
1. Touch up minor damage to finish on equipment with standard factory applied baked enamel finish. If, in Consultant's opinion, damage is too extensive to be remedied by touch up, replace damaged equipment.
 2. Clean steel by scraping, wire brushing or other effective means to remove base scale, rust, oil, dirt or other foreign matter.
 3. Apply one coat of zinc chromate iron oxide primer, conforming to CAN/CGSB-1.40-M to miscellaneous steel.
 4. In field, touch up bolt heads and nuts, previously unpainted connections and surfaces damaged during erection with primer as herein before specified.
 5. Give two coats of primer to surfaces which will be inaccessible after erection.
 6. Remove foreign matter from steelwork on completion of installation.
 7. With exception of prime painting of miscellaneous steel or any other specific requirements as specified above or under respective Sections of Division 15, or equipment otherwise factory painted, painting will be provided under Division 9, Finishes.

3.5 CONCRETE INSERTS

- .1 Install inserts required for attachment of hangers, either for suspension of piping or equipment.
- .2 For masonry or poured concrete construction use expansion type units. Insert into concrete after concrete has cured. Anchors or inserts installed by explosive means shall not be used.

END OF SECTION

PART 1 GENERAL

1.1 GENERAL

- .1 This section of the specification shall be read in conjunction with and be governed by the requirements of Section 15010 – Mechanical General Requirements.

1.2 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 15010 – Mechanical General Requirements.
- .2 Submit for approval, manufacturer's catalogue literature related to installation and fabrication.

PART 2 PRODUCTS

2.1 GENERAL

- .1 Supply access doors to the relevant building trade to provide access in furred ceilings for the following:
 1. Servicing equipment.
 2. Access to plumbing cleanouts.
 3. Access to shut-off valves.
 4. Inspection of life safety equipment.
 5. Service of operating devices.
 6. All locations where periodic maintenance is required.
- .2 Access door sizes shall be as follows:
 1. Body Entry: 24” x 24” (600 x 600 mm)
 2. For Hand Entry: 18” x 18” (450 x 450 mm)
 3. For Viewing Only: 12” x 12” (300 x 300 mm)
- .3 All doors shall open 180 degrees and have rounded safety corners.
- .4 For fire rated ceilings or wall provide a fire rated access door that will match the fire rating of the wall that the access door is installed in. The Division 15 Contractor shall be responsible for reviewing the drawings and providing fire rated access doors where they are required.
- .5 Where body access is possible the access doors shall be provided with a releasing mechanism on both sides of the door.
- .6 Refer to Section 08310 of the specification.

2.2 RECESSED ACCESS DOOR FOR DRYWALL APPLICATIONS

- .1 Door shall be 16 gauge steel. Mounting frame shall be 14 gauge galvanized steel.
- .2 Door shall be provided with a 25 mm (1") recess or 14 mm (5/8") to suit the thickness of the drywall ceiling.
- .3 The frame shall be provided with a galvanized steel drywall taping bead on all sides.
- .4 The hinge shall be a concealed pivoting rod.
- .5 The latch shall be a flush to the surface, screwdriver operated cam latch.
- .6 The steel finish shall be 5 stage iron phosphate preparation with prime coat of grey baked enamel.
- .7 Standard of Acceptance: Acudor DW-5015, Mifab, Zurn, Watrous, Williams Brothers.

2.3 RECESSED ACCESS DOOR FOR PLASTER APPLICATIONS

- .1 Door shall be 16 gauge steel. Mounting frame shall be 14 gauge galvanized steel.
- .2 Door shall be provided with a 14 mm (5/8") recess and shall be lined with self-furring galvanized lath.
- .3 The frame shall be provided an expansion casing bead with 75 mm (3") wide galvanized lath, recessed 20 mm (3/4") to receive plaster.
- .4 The hinge shall be a concealed pivoting rod.
- .5 The latch shall be a flush to the surface, screwdriver operated cam latch.
- .6 The steel finish shall be 5 stage iron phosphate preparation with prime coat of grey baked enamel.
- .7 Standard of Acceptance: Acudor AP-5010, Mifab, Zurn, Watrous, Williams Brothers.

2.4 FLUSH ACCESS DOORS FOR TILED WALL APPLICATIONS

- .1 For doors 400 x 400 mm (16" x 16") and smaller the door shall be 16 gauge with 18 gauge mounting frame.
- .2 For doors over 400 x 400 mm (16" x 16") the door shall be 14 gauge with 16 gauge mounting frame.
- .3 Door shall be flush to frame with rounded safety corners.
- .4 The frame shall be one piece welded to the mounting frame.

- .5 The hinge shall be a continuous concealed hinge.
- .6 The latch shall be a stainless steel screwdriver cam latch.
- .7 The finish shall be type 304 #4 satin polish stainless steel.
- .8 Standard of Acceptance: Acudor UF-5000, Mifab, Zurn, Watrous, Williams Brothers.

2.5 FIRE RATED ACCESS DOORS

- .1 Door shall be constructed of 20 gauge steel with a 16 gauge mounting frame.
- .2 Door shall be filled with 50 mm (2") thick fire rated insulation.
- .3 The door frame shall be provided with a 25 mm (1") wide flange and mounting frame to have anchor straps.
- .4 The hinge shall be concealed and shall be provided with a spring closer.
- .5 Door shall be UL/ULC rated for 1 ½ hour "B" label with 250 degree F temp rise in 30 minutes.
- .6 The latch shall be a universal self-latching bolt, operated by either a knurled knob.
- .7 The steel finish shall be 5 stage iron phosphate prepared with a prime coat of grey baked enamel.
- .8 Door shall be provided with an interior latch release.
- .9 For drywall applications, provide a galvanized steel drywall taping bead flange.
- .10 Standard of Acceptance: Acudor FB-5060, Mifab, Zurn, Watrous, Williams Brothers.

2.6 FIRE RATED ACCESS DOOR WITH INSIDE LATCH RELEASE

- .1 Door shall be constructed of 16 gauge steel with a 16 gauge mounting frame.
- .2 Door shall be flush to frame with reinforced edges.
- .3 The door frame shall be provided with a 25 mm (1") wide flange and shall be provided with anchor straps.
- .4 The hinge shall be concealed and shall be provided with a spring closer.
- .5 The door shall be UL/ULC rated for 1 ½ hour "B" label or 2 hour "B" label as required where temperature rise is not a factor.
- .6 The latch shall be a universal self-latching bolt, operated by either a knurled knob.

- .7 The steel finish shall be 5 stage iron phosphate prepared with a prime coat of grey baked enamel.
- .8 Door shall be provided with an interior latch release.
- .9 For drywall applications provide a galvanized steel drywall taping bead flange.
- .10 Standard of Acceptance: Acudor FB-5060, Mifab, Zurn, Watrous, Williams Brothers.

2.7 VALVE BOX – SURFACE MOUNT

- .1 Door shall be stainless steel in public areas and steel in mechanical rooms and service areas.
- .2 Door and box shall be 16 gauge steel.
- .3 The door shall overlap the box, providing a tight and secure fit.
- .4 The box shall be fully enclosed, attached to the door.
- .5 The hinge shall be a continuous piano hinge.
- .6 The door shall be provided with a cylinder lock and key.
- .7 For steel doors the finish shall be 5 stage iron phosphate preparation with prime coat of grey baked enamel.
- .8 Stainless steel doors shall be #4 satin finish.
- .9 Standard of Acceptance: Acudor ASVB, Mifab, Zurn, Watrous, Williams Brothers.

2.8 VALVE BOX – RECESSED

- .1 Door shall be stainless steel in public areas and steel in mechanical rooms and service areas.
- .2 Door and box shall be 16 gauge steel.
- .3 The door shall be flush to the frame with rounded safety corners.
- .4 The box shall be fully enclosed, completely attached to the frame.
- .5 The hinge shall be a continuous concealed hinge.
- .6 The door shall be provided with a cylinder lock and key.
- .7 For steel doors the finish shall be 5 stage iron phosphate preparation with prime coat of grey baked enamel.

- .8 Stainless steel doors shall be #4 satin finish.
- .9 Standard of Acceptance: Acudor ARVB, Mifab, Zurn, Watrous, Williams Brothers.

PART 3 EXECUTION

3.1 INSTALLATION

- .1 On some drawings, access door locations have been indicated for coordination. The drawings do not show all access doors required.
- .2 The Division 15 Contractor shall provide a set of drawings showing locations and types of all access doors located in public areas to the Consultant for approval, prior to commencing the installation of any piping or ductwork within these areas.
- .3 Access doors shall be turned over to the building trade that is responsible for finishing the wall or ceiling where the access door is required.
- .4 The Division 15 Contractor shall be responsible for providing the access doors required to be installed in ductwork. Refer to section 15820 for requirements.

END OF SECTION

PART 1 GENERAL

1.1 GENERAL

- .1 This section includes:
 - 1. Valve tags.
 - 2. Pipe Markers/Arrow Tape above ground.
 - 3. Underground Piping Warning Tape.
 - 4. Mechanical Equipment and HVAC Controls Identification.
 - 5. Safety Signs.
 - 6. Isolation Valves Numbering.

1.2 DEFINITIONS

- .1 Exposed Areas
 - 1. Finished areas and other areas used by personnel in normal use of building, such as equipment rooms and storage rooms.
- .2 Concealed Areas
 - 1. Duct or pipe tunnels, duct or pipe chases, spaces above accessible ceilings, and crawl spaces.

PART 2 PRODUCTS

2.1 STANDARD OF ACCEPTANCE

- .1 W. H. Brady Co. catalogue numbers are used as a basis of identification.
- .2 Stock catalogue numbers are listed in these specifications. Subcontractor is responsible to review schedules and provide required markers. In some instances, "non-stock" markers (special) may be required.

2.2 MANUFACTURER'S NAMEPLATES

- .1 Manufacturer's nameplates:
 - 1. Provide metal nameplate on each piece of equipment, mechanically fastened with raised or recessed letters.
 - 2. Provide Underwriters' Laboratories or CSA registration plates, as required by respective agency.
 - 3. Manufacturers nameplate to indicate size, equipment model, manufacturer's name, serial number, voltage, cycle, phase and power of motors.

4. Locate nameplates so that they are easily read. Do not insulate or paint over plates.

2.3 VALVE TAGS

- .1 Metal Tags: Brass or aluminium with stamped or engraved letters; tag sizes minimum 2" (round, square, or rectangle) with smooth edges. Thickness 19 gauge (0.040") minimum.
- .2 Beaded Chain: Size 6, brass or aluminium, 4-1/2" long with locking link.

2.4 PIPE MARKERS/ARROW TAPE ABOVE GROUND

- .1 Colour: Conform to ANSI A13.1.
- .2 Self-Sticking Pipe Markers/Arrow Tape: Material B-946, flexible, vinyl film tape with pressure sensitive permanent adhesive backing and printed markings.
- .3 Suitable for indoor/outdoor application.
- .4 Temperature range: Minus 40 degrees to 180 degrees F.

2.5 UNDERGROUND PIPING WARNING TAPE

- .1 Tracer wire and test station(s) required when burying cast iron, ductile iron, or non-metallic piping.
- .2 Tracer Wire: #10AWG THHN/THWN, yellow, solid copper.
- .3 Tracer Wire Test Station: C.P. Test Services. Test Station: Plastic Pipe, cast iron cover, 2-point terminal box.

2.6 CONTROLS IDENTIFICATION

- .1 Refer to Section 15900.

2.7 EQUIPMENT IDENTIFICATION

- .1 Labelling shall be furnished and installed by the contractor.
- .2 Engraved signs shall be dark letters on light background.
- .3 Identify mechanical equipment and HVAC controls, e.g., air handling units, pumps, heat transfer equipment, water treatment devices, controls instruments, stationary tanks/containers, and similar items, with nameplates or tags.
- .4 Provide engraved nameplates made of rigid plastic laminate in which coloured top and bottom layers of the material are thermoset with a contrasting colour core. Minimum thickness 0.062".

- .5 Size: Minimum 1" x 3".
- .6 Material Colour: White background/black lettering.
- .7 Manufacturer: Brady, No. B-1.
- .8 Provide lettering as follows:
 - 1. Size: 10 point minimum.
 - 2. Spacing: 1/4" from top, 1/8" from bottom, 1/16" between lines.
 - 3. Provide nameplate with component nomenclature as noted in the Equipment Schedules. Coordinate with the controls sub-contractor.
- .9 As a minimum, identify the system, e.g., HVAC (heating, ventilating, and air conditioning), the component, e.g., FGF (furnace, gas fired), and the sequence number.

2.8 SAFETY SIGNS

- .1 Colours associated with specific words such as "Danger," "Warning," "Caution," or "Notice" shall conform to ANSI Z35.1.

PART 3 EXECUTION

3.1 PREPARATION

- .1 Degrease and clean surfaces to receive adhesive for identification materials.

3.2 INSTALLATION

- .1 Valve Tags:
 - 1. Install with brass beaded chain.
 - 2. Steel stamp or engrave valve tag in accordance with schedule herein.
 - 3. Letter style block, 1/4" height minimum.
 - 4. Tag all valves in concealed or exposed areas except isolation and by-pass valves installed adjacent to the equipment they serve.
 - 5. Provide typewritten letter size list of applied tags and location. Frame under glass and hang where directed.
- .2 Pipe Markers above Ground:
 - 1. Install in accordance with manufacturer's instructions.
 - 2. Seal markers with clear lacquer.
 - 3. Identify piping in exposed or concealed areas in accordance with schedule herein.
 - 4. Pipe marker consists of pipe contents identification with flow direction arrow tape. Provide consistent colour scheme, unless otherwise noted.
 - 5. Wrap arrow tape completely around pipe at both ends of pipe markers.
 - 6. Install in clear view and align with axis of piping.

7. Label piping at intervals of not more than 20 feet on horizontal and vertical runs, at each branch connection, and where pipe penetrates walls, ceilings and floors (both sides).
8. Size of label depends on outside diameter (OD) of pipe. Pipe OD includes insulation or protective coating.
9. Minimum length of marker, including arrows:
 - a. 2" diameter pipe or smaller: 8"
 - b. 2" to 8": 12"
 - c. 8" to 10" 24"
 - d. Over 10" 32"

.3 Safety Signs

1. Install in clear view.

END OF SECTION

PART 1 GENERAL

1.1 GENERAL

- .1 This section of the specification shall be read in conjunction with and be governed by the requirements of Section 15010.

1.2 QUALITY ASSURANCE

- .1 Comply with OBC and NFPA 90A requirements, particularly paragraphs pertaining to the maximum flame spread index (currently set at 25) and maximum smoke development index (currently set at 50).
- .2 All materials shall be compatible and suitable for service temperature and shall not contribute to corrosion or otherwise attack surface to which applied in either the wet or dry state.
- .3 Every package or standard container of insulation or accessories delivered to the job site for use must have a manufacturer's stamp or label giving the name of the manufacturer and description of the material.

1.3 SUBMITTALS

- .1 Submit Shop Drawings and Product Data in accordance with Section 15010.
- .2 Provide the following:
 1. Insulation materials: Specify each type used and state surface burning characteristics.
 2. Insulation facings and jackets: Each type used. Make it clear that white finish will be furnished for exposed ductwork, casings and equipment.
 3. Insulation accessory materials: Each type used.
 4. Manufacturer's installation and fitting fabrication instructions for flexible unicellular insulation.

1.4 STORAGE AND HANDLING OF MATERIAL

- .1 Store materials in clean and dry environment, pipe covering jackets shall be clean and unmarred. Place adhesives in original containers. Maintain ambient temperatures and conditions as required by printed instructions of manufacturers of adhesives, mastics and finishing cements.

1.5 STANDARDS OF ACCEPTANCE

- .1 Knauf Fiber Glass

- .2 Owens/Corning Fiberglass
- .3 Armstrong
- .4 Johns Manville
- .5 Rockwool Manufacturing

PART 2 PRODUCTS

2.1 GENERAL

- .1 K-factors (thermal conductivity) shown are expressed in BTU•in/hr•ft²•F.

2.2 FIBERGLASS PIPE INSULATION

- .1 Insulation
 - 1. Rigid molded in compliance with ASTM C547, Class 1, minimum density 3.5 pounds/cubic foot, K-factor of approximately 0.24 at 75°F, suitable for temperatures from -20°F to 450°F.
- .2 Vapor Barrier
 - 1. Factory applied vapor barrier all-service type with self-sealing lap and butt strips.
- .3 Valves and Fitting Covers
 - 1. Pre-molded PVC covers with fiber glass insert. Manufacturers: Proto Corp., Ceelco.
- .4 Applications
 - 1. All domestic cold water piping.
 - 2. All hot water heating piping.
 - 3. All domestic hot water supply and recirculation piping.

2.3 INSULATION THICKNESS

PIPE INSULATION THICKNESS					
Service	Fluid Design Operating Temperature Range (°F)	Nominal Pipe Size Insulation Thickness			
		Runouts Up To 2	1 & Less	1-3/4 To 2	2-1/2 To 4
Dom. Hot Water & Recirc. Piping & Tempered Water	Up to 140°F (60°C)	1" (25mm)	1" (25mm)	1" (25mm)	1.5" (40mm)
Hot Water Heating (all sizes)		1" (25mm)	1" (25mm)	1" (25mm)	1" (25mm)
Domestic Cold Water	40°F to 50°F	1" (25mm)	1" (25mm)	1" (25mm)	1" (25mm)

2.4 ADHESIVE, MASTIC, CEMENT

- .1 ASTM C449: Mineral fiber hydraulic setting thermal insulating and finishing cement.
- .2 Other: Insulation manufacturers' published recommendations.

2.5 MECHANICAL FASTENERS

- .1 Wire: 1.3 mm thick (18 gage) soft annealed galvanized or 1.9 mm (14 gage) copper clad steel or nickel copper alloy.
- .2 Bands: 20 mm (3/4 inch) nominal width, brass, galvanized steel, aluminum or stainless steel.

2.6 CANVAS JACKETING

- .1 Apply in concealed areas, compact, firm ULC listed heavy plain weave, cotton fabric at 220 g/m sq.

2.7 PVC JACKETING

- .1 Apply in exposed areas on piping with operating temperatures less than 180°F (80°C).
- .2 Piping: ULC listed PVC moulded type jacketing material, gloss white complying with 25 Flame Spread and 50 Smoke Developed ratings.
- .3 Fittings: ULC listed PVC, gloss white, 1-piece, pre-moulded fittings complying with 25 Flame Spread and 50 Smoke Developed ratings.

- .4 PVC Application: strictly in accordance with the requirements of Authorities having jurisdiction.
- .5 Ultraviolet resistant.
- .6 Fastenings: To manufacturer's standard(s).

2.8 METAL JACKETING

- .1 At all locations where the pipe is located outdoors or in heavy abuse areas, use metal jacketing to protect piping or ductwork insulation.
- .2 Jacketing: Aluminum, 0.016" thick, embossed surface with factory bonded moisture barrier.
- .3 Valve and Fitting Insulation Covers: Fabricate from same material as jacketing or use prefabricated insulation covers made in two matching halves.
- .4 Metal Jacketing Bands: 0.5" wide, aluminum or stainless.

2.9 PROTECTION SADDLES AND SHIELDS

- .1 Provide factory engineered galvanized steel hanger shields on horizontal insulated pipe complying with MSS SP-58 and MSS SP-59 standards for gauge and length of saddle.

2.10 SADDLES (PIPING/TUBING UP TO 2 INCHES)

- .1 Use 180 degree saddle on systems utilizing teardrop type hangers.
- .2 Use 360 degree saddle on systems utilizing trapeze hangers or clamps.

2.11 INSERTS AND SHIELDS (PIPING/TUBING OVER 2 INCHES)

- .1 Use 360 degree calcium silicate insert with a 180 degree shield on systems utilizing clevis or teardrop type hangers.
- .2 Use 360 degree calcium silicate with a 360 degree shield on systems utilizing trapeze hangers or clamps.
- .3 The unit shall have an integral moisture barrier consisting of a tri-laminate All-Service Jacket equal and similar to the jacketing on the adjoining insulation.
- .4 Insert: Calcium silicate, minimum density 9 psi.

PART 3 EXECUTION

3.1 EXAMINATION

- .1 Verify that items to be insulated have been pressure tested and approved before applying insulation material.
- .2 Verify that surfaces are clean, foreign material removed, and dry.

3.2 INSTALLATION – GENERAL

- .1 Install materials in accordance with manufacturer's instructions.
- .2 Required pressure tests of piping joints and connections shall be completed and the work approved by the Consultant for application of insulation. Surface shall be clean and dry with all foreign materials, such as dirt, oil, loose scale and rust removed.
- .3 Except for specific exceptions, insulate entire specified equipment, piping (pipe, fittings, valves, accessories). Insulate each pipe and duct individually. Do not use scrap pieces of insulation where a full length section will fit.
- .4 Insulation materials shall be installed with smooth and even surfaces, with jackets and facings drawn tight and smoothly cemented down at all laps. Insulation shall be continuous through all sleeves and openings, except at fire dampers and duct heaters (NFPA 90A). Vapor retarders shall be continuous and uninterrupted throughout systems with operating temperature 16°C (60°F) and below. Lap and seal vapor barrier over ends and exposed edges of insulation. Anchors, supports and other metal projections through insulation on cold surfaces shall be insulated and vapor sealed for a minimum length of 150 mm (6”).
- .5 Install vapor stops at all insulation terminations on either side of valves, pumps and equipment and particularly in straight lengths of pipe insulation.
- .6 Insulation on hot piping and equipment shall be terminated square at items not to be insulated, such as access openings and nameplates. Cover all exposed raw insulation with white sealer or jacket material.
- .7 Protect all insulations outside of buildings with aluminum jacket using lock joint or other approved system for a continuous weather tight system. Access doors and other items requiring maintenance or access shall be removable and sealable.
- .8 Piping work not to be insulated:
 1. In hot piping: Unions, flexible connectors, control valves, PRVs, safety valves and discharge vent piping, vacuum breakers, thermostatic vent valves, exposed piping through floor for convectors and radiators. Insulate piping to within approximately 75 mm (3 inches) of uninsulated items.
- .9 Plumbing work not to be insulated:
 1. Piping and valves of fire protection system.
 2. Chromium plated brass piping.

3. Piping in pipe basement serving wall hydrants.
4. Small horizontal cold water branch runs in partitions to individual fixtures may be without insulation for maximum distance of 900 mm (3 feet).
- .10 Work shall be performed by qualified insulation journeymen.
- .11 Apply insulation and coverings on hot piping while surface is between 50 to 60°C.
- .12 Vapor barriers and insulation to be complete over full length of pipe or surface, without penetration for hangers, and without interruption at sleeves, pipe and fittings.
- .13 Do not insulate factory-insulated equipment.
- .14 Do not insulate nameplates.
- .15 Fit insulation tightly against surface to which it is applied.
- .16 For non-fire rated barriers (e.g., wall, floor, ceiling, or roof) continue insulation and vapor barrier through penetrations. For fire rated barriers, provide ULC/FM approved through penetration stop systems.
- .17 Weatherproof outdoor installations of piping or ductwork covered with aluminum jacket. Provide watershed lap joints and seal with mastic as required.
- .18 Do not install metal jacketing with raw edges; provide a safety edge.

3.3 INSTALLATION – PIPING

- .1 On exposed piping located in finished areas, locate cover seams in least visible area.
- .2 Provide continuous insulation through pipe hangers or supports. Do not notch insulation. Provide shields or saddles to prevent crushing insulation.
- .3 Where insulation terminates, taper to pipe and finish with insulating cement or acrylic mastic.
- .4 Cover insulated pipes located outdoors or in utility tunnels with aluminum jacket. Secure with aluminum bands and screws as required.
- .5 Tape circumferential joints of pipe insulation with 3” wide white vinyl tape.
- .6 Insulate fitting and valves where required with same material thickness as specified for adjacent pipe.
- .7 Insulate potable and non-potable cold water piping within walls, chases, or ceiling plenums where return air is present.

- .8 Insulate potable and non-potable cold water piping in equipment rooms.
- .9 Do not insulate unions, flanges and valves in potable or non-potable piping systems of 140°F or less, except for chilled water.
- .10 Vertical pipe over 3" diameter: use insulation supports welded or bolted to pipe directly above lowest pipe fitting. Thereafter locate on 12 feet centers and at each valve and flange.
- .11 Expansion joints: Terminate single layer and each layer of multiple layers in straight cut. Leave space of 1" between terminations. Pack void tightly with glass wool. Protect joints with aluminum sleeves.
- .12 Use factory fabricated, easily disassembled insulation, for valves, fittings and process equipment requiring periodic maintenance of parts and sub-assemblies listed or indicated.

END OF SECTION

1 General

1.1 DESCRIPTION

- .1 Water piping to connect HVAC equipment, including the following:
 - .1 Heating hot water.

1.2 SUBMITTALS

- .1 Submit in accordance with Section 15010, shop drawings, product data, and samples for the following:
 - .1 Pipe and equipment supports.
 - .2 Pipe and tubing, with specification, class or type, and schedule.
 - .3 Pipe fittings, including miscellaneous adapters and special fittings.
 - .4 Flanges, gaskets and bolting.
 - .5 Valves of all types.
 - .6 Strainers.
 - .7 Flexible connectors for water service.
 - .8 Pipe alignment guides.
 - .9 Expansion joints.
 - .10 Expansion compensators.

2 PRODUCTS

2.1 PIPE AND TUBING

- .1 Heating Hot Water:
 - .1 Steel: ASTM A53 Grade B, seamless or ERW, Schedule 40.
 - .2 Copper water tube option: ASTM B88, Type K or L, hard drawn. Soft drawn tubing, 20 mm (3/4 inch) and larger, may be used for runouts to floor mounted fan coil units or perimeter convectors

2.2 FITTINGS FOR STEEL PIPE

- .1 65 mm (2½ inches) and Larger: Welded or flanged joints.
 - .1 Butt welding fittings: ASME B16.9 with same wall thickness as connecting piping. Elbows shall be long radius type, unless otherwise noted.
 - .2 Welding flanges and bolting: ASME B16.5:
 - .3 Weld neck or slip on, plain face, with 6 mm (1/8 inch) thick full face neoprene gasket suitable for 104 degrees C (220 degrees F).

- .4 Flange bolting: Carbon steel machine bolts or studs and nuts, ASTM A307, Grade B.
- .2 50 mm (2 inches) and Smaller: Screwed or welded.
 - .1 Butt welding: ASME B16.9 with same wall thickness as connecting piping.
 - .2 Forged steel, socket welding or threaded: ASME B16.11.
 - .3 Screwed: 150 pound malleable iron, ASME B16.3. 125 pound cast iron, ASME B16.4, may be used in lieu of malleable iron. Bushing reduction of a single pipe size, or use of close nipples, is not acceptable.
 - .4 Unions: ASME B16.39.
 - .5 Welded Branch and Tap Connections: Forged steel weldolets, or branchlets and threadolets may be used for branch connections up to one pipe size smaller than the main. Forged steel half couplings, ASME B16.11 may be used for drain, vent and gage connections.

2.3 FITTINGS FOR COPPER TUBING

- .1 Solder Joint:
 - .1 Joints shall be made up in accordance with recommended practices of the materials applied. Apply 95/5 tin and antimony on all copper piping.
 - .2 Mechanically formed tee connection in water and drain piping: Form mechanically extracted collars in a continuous operation by drilling pilot hole and drawing out tube surface to form collar, having a height of not less than three times the thickness of tube wall. Adjustable collaring device shall insure proper tolerance and complete uniformity of the joint. Notch and dimple joining branch tube in a single process to provide free flow where the branch tube penetrates the fitting.
 - .3 Bronze Flanges and Flanged Fittings: ASME B16.24.

2.4 DIELECTRIC FITTINGS

- .1 Provide where copper tubing and ferrous metal pipe are joined.
 - .1 50 mm (2 inches) and Smaller: Threaded dielectric union, ASME B16.39.
 - .2 65 mm (2½ inches) and Larger: Flange union with dielectric gasket and bolt sleeves, ASME B16.42.
 - .3 Temperature Rating, 99 degrees C (210 degrees F).

2.5 SCREWED JOINTS

- .1 Pipe Thread: ANSI B1.20.

- .2 Lubricant or Sealant: Oil and graphite or other compound approved for the intended service.

2.6 VALVES

- .1 Asbestos packing is not acceptable.
- .2 All valves of the same type shall be products of a single manufacturer. Provide gate and globe valves with packing that can be replaced with the valve under full working pressure.
- .3 Provide chain operators for valves 100 mm (4 inches) and larger when the centerline is located 2400 mm (8 feet) or more above the floor or operating platform.
- .4 Standard of Acceptance: Crane, Jenkins, Toyo, Kitz.
- .5 Gate Valves:
 - .1 50 mm (2 inches) and smaller: MSS SP80, Bronze, 1034 kPa (150 lb.), wedge disc, rising stem, union bonnet.
 - .2 65 mm (2½ inches) and larger: Flanged, outside screw and yoke.
 - .3 MSS SP 70, iron body, bronze mounted, 861 kPa (125 psig) wedge disc.
- .6 Globe, Angle and Swing Check Valves:
 - .1 50 mm (2 inches) and smaller: MSS SP 80, bronze, 1034 kPa (150 lb.) Globe and angle valves shall be union bonnet with metal plug type disc.
 - .2 65 mm (2½ inches) and larger: 861 kPa (125 psig), flanged, iron body, bronze trim, MSS SP 85 for globe valves and MSS SP 71 for check valves.
 - .3 Non Slam or Silent Check Valve: Spring loaded double disc swing check or internally guided flat disc lift type check for bubble tight shut off. Provide where check valves are shown in chilled water and hot water piping.
 - .1 Body: Cast iron, ASTM A126, Class B, or steel, ASTM A216, Class WCB, or ductile iron, ASTM 536, flanged, grooved, or wafer type.
 - .2 Seat, disc and spring: 18 8 stainless steel, or bronze, ASTM B62. Seats may be elastomer material.
- .7 Butterfly Valves:
 - .1 May be used in lieu of gate valves. Provide stem extension to allow 50 mm (2 inches) of pipe insulation without interfering with valve operation.
 - .2 MSS SP 67, flange lug type (for end of line service) or grooved end rated 1205 kPa (175 psig) working pressure at 93 degrees C (200 degrees F).

- .3 Body: Cast iron, ASTM A126, Class B. Malleable iron, ASTM A47 electro-plated, or ductile iron, ASTM A536, Grade 65 45 12 electro-plated.
- .4 Trim: Bronze, aluminum bronze, or 300 series stainless steel disc, bronze bearings, 316 stainless steel shaft and manufacturer's recommended resilient seat. Resilient seat shall be field replaceable, and fully line the body to completely isolate the body from the product. A phosphate coated steel shaft or stem is acceptable, if the stem is completely isolated from the product.
- .5 Actuators: Field interchangeable. Valves for balancing service shall have adjustable memory stop to limit open position.
- .6 Valves 150 mm (6 inches) and smaller: Lever actuator with minimum of seven locking positions, except where chain wheel is required.
- .7 Valves 200 mm (8 inches) and larger: Enclosed worm gear with handwheel, and where required, chain wheel operator.
- .8 Ball Valves:
 - .1 Brass or bronze body with chrome-plated ball with full port and Teflon seat at 2760 kPa (400 psig) working pressure rating. Screwed or solder connections. Provide stem extension to allow operation without interfering with pipe insulation.
- .9 Water Flow Balancing Valves
 - .1 For flow regulation and shut off. Valves shall be line size rather than reduced to control valve size and be one of the following types.
 - .2 Butterfly valve as specified herein with memory stop.
 - .3 Eccentric plug valve: Iron body, bronze or nickel plated iron plug, bronze bearings, adjustable memory stop, operating lever, rated 861 kPa (125 psig) and 121 degrees C (250 degrees F).
- .10 Circuit Setter Valve
 - .1 A dual purpose flow balancing valve and adjustable flow meter, with bronze or cast iron body, calibrated position pointer, valved pressure taps or quick disconnects with integral check valves and preformed polyurethane insulating enclosure. Provide a readout kit including flow meter, readout probes, hoses, flow charts or calculator, and carrying case.
- .11 Automatic Balancing Control Valves
 - .1 Factory calibrated to maintain constant flow (plus or minus five percent) over system pressure fluctuations of at least 10 times the minimum required for control. Provide standard pressure taps and four sets of capacity charts. Valves shall be line size and be one of the following designs:

- .1 Gray iron (ASTM A126) or brass body rated 1205 kPa (175 psig) at 93 degrees C (200 degrees F), with stainless steel piston and spring.
- .2 Brass or ferrous body designed for 2067 kPa (300 psig) service at 121 degrees C (250 degrees F), with corrosion resistant, tamper proof, self cleaning piston/spring assembly that is easily removable for inspection or replacement.
- .3 Combination assemblies containing ball type shut off valves, unions, flow regulators, strainers with blowdown valves and pressure temperature ports shall be acceptable.

.2 Provide a readout kit including flow meter, probes, hoses, flow charts and carrying case.

.12 Manual Radiator/Convectur Valves

- .1 Brass, packless, with position indicator.

2.7 STRAINERS

- .1 Basket or Y Type. Tee type is acceptable for water service.
- .2 Screens: Bronze, monel metal or 18 8 stainless steel, free area not less than 2 1/2 times pipe area, with perforations as follows: 1.1 mm (0.045 inch) diameter perforations.
- .3 100 mm (4 inches) and larger: 3.2 mm (0.125 inch) diameter perforations.
- .4 Suction Diffusers: Specified in the HYDRONIC PUMPS section.

2.8 EXPANSION JOINTS

- .1 Factory built devices, inserted in the pipe lines, designed to absorb axial cyclical pipe movement which results from thermal expansion and contraction. This includes factory-built or field-fabricated guides located along the pipe lines to restrain lateral pipe motion and direct the axial pipe movement into the expansion joints.
- .2 Manufacturing Quality Assurance: Conform to Expansion Joints Manufacturers Association Standards.
- .3 Bellows Internally Pressurized Type:
 - .1 Multiple corrugations of Type 304 or Type A240-321 stainless steel.
 - .2 Internal stainless steel sleeve entire length of bellows.
 - .3 External cast iron equalizing rings for services exceeding 340 kPa (50 psig).
 - .4 Welded ends.
 - .5 Design shall conform to standards of EJMA and ASME B31.1.
 - .6 External tie rods designed to withstand pressure thrust force upon anchor failure if one or both anchors for the joint are at change in direction of pipeline.
 - .7 Integral external cover.

.4 Bellows Externally Pressurized Type:

- .1 Multiple corrugations of Type 304 stainless steel.
- .2 Internal and external guide integral with joint.
- .3 Design for external pressurization of bellows to eliminate squirm.
- .4 Welded ends.
- .5 Conform to the standards of EJMA and ASME B31.1.
- .6 Threaded connection at bottom, 25 mm (one inch) minimum, for drain or drip point.
- .7 Integral external cover and internal sleeve.

.5 Expansion Compensators:

- .1 Corrugated bellows, externally pressurized, stainless steel or bronze.
- .2 Internal guides and anti torque devices.
- .3 Threaded ends.
- .4 External shroud.
- .5 Conform to standards of EJMA.

.6 Expansion Joint Identification

- .1 Provide stamped brass or stainless steel nameplate on each expansion joint listing the manufacturer, the allowable movement, flow direction, design pressure and temperature, date of manufacture, and identifying the expansion joint by the identification number on the contract drawings.

.7 Guides

- .1 Provide factory-built guides along the pipe line to permit axial movement only and to restrain lateral and angular movement. Guides must be designed to withstand a minimum of 15 percent of the axial force which will be imposed on the expansion joints and anchors. Field-built guides may be used if detailed on the contract drawings.

2.9 GAGES, PRESSURE AND COMPOUND

- .1 ASME B40.100, Accuracy Grade 1A, (pressure, vacuum, or compound for air, oil or water), initial mid scale accuracy 1 percent of scale (Qualify grade), metal or phenolic case, 115 mm (4 1/2 inches) in diameter, 6 mm (1/4 inch) NPT bottom connection, white dial with black graduations and pointer, clear glass or acrylic plastic window, suitable for board mounting. Provide red "set hand" to indicate normal working pressure.
- .2 Provide brass lever handle union cock. Provide brass/bronze pressure snubber for gages in water service.
- .3 Range of Gages: Provide range equal to at least 130 percent of normal operating range.

2.10 PRESSURE/TEMPERATURE TEST PROVISIONS

- .1 Pete's Plug: 6 mm (1/4 inch) MPT by 75 mm (3 inches) long, brass body and cap, with retained

safety cap, nordel self closing valve cores, permanently installed in piping where shown, or in lieu of pressure gage test connections shown on the drawings.

- .2 Provide one each of the following test items to the Owner:
 - .1 6 mm (1/4 inch) FPT by 3 mm (1/8 inch) diameter stainless steel pressure gage adapter probe for extra long test plug. PETE'S 500 XL is an example.
 - .2 90 mm (3 1/2 inch) diameter, one percent accuracy, compound gage, , —100 kPa (30 inches) Hg to 700 kPa (100 psig) range.
 - .3 0 - 104 degrees C (220 degrees F) pocket thermometer one half degree accuracy, 25 mm (one inch) dial, 125 mm (5 inch) long stainless steel stem, plastic case.

2.11 THERMOMETERS

- .1 Mercury or organic liquid filled type, red or blue column, clear plastic window, with 150 mm (6 inch) brass stem, straight, fixed or adjustable angle as required for each in reading.
- .2 Case: Chrome plated brass or aluminum with enamel finish.
- .3 Scale: Not less than 225 mm (9 inches), range as described below, two degree graduations.
- .4 Separable Socket (Well): Brass, extension neck type to clear pipe insulation.
- .5 Scale ranges may be slightly greater than shown to meet manufacturer's standard. Required ranges in degrees C (F):

2.12 VACUUM AND AIR RELIEF VALVES

- .1 Vacuum and air relief valves shall be iron body with bronze trim, and stainless steel floats.

3 EXECUTION

3.1 GENERAL

- .1 The drawings show the general arrangement of pipe and equipment but do not show all required fittings and offsets that may be necessary to connect pipes to equipment, fan-coils, coils, radiators, etc., and to coordinate with other trades. Provide all necessary fittings, offsets and pipe runs based on field measurements and at no additional cost to the government. Coordinate with other trades for space available and relative location of HVAC equipment and accessories to be connected on ceiling grid. Pipe location on the drawings shall be altered by contractor where necessary to avoid interferences and clearance difficulties.
- .2 Store materials to avoid excessive exposure to weather or foreign materials. Keep inside of piping relatively clean during installation and protect open ends when work is not in progress.
- .3 Support piping securely.

- .4 Install piping generally parallel to walls and column center lines, unless shown otherwise on the drawings. Space piping, including insulation, to provide 25 mm (one inch) minimum clearance between adjacent piping or other surface. Unless shown otherwise, slope drain piping down in the direction of flow not less than 25 mm (one inch) in 12 m (40 feet). Provide eccentric reducers to keep bottom of sloped piping flat.
- .5 Locate and orient valves to permit proper operation and access for maintenance of packing, seat and disc. Generally locate valve stems in overhead piping in horizontal position. Provide a union adjacent to one end of all threaded end valves. Control valves usually require reducers to connect to pipe sizes shown on the drawing. Install butterfly valves with the valve open as recommended by the manufacturer to prevent binding of the disc in the seat.
- .6 Offset equipment connections to allow valving off for maintenance and repair with minimal removal of piping. Provide flexibility in equipment connections and branch line take offs with 3 elbow swing joints where noted on the drawings.
- .7 Tee water piping runouts or branches into the side of mains or other branches. Avoid bull-head tees, which are two return lines entering opposite ends of a tee and exiting out the common side.
- .8 Provide manual air vent at all piping system high points and drain valves at all low points.
- .9 Connect piping to equipment as shown on the drawings. Install components furnished by others such as:
 - .1 Water treatment pot feeders and condenser water treatment systems.
 - .2 Flow elements (orifice unions), control valve bodies, flow switches, pressure taps with valve, and wells for sensors.
- .10 Thermometer Wells: In pipes 65 mm (2 1/2 inches) and smaller increase the pipe size to provide free area equal to the upstream pipe area.
- .11 Firestopping: Fill openings around uninsulated piping penetrating floors or fire walls, with firestop material.
- .12 Where copper piping is connected to steel piping, provide dielectric connections.

3.2 PIPE JOINTS

- .1 Welded: Beveling, spacing and other details shall conform to ASME B31.1 and AWS B2.1.
- .2 Screwed: Threads shall conform to ASME B1.20; joint compound shall be applied to male threads only and joints made up so no more than three threads show. Coat exposed threads on steel pipe with joint compound, or red lead paint for corrosion protection.
- .3 Mechanical Joint: Pipe grooving shall be in accordance with joint manufacturer's specifications. Lubricate gasket exterior including lips, pipe ends and housing interiors to prevent pinching the gasket during installation. Lubricant shall be as recommended by coupling manufacturer.

- .4 125 Pound Cast Iron Flange (Plain Face): Mating flange shall have raised face, if any, removed to avoid overstressing the cast iron flange.
- .5 Solvent Welded Joints: As recommended by the manufacturer.

3.3 EXPANSION JOINTS (BELLOWS AND SLIP TYPE)

- .1 Anchors and Guides: Provide type, quantity and spacing as recommended by manufacturer of expansion joint and as shown.
- .2 Cold Set: Provide setting of joint travel at installation as recommended by the manufacturer for the ambient temperature during the installation.
- .3 Preparation for Service: Remove all apparatus provided to restrain joint during shipping or installation. Representative of manufacturer shall visit the site and verify that installation is proper.
- .4 Access: Expansion joints must be located in readily accessible space. Locate joints to permit access without removing piping or other devices. Allow clear space to permit replacement of joints and to permit access to devices for inspection of all surfaces and for adding packing.

3.4 LEAK TESTING

- .1 Inspect all joints and connections for leaks and workmanship and make corrections as necessary, to the satisfaction of the Consultant. Tests may be either of those below, or a combination, as approved by the Owner.
 - .1 An operating test at design pressure, and for hot systems, design maximum temperature. The design maximum pressure would usually be the static head, or expansion tank maximum pressure, plus pump head
 - .2 A hydrostatic test at 1.5 times design pressure.

3.5 FLUSHING AND CLEANING PIPING SYSTEMS

- .1 Water Piping: Clean systems as recommended by the suppliers of chemicals specified.
- .2 Initial flushing:
 - .1 Remove loose dirt, mill scale, metal chips, weld beads, rust, and like deleterious substances without damage to any system component. Provide temporary piping or hose to bypass coils, control valves, exchangers and other factory cleaned equipment unless acceptable means of protection are provided and subsequent inspection of hide out areas takes place. Isolate or protect clean system components, including pumps and pressure vessels, and remove any component which may be damaged. Open all valves, drains, vents and strainers at all system levels. Remove plugs, caps, spool pieces, and components to facilitate early debris discharge from system. Sectionalize system to obtain debris carrying velocity of 1.8 m/S (6 feet per second), if possible. Connect dead end supply and return headers as

necessary. Flush bottoms of risers. Install temporary strainers where necessary to protect downstream equipment. Supply and remove flushing water and drainage by various type hose, temporary and permanent piping and Contractor's booster pumps. Flush until clean as approved by the Consultant.

.3 Cleaning

- .1 Using products supplied by the chemical treatment manufacturer, circulate systems at normal temperature to remove adherent organic soil, hydrocarbons, flux, pipe mill varnish, pipe joint compounds, iron oxide, and like deleterious substances not removed by flushing, without chemical or mechanical damage to any system component. Removal of tightly adherent mill scale is not required. Keep isolated equipment which is "clean" and where dead end debris accumulation cannot occur. Sectionalize system if possible, to circulate at velocities not less than 1.8 m/S (6 feet per second). Circulate each section for not less than four hours. Blow down all strainers, or remove and clean as frequently as necessary. Drain and prepare for final flushing.

.4 Final Flushing

- .1 Return systems to conditions required by initial flushing after all cleaning solution has been displaced by clean make up. Flush all dead ends and isolated clean equipment. Gently operate all valves to dislodge any debris in valve body by throttling velocity. Flush for not less than one hour.

END OF SECTION

PART 1 - GENERAL

1.1 GENERAL

1.1.1 This section of the specification shall be read in conjunction with and be governed by the requirements outlined in Section 15010.

1.2 SHOP DRAWINGS

1.2.1 Submit shop drawings in accordance with Section 15010.

1.2.2 Indicate:

- .1 Equipment, capacity, piping, and connections.
- .2 Dimensions, internal and external construction details, recommended method of installation with proposed structural steel support, sizes and location of mounting bolt holes.
- .3 Shop drawings shall indicate location of supply and return hook-ups in addition to interconnection details for each zone.

1.3 MAINTENANCE DATA

1.3.1 Provide maintenance data for incorporation into maintenance manual specified in Section 15010.

PART 2 - PRODUCTS

2.1 GENERAL

2.1.1 All convector covers, force flow heaters and radiant panels shall be factory painted with factory baked enamel finish. Colour to be chosen at shop drawings stage. A paint chip will be provided by the Architect.

2.1.2 Provide for noiseless expansion of all components.

2.1.3 Radiation to give output indicated on the schedule.

2.2 SLOPED TOP CONVECTOR

2.2.1 Heating elements: NPS 3/4" (20 mm) seamless copper tubing, 18 gauge (1.2 mm) minimum wall thickness, mechanically expanded into flanged collars of evenly spaced aluminum fins, 4" x 4" (100 x 100) mm nominal, 50 fins/ft (170 fins per meter) suitable for sweat fittings.

2.2.2 Element hangers: ball bearings plastic lined cradle type providing unrestricted longitudinal movement on enclosure brackets. Space brackets 36" (900) mm centers maximum.

2.2.3 Enclosures: 16-gauge steel complete with components for wall to wall or complete with end

caps as indicated. Joints and filler pieces to be recessed. Support rigidly top and bottom, on wall mounted brackets. Joints and filler pieces to be clear of cover grilles.

- 2.2.4 Enclosure to have bottom inlet and top punched hole top outlet.
- 2.2.5 Capacity as shown on drawings. Unit to be sized for 160 °F EWT and 140 °F LWT.
- 2.2.6 All wall convector enclosures shall be site measured to run wall to wall. The lengths indicated on the drawings indicate the length in inches of the heating element required.

2.3 FIELD DEVICES

.1 Automatic Control Valves

- .1 Automatic control valves shall be supplied and installed by the Mechanical Contractor.
- .2 Automatic control valves, unless otherwise specified, shall be globe type valves. The use of ball valves in sizes 1-1/2" (40mm) and smaller shall also be acceptable. Valves and actuators shall be ordered as one factory-assembled and tested unit.
- .3 Submit to the Engineer for review, a valve schedule containing the following information for each valve:
 - Valve type and size
 - Connection type
 - Line size
 - Valve manufacturer and model number
 - Valve flow coefficient
 - Design flow
 - Pressure drop across valve
 - Maximum close-off pressure
 - Actuator manufacturer and model number
 - Actuator maximum torque
- .4 Valves 2" (50mm) and smaller shall be constructed of bronze. Valves 2 1/2" (65mm) and larger shall have iron bodies and bronze mountings.
- .5 All control valves shall have stainless steel stems.
- .6 The bronze in bodies and bonnets of all bronze valves shall conform to ASTM B62 for valves rated up to 150psig (1035 Kpa) working pressure and to ASTM B61 for valves rated at 200 psig (1380 Kpa) working pressure.
- .7 The bodies and bonnets of iron body valves shall conform to ASTM A126, Class B.
- .8 Control valve discs and seats shall be of bronze for 100 °C or less fluid temperature and of stainless steel for fluid temperatures above 100 °C.

- .9 The control valves shall have tight shut-off. Flat disk valves are not acceptable.
- .10 Control valves 2" (50mm) and smaller shall be complete with screwed ends type, except for bronze valves installed in soldered copper piping which shall be complete with soldering ends. Control valves larger than 2" (50mm) shall be complete with flanged end type and proper flanged adapters to copper shall be provided where flanged valves are installed in copper piping.
- .11 The water control valves shall be sized for a pressure drop of 6 ft. water column or as indicated on mechanical drawings.
- .12 Each automatic control valve must provide the design output and flow rates at pressure drops compatible with equipment selected.
- .13 Each automatic control valve must be suitable for the particular system working pressure.
- .14 Each automatic control valve shall be fitted with a position indicator.
- .15 All the same type control valves shall be the products of a single manufacturer and have the manufacturer's name, pressure rating and size clearly marked on the outside of the body.
- .16 Unless otherwise indicated and except the steam zone control valves, control valves for proportional operation shall have equal percentage characteristics, while the control valves for open/shut two-position operation shall have straight line flow characteristics.
- .17 Heating valves shall be normally open and cooling valves are to be normally closed, unless otherwise specified.
- .18 Standard of Acceptance:
 - Siemens Flowrite Globe Valve with SKC/SKD actuators

.2 Automatic Control Valve Actuators

- .1 Each automatic control valve shall be fitted with a "fail-safe" operator capable of tight shut-off against the differential imposed by the system.
- .2 For interior zone applications such as perimeter radiation, VAV box coils and force flow units where there is minimal risk of equipment freezing due to actuator failure, the use of non-spring return actuators shall be allowed.
- .3 Operators for valves in electric-electronic control systems shall be single phase AC, 24V electric motor operators.
- .4 Valve actuators on valves 3 in. dia. and larger shall be provided with a manual position override.

- .5 Valve actuators shall accept a 0-10VDC or 4-20mA control signal for all proportional applications
- .6 Floating point control of valves is not acceptable under any circumstances.

PART 3 - EXECUTION

3.1 INSTALLATION - GENERAL

- 3.1.1 Install according to piping layout. Provide for pipe movement during normal operation.
- 3.1.2 Maintain proper clearance around equipment to permit performance of service maintenance. Check final location with Consultant if different from that indicated prior to installation.
- 3.1.3 Should deviations beyond allowable clearances arise, request and follow Consultant's directive.
- 3.1.4 Refer to manufacturer's installation drawings. Verify electrical service work with characteristics stamped on unit.
- 3.1.5 Check that all openings for appurtenances and operating weight conform to shop drawings.
- 3.1.6 Valves
 - .1 Install valves with stems upright or horizontal unless approved otherwise.
 - .2 Install isolating ball valves and circuit balancing valves on each unit.
- 3.1.7 Provide screwdriver vent on convectors and radiators. Clean all finned tubes and comb straight.

END OF SECTION

PART 1 - GENERAL

1.1 GENERAL

- .1 This section of the specification shall be read in conjunction with and be governed by the requirements outlined in Section 15010.

1.2 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 15010.
- .2 Indicate:
 - 1) Equipment, capacity, piping, and connections.
 - 2) Dimensions, internal and external construction details, recommended method of installation with proposed structural steel support, sizes and location of mounting bolt holes.
 - 3) Shop drawings shall indicate location of supply and return hook-ups in addition to interconnection details for each zone.

1.3 MAINTENANCE DATA

- .1 Provide maintenance data for incorporation into maintenance manual specified in Section 15010.

PART 2 - PRODUCTS

2.1 GENERAL

- .1 All forced flow heaters panels shall be factory painted with factory baked enamel finish. Colour shall be as noted on the Drawings. A paint chip shall be provided to the Architect at the time of Shop Drawing Submission.
- .2 Provide for noiseless expansion of all components.
- .3 Radiation to give output indicated on the schedule.

2.2 FORCED FLOW HEATER

- .1 Casings shall be constructed of 16 gauge (1.5mm) satin coat steel throughout with electrostatically applied powder coat prime finish. Casing shall incorporate an integral piping pocket, removable front panel, and hinged access door to electrical junction box. Recessed units shall be furnished with a recessing frame.
- .2 Coils shall be 1/2" (13mm) copper tube with rippled aluminum fins and sweat connections. Coils to be factory tested with air at 300 psig (2070 kPa).
- .3 Fans shall be double width, double inlet, forward curved centrifugal type, balanced for quiet vibration free operation.

- .4 Motors shall be 3-speed permanent split capacitor, open type, resiliently mounted, incorporating sleeve bearings and internal automatic re-set overload protection.
- .5 Units must be CSA approved and bear the CSA label.
- .6 Provide the following factory installed options:
 - Cleanable wire frame filter
 - Internal insulation
 - Fused starter with toggle switch
 - Wall-mounted line voltage thermostat
 - Key lock access door
- .7 Wall mounted thermostat and/or switches, where required, to be provided by others.
- .8 Optional high static 3-speed permanent split capacitor motors: 1/6 HP (0.124kW) 3.7 amps 1550 RPM CUH-1 through CUH-6; 1/4 HP (0.187 kW) 3.3 amps 1625 RPM CUH-7 through CUH-9; 1/2 HP (0.373 kW) 9.4 amps 1625 RPM CUH-10 through CUH-12.
- .9 Units shall be Engineered Air, model numbers and sizes as indicated on drawings and/or schedule. Capacity as shown on drawings. Unit to be sized for 180oF EWT and 160 oF LWT

2.3 FIELD DEVICES

- .1 Automatic Control Valves
 - .1 Not required.

PART 3 - EXECUTION

3.1 INSTALLATION – GENERAL

- .1 Install according to piping layout. Provide for pipe movement during normal operation.
- .2 Maintain proper clearance around equipment to permit performance of service maintenance. Check final location with Consultant if different from that indicated prior to installation.
- .3 Should deviations beyond allowable clearances arise, request and follow Consultant's directive.
- .4 Refer to manufacturer's installation drawings. Verify electrical service work with characteristics stamped on unit.
- .5 Check that all openings for appurtenances and operating weight conform to shop drawings.
- .6 Provide screwdriver vent on convectors and radiators. Clean all finned tubes and comb

straight.

3.2 VALVES

- .1 Install valves with stems upright or horizontal unless approved otherwise.
- .2 Install isolating ball valves and circuit balancing valves on each unit.
- .3 Provide all as per the detail on the drawing.

END OF SECTION

CONTENT

<u>SECTION</u>	<u>TITLE</u>
16000	Electrical Specifications Content
16010	Electrical General Requirements
16050	Basic Materials and Methods

END OF SECTION

PART 1 GENERAL

1.1 REFERENCES

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

1.2 APPLICATION

- .1 This section applies to and is a part of all Sections of Division 16.

1.3 WORK INCLUDED

- .1 Sections of these Electrical Specifications are not intended to delegate functions nor work and supply to any specific trade and the work shall include all labour, materials, equipment and tools required for a complete and working installation as described.

1.4 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 Trade, Division 16.
- .2 Supplementary to definitions established are: `Supply' shall mean furnishing to site in location required or directed complete with accessory parts. `Install' shall mean set in place and secured or affixed to building structure as noted or directed. `Provide' shall mean supply and install as each is described.
- .3 Where used, wordings such as "approved, to approval, as directed, permitted, permission, accepted, acceptance", shall mean: approved, directed, permitted, and accepted, by authorized representative of the Owner.
- .4 Equipment and installation provided under this Division shall conform to applicable standards and regulations of the following organizations:

Canadian Standards Association (CSA)
Underwriter's Laboratories of Canada (ULC)
Ontario Electrical Safety Code (OESC)
Electrical Safety Authority (ESA)
Ontario Building Code (OBC)

1.5 WORKMANSHIP

- .1 Workmanship and method of installation shall conform to best standards and practice. Where required by local or other By-Laws and Regulations, tradesmen shall be licensed in their trade.

1.6 TEMPORARY & TRIAL USAGE

- .1 Temporary or trial usage of any equipment or materials shall not be construed as evidence of acceptance of same and no claim for damage shall be made for injury to or breaking of any part of such work which may be so used.

1.7 BY-LAWS & REGULATIONS

- .1 Work shall conform to the latest rules, regulations and definitions of the Canadian Electrical Code and applicable Municipal and Provincial Codes and Regulations, and with requirements of other authorities having jurisdiction in the area where work is to be performed. Minor changes required by an authority having jurisdiction shall be carried out without change to the Contract amount. Standards established by drawings and specifications shall not be reduced by applicable codes or regulations.

1.8 PERMITS & FEES

- .1 File Contract Drawings with proper authorities and obtain their approval of installation and permits for same before proceeding with work. Prepare and submit necessary detailed shop drawings as required by Authorities.
- .2 Pay all fees in connection with examination of drawings, permits, inspections and final certificate of approval.

1.9 CERTIFICATES

- .1 Finish necessary certificates as evidence that work installed conforms to laws and regulations of authorities having jurisdiction.

1.10 GUARANTEE-WARRANTY

- .1 Guarantee and warranty requirements of the Contract shall apply except for incandescent lamps which shall be guaranteed for a period of ninety days after acceptance by the Owners.

1.11 SPECIFICATIONS, DRAWINGS, AND JOB CONDITIONS

- .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 electrical work or equipment locations to accommodate structural conditions. Equipment locations may be altered by Engineer without extra charge provided change is made before installation and does not necessitate major additional material.

- .2 Examine site and local conditions. Examine carefully all drawings and complete specifications to ensure that work can be satisfactorily carried out as shown. Before commencing work, examine the work of other Sections and report at once any defect or interference affecting the work, its completion or warranty. No allowance will be made later for any expense incurred through failure to make these examinations or to report any such discrepancies in writing.
- .3 Relocate equipment and/or material installed but not coordinated with work of other Sections as directed, without extra charge.
- .4 Furnish "built-in" items in ample time and give necessary information and assistance in connection with building-in of same. Notify Section concerned in writing of size and location of recesses, openings and chases at least 48 hours before walls are erected, floors poured and similar work.

1.12 TENDER & SUBSTITUTIONS

- .1 Tender shall be submitted based on specified manufacturer or "approved manufacturers" and equipment only.
- .2 Substitutions for materials may be proposed by submitting details with Supplementary Tender Form together with price difference to Stipulated Sum Tender amount under the following conditions:
 1. Product name shall be stated together with price difference, if any, to stipulated sum for each substitution proposed.
 2. Material or equipment substituted shall not exceed space requirements allocated. Extra charges will not be allowed for any additional installation cost resulting from acceptance of proposed substitutions.
 3. If an item of material specified is unobtainable or unavailable to meet proposed completion, state in tender the proposed substitute and amount to be added or deducted for its use. Extra charges will not be allowed for substitutions after the Contract has been awarded.

1.13 INTERFERENCE DRAWINGS

- .1 Prepare and submit composite interference drawings if required to avoid and/or resolve conflict of trades and to co-ordinate work of Electrical Division with all other trades.
- .2 Interference drawings shall indicate exact arrangements, of all areas and equipment to scale with dimensions.
- .3 Co-operate with work of Division 15 and provide data requested and as required in the preparation of interference drawings for the work of Division 15.

- .4 Make interference drawings in conjunction with all parties and trades concerned showing sleeves and openings and passage of electrical work through building structure. Drawings shall also show inserts, special hangers and other features to indicate routing through confined spaces, installation of equipment in such areas.
- .5 Provide detail drawings, fully dimensioned, of equipment in Boiler and Mechanical Equipment Rooms, Electrical Rooms, Fan Rooms, etc. Base equipment drawings on approved Shop Drawings and include, but do not necessarily limit to, details pertaining to access, clearances, sleeves, connections, etc.
- .6 Provide detailed drawings of pulling pits, equipment bases, anchors, floor and roof curbs, etc., pertaining to Electrical work.

1.14 SHOP DRAWING MATERIAL & LISTS

- .1 Prepare and submit shop drawings and lists of materials for review in accordance with Architectural Sections. Make submittals of more than two pages in booklet form. Individual and loose drawings will not be accepted for review.
- .2 Prior to equipment fabrication, delivery or installation, submit complete lists of materials proposed, indicating manufacturer, catalogue numbers and complete performance data.
- .3 Review of Shop Drawings by Consultant is for sole purpose of ascertaining conformance with general design concept. This review shall not mean that Architect and/or Engineer approves detail design inherent in Shop Drawings, responsibility for which shall remain with Contractor and such review shall not relieve Contractor of his responsibility for meeting all requirements of Contract Documents. Contractor is responsible for dimensions to be confirmed and correlated at site, for information that pertains solely to fabrication processes or to techniques of construction and installation and for co-ordination of work with all trades.
- .4 Shop drawings transmitted via facsimile (fax) machines, or copies of same, will not be accepted for review.

1.15 RECORD DOCUMENTS

- .1 Conform to General Requirements. Maintain at least 2 sets of documents and clearly mark on same as job progresses, changes and deviations from work shown so that on completion Owner will have records of exact location of ducts and equipment and record of material and equipment changes.
- .2 Record all homerun conduits, junction boxes for complete lighting, power and systems on As-Built Drawings.
- .3 Contractor shall obtain clean set of prints from Consultant at start of Contract Work and shall keep these prints up-to-date at jobsite, accurately recording all changes made on project and locating all services, equipment, etc. which may have been shown only diagrammatically on Contract Documents.

- .4 Contractor shall ensure that as-built information is accurately recorded and shall check same. As-Built drawings shall be reviewed with Consultant at each jobsite meeting.
- .5 Upon completion of Contract Work, prior to Substantial Performance inspection and after final review with Consultants, Contractor shall neatly transfer recorded information and make final As-Built submission to Consultant in the following form:
 - One (1) set of clean, legible prints.
 - Updated ACAD R2010 drawings.
- .6 Consultants shall be responsible for reviewing As-Built information provided by Contractor. Revise drawings to suit any comments until acceptable for submission to owner.

1.16 JOB SITE WORK SHOP AND STORAGE

- .1 Supply job site office, workshop, tools, scaffolds and material storage as required to complete the work of this Division. Location of temporary buildings, use of space on site or within building shall be to later direction.

1.17 PROTECTION

- .1 Securely plug or cap open ends of electrical raceways or equipment to prevent entry of dirt, dust, debris, water, snow or ice. Clean all equipment inside and outside before testing.
- .2 Equipment stored on site shall be protected from weather and kept dry and clean at all times. Take care to avoid corrosion of metal parts.
- .3 Protect work installed from damage. Secure all unfinished or loose work to prevent movement.

1.18 INSTRUCTIONS TO OPERATOR

- .1 Instruct Building Operators in repair, maintenance and operation of Electrical Systems and associated equipment.
- .2 Supply three (3) full Operation and Maintenance Instructions each in stiff cover, three-ring binder suitably indexed, separated and labeled. Operate each item of equipment in presence of Operators to ensure understanding of working parts and function of each item of equipment. Supply one complete set of "Reviewed" Shop Drawings in separate hard cover binder suitably separated and labelled for Owner's use.
- .3 Operation and maintenance manuals shall be carefully prepared in co-operation with equipment manufacturers and include miscellaneous parts necessary for proper, efficient operation of all equipment.

- .4 Manuals shall also include spare parts list for each type of equipment, component, control and device installed together with manufacturer's name and address so such items can be suitably identified and purchased. Include list of recommended spares.

1.19 CLEANING, LUBRICATION AND ADJUSTMENT

- .1 Immediately prior to completion of work:
 1. Remove all dust, dirt and other foreign matter from internal surfaces of enclosed electrical apparatus and equipment.
 2. Remove all temporary protective coverings and coatings, temporary labels.
 3. Clean, repair, lubricate and adjust all mechanism and moveable parts of apparatus and equipment leaving it in new condition and operating properly.
 4. Balance demand loads for service and distribution feeders within 5 percent upon completion of work and after the building is in full operation.

1.20 INSPECTION & TESTING

- .1 Systems, equipment, and all major items of material shall be tested to the satisfaction of the Architect, and as required to establish compliance with plans and specifications, and with the requirements for the Supply and Inspection Authorities.
- .2 Faulty and defective equipment shall be replaced with new materials. Conductors which are found to be shorted or grounded, or to have less than proper insulation resistance, shall be replaced with new conductors.
- .3 Tests shall include but are not limited to the following:
 1. Test of secondary voltage cables shall include megger tests to establish proper insulation resistance, and phase-to-ground resistance of cables.
 2. Proper functioning of all systems.
 3. Polarity tests - to establish proper polarity connections to all sockets and receptacles.
 4. Test of system neutral to establish proper insulation resistance and isolation of neutral from ground except for required ground connection at Service.

1.21 CERTIFICATE OF TESTS

- .1 When work is complete submit three copies of test results and a signed statement listing all tests that have been performed as required by specifications and manufacturer's instructions.

1.22 COMPLETION

- .1 Provide receipts from designated representative of Owner for portable and loose materials (e.g. spare fuses, fixture re-lamping equipment and the like).
- .2 Provide copy of final inspection certificate from Electrical Inspection Authority and fire alarm verification report.
- .3 Provide manufacturers corrected "as built" shop drawings for all major electrical items and systems, including all shop drawings returned for modifications.

1.23 ALTERATIONS TO EXISTING BUILDING

- .1 Note that certain alterations and structural changes are to be made to existing building. Architectural drawings and site are to be examined to determine extent of alterations affecting existing electrical systems. Where existing conduits and wires run through areas to be altered, to feed other parts of existing building, they shall be re-routed and reconnected to maintain their original function. Drawings do not necessarily indicate outlets, switches, receptacles, and the like, and other electrical equipment which are required to be relocated or abandoned. Provide decorative blank cover plates for obsolete outlet boxes remaining.
- .2 Electrical services and auxiliary services (fire alarm, P.A. intercom, and the like) shall be maintained continuously without interruption. Interruptions to services shall be confined to periods of time to be designated by Architect, and/or Owner's designated representative. Include in tender for temporary connections, overtime labour charges, and such related allowances in order to conform to these conditions.
- .3 The Electrical Contractor is responsible for removal, reinstallation, cutting and patching of ceiling and walls as required in the existing building.
- .4 Cutting directly related to electrical work, regardless of whether such work occurs in new or existing construction, shall be coordinated and paid for by Electrical Subcontractor involved, under supervision of Contractor.
- .5 Where existing electrical items or systems are demolished and removed from existing construction assemblies, Electrical Subcontractor involved shall be responsible for infilling entire hole left after removal of item or system with new construction assembly to match existing. Where new electrical items or systems are installed through existing construction assemblies, Electrical Subcontractor involved shall be responsible for properly sized and accurate cutting of existing construction assembly to allow installation of new work.

1.24 PROJECT SPECIFIC NOTES

- .1 Obtain all approvals from public authorities having jurisdiction prior to commencing any work. Include, in the tender price, for all ESA permit and inspection fees. Arrange for and attend all inspections required as per requirements of the electrical safety authority and the building department.

- .2 Examine architectural drawings and specifications and all contract documents before proceeding with the work. Any discrepancies between the drawings and specifications of all disciplines must be referred to the architect before any affected work is commenced.
- .3 The electrical contractor shall furnish all labour, material, tools, equipment, etc. required to complete all work shown on the drawings and as specified in the contract documents. The work shall be performed in accordance with rules and regulations of all authorities having legal jurisdiction over the work. This contractor shall provide any small items of work not specifically called for but required to complete the intended installation and/or required to achieve the desired intent or functional utility.
- .4 Perform all work in full accordance with the Ontario building code, Ontario electrical safety code, TDSB standards and good practices and the requirements of all other authorities having jurisdiction. All work performed by this division shall be done in accordance with all manufacturer's recommendations. Obtain all available manufacturer's recommendations and comply.
- .5 All cutting, patching, coring, scanning, xraying, making good and fire stopping required for the work of this division shall be carried out by this division. The electrical contractor is responsible for and shall pay for any and all damage to the building and/or surrounding area incurred by work of this division.
- .6 Review the designated substances survey provided by the board in detail prior to commencing any work.
- .7 The electrical contractor must review and submit shop drawings for the proposed door hardware in conjunction with the general contractor to the architect and electrical consultant prior to ordering. Order only upon receipt of approval. Order, supply and install as per all comments.
- .8 All materials used throughout shall be new, of best quality, C.S.A. approved, and of one manufacturer. Wherever trade names are not used to describe materials, these materials shall be of the best available quality. Obtain and pay for special ESA inspections of specified non-C.S.A. electrical equipment.
- .9 Provide all wiring, raceways, electrical boxes, and such components as required for a complete and operational installation.
- .10 All conduit shall be rigid steel or EMT with gland watertight connectors and compression type couplings, unless otherwise noted. Exposed raceways in finished areas shall be wiremold channels installed neatly in appearance, run parallel to building lines, and concentric right angle bends only shall be used. Exterior exposed conduit shall be rigid galvanized steel. Supply and install access doors as necessary due to the proposed work. All access panel ratings shall match that of the surface in which it is being installed.
- .11 All wiring shall be of minimum #12 Gauge copper, except as otherwise noted. All wiring shall be 600 Volt type RW90. All wiring shall be run in conduit from the source to the

- load. BX cable may be used where permitted by code in ceiling space for final connections only and for a maximum length of 5'. Maximum voltage drop shall not exceed 2 percent.
- .12 Coordinate with all other trades present on site throughout the full course of construction. Lay out of all work so as not to conflict with the work of other trades. Carry out work promptly which may interfere with the work and/or schedule of any other trades.
 - .13 After completion of the work, provide the consultant with a set of 'as-built' record drawings in pdf format prior to submission to the owner. Incorporate all changes in the pdf drawings.
 - .14 Alterations and additions: contractors shall note that this contract is an alteration to an existing building and as such the contractor shall thoroughly investigate the existing electrical installation and electrical, mechanical, structural, and architectural conditions prior to pricing and construction.
 - .15 Demolition: remove all exposed conduits, branch wiring, outlets, etc. from surfaces being demolished.
 - .16 Cleanup and garbage: the contractor is responsible for maintaining as clean of a work area as possible during construction. The contractor is responsible to clean-up and remove tools from the site at the end of every working day. Disposal of all redundant materials, devices, and equipment is the responsibility of the contractor on a daily basis.
 - .17 All work shall be done with minimum possible interruption to the existing building systems and in the time schedule permitted by the school board. Consult with the project supervisor prior to pricing. Complete the project within the allocated schedule.
 - .18 Paint all exposed conduit and backboxes, inside and outside of the building, to match the surrounding colour. Minimize exterior conduit run where feasible.
 - .19 All backboxes installed indoors shall be wiremold or approved equal. All backboxes installed outside shall be of cast aluminum finish.
 - .20 For all panels where new circuits are added, provide a new typed panel directory based on the new loads. Incorporate all existing circuit information from the existing panel directory on site in the new panel directory.

1.25 CLOSEOUT DOCUMENTS

- .1 Coordinate with the General Contractor to submit a consolidated copy of Closeout Documents, in which all Electrical Closeout Documents too shall be included. Documents shall be provided in one (1) hard copy (binder) format and three (3) electronic CD/USB formats. Electrical Closeout Documents shall include:
 1. Electrical Contractor Warranty Letter.
 2. ESA Inspection Certificate.
 3. ESA 'Final Requested' Certificate
 4. All Project Shop Drawings.
 5. O&M Manuals for all major equipment installed for the project.

6. As-Built Drawings.

END OF SECTION

PART 1 GENERAL

1.1 REFERENCES

- .1 Conform to Section 16010 - Electrical General Requirements.

1.2 MATERIALS

- .1 Materials shall be new, of Canadian manufacture where available, first quality and uniform throughout. Submit tender based on the use of materials and equipment specified, or on the listed acceptable alternate equipment as further detailed.
- .2 Electrical materials shall be C.S.A. approved and be so labeled. Material not C.S.A. approved shall receive acceptance for installation by Electrical Safety Authority (ESA) Special Inspections Branch before delivery, and modifications and charges required for such acceptance shall be included in work of this Section. Material shall not be installed or connected to the source of electrical power until approval is obtained.
- .3 Confirm capacity, ratings and characteristics of equipment items being provided to supply power to equipment provided under other Sections of the work. Resolve discrepancies before such items are purchased.

1.3 MATERIAL ACCEPTANCE

- .1 Acceptance of materials installed presumes that materials have not been damaged or exposed to conditions that would adversely affect performance and life expectancy.
- .2 If in the opinion of the Consultant, materials have sustained damage, or have been exposed to abnormal conditions it shall be the responsibility of the Contractor to have such tests performed as deemed necessary by the Consultant to establish condition and therefore, acceptability of installed materials.

PART 2 PRODUCTS

2.1 RACEWAYS

- .1 Rigid galvanized steel conduit shall comply with CSA Specification C22.2 No. 45.
- .2 Electrical metallic tubing (EMT) shall comply with CSA Specification C22.2 No. 83. Connectors and couplings to be forged steel and rain tight in sprinklered areas. Connectors to have factory-installed insulated throats.
- .3 Rigid PVC conduit shall comply with CSA Specification C22.2 No. 136.
- .4 Watertight flexible conduit: "Sealtite" PVC jacketed flexible steel with Hubbell-Kellum strain relief grips; shall comply with CSA Standard C22.2 No. 56.

- .5 Surface wall-mounted raceways shall be Wiremold No. 4000 metallic type complete with two channels and all necessary fittings, closers, device modules, etc. Wiremold or approved equal only.

2.2 WIRE & CABLE

- .1 Branch wire and cable shall comprise copper conductors, sized as noted, rated 75 deg. C., 600 volt minimum flame retardant insulation, and CSA approved for application.
- .2 Wire and cable installed in conduit shall be PVC insulated Type TWH - Flame retardant and comply with CSA Specification C22.2 No. 75.
- .3 Use Electrovert "Z-Type" code markers for control & communication conductors.
- .4 All branch wiring shall be RW90.

2.3 DEVICES

- .1 Wiring devices unless otherwise specified herein, or noted, shall be as manufactured by Hubbell, Leviton or Pass & Seymour.
- .2 Switches for 120 volt branch lighting circuits, generally shall be A.C. "Quiet Type" rated 20 Ampere, 120 Volt, totally enclosed phenolic housing Hubbell 1200 Series, beige toggle handle.
- .3 Double Pole lighting switches shall be connected to 2 pole circuit breakers.
- .4 Key-operated switches shall be Hubbell 1221-L Series of the types listed above, except key-operated, and shall be keyed-alike.
- .5 Standard 15 Ampere, 125 volt duplex receptacles generally shall be specification grade Hubbell Cat. No.5262, beige, CSA #5-15R.
- .6 Receptacles with integral ground fault interrupter shall be Hubbell No. GF-5252 or approved equal.
- .7 Service receptacle shall be Hubbell No. 5262-RD.

2.4 DEVICES-SPECIALIZED

- .1 Flush floor boxes shall be Hubbell Cat. No. 3SFB-SSC 3-service box complete with devices shown on drawings.
- .2 Provide low-voltage lighting control, as detailed.

2.5 DEVICE COVER PLATES

- .1 Switch and receptacle and other device faceplates for flush mounted devices, generally shall be single or multi-gang as required, type 301, stainless steel, #4 brushed finish with removable protective covering.
- .2 Weatherproof enclosures for outdoor receptacles shall be P & S 4600 with 4600-26 Mounting Plate, duplex ground fault receptacles and two #4609 Keys.
- .3 Cover plates for other devices such as flush fan controls, telephone, etc., shall be stainless steel to match above.

PART 3 EXECUTION

3.1 EQUIPMENT LOCATIONS

- .1 Approximate locations of electrical equipment, fixtures switches, outlets, and the like, are given on the drawings. Refer to the architectural drawings and room elevations for application. In absence of definite detail exact location of outlets shall be determined on site as work progresses.
- .2 Device plates shall cover opening left for outlet box, and plates shall be attached to boxes in an approved manner. Outlets and fixtures are to be located symmetrically, (i.e. centered in wall panels, ceiling panels or tiles, columns, between and above doors and the like).
- .3 The right is reserved to alter the location of equipment and outlets a distance of up to 3 metres without involving a change to the Contract amount, providing notice is given prior to installation.

3.2 MOUNTING HEIGHTS

- .1 Mounting heights of outlets, top of outlet to finished floor, except for exposed masonry construction, shall generally be as follows:

Lighting/Exhaust Fann Switches - 1100 mm (to the center of the switch)
Receptacles - 400 mm above finished floor
Television Outlets - 400 mm
Telephone Outlets - 400 mm
Manual Fire Alarm Stations - 1200 mm
Automatic Fire Alarm Stations - ceiling
Panelboards - 2000 mm to top of trim for standard panels.
Clocks - 2000 mm or 300 mm below ceiling.
Thermostats - 1200 mm
Fire Alarm Audible Temporal Pattern Horn/Strobes – 2300 mm

3.3 HOLES & DRILLING

- .1 Pneumatic hammers and percussion drills are prohibited.
- .2 Where not sleeved, make holes through concrete walls and floors by core-drill only. Obtain Architect's approval before drilling.
- .3 Seal holes and sleeves through floors to serve as water dam.

3.4 CUTTING & PATCHING

- .1 Layout and install work in advance of other Sections for all new work. Bear all costs resulting from failing to comply with this requirement.
- .2 Pay for cutting and patching and making good as required for work of this Division by reason of faulty or late work. Employ appropriate trades already engaged on the site to perform such cutting, patching and making good existing walls, floor, ceiling, etc. Before commencing, obtain Architect's approval for extent and nature of cutting. Make good, disturbed surfaces to the Architect's approval.

3.5 HANGERS & INSERTS

- .1 Provide necessary hangers and inserts for work of this Division.
- .2 Fasten to cast-in place concrete by suitable drilled or cast-in inserts.
- .3 Fasten to structural steel using bolts or welded fasteners.
- .4 Do not use wood, chain, wire lashings, strap or grappler bar hangers except where noted or detailed.
- .5 Support fixtures independently of ceiling suspension systems. Provide additional supports as required, which shall be fastened to building structure steel members, joists, beams, etc., but not metal pan or roof decking. Material for additional supports and their installation shall comply with requirements of U.L.C. Refer to "List of Equipment and Materials" Vol. 2, and "Supplement" for application to rated assemblies.
- .6 Support outlet and junction boxes independently of the conduits running to them where required by electrical code and where deemed necessary by the Architect, use steel angle brackets or steel rods to support outlets and fixtures, to the building structure.
- .7 Drilled fastenings to concrete shall be self-drilling concrete anchors, Phillips 'Red-Head' or approved equal. The maximum weight per fastening shall not exceed 25% of manufacturer's 'pull-out' load data.

- .8 Surface mounted or stem suspended fixtures fastened to non-removable ceilings, 2 hr. fire rated ceiling assemblies, or mounted between metal suspension of exposed T-grid ceilings, shall be provided with minimum of two points of attachment for each 300 mm x 1200 mm (1' x 4') luminaire, using metal `channel-bar' fastened to building structure. Attach luminaires to `channel-bar' by means of threaded steel rods. Channel-bar shall be adequately supported and of a construction to prevent deflection under load, as selected from manufacturer's published data, and to Architect's approval. `Channel-bar' shall be Unistrut, Burndy, Flexibar, Cantrough, or Canadian Strut Products or approved equal.
- .9 Use support clips (e.g. Caddy Type IDS) for suspension of fixtures attached to exposed T-grid ceilings. Clips shall be supported directly from building structure and not from suspended ceiling system.
- .10 Provide recessed fluorescent fixtures with support frames, and plastering frames where applicable.
- .11 Chain where permitted and specified for the installation of fluorescent lighting fixtures shall be No. 4, 2 mm (.080") Tenso Pattern coil steel chain, plated with a strength of 82 kg (180 lbs.) as manufactured by Dominion Chain Co. Ltd. or approved equal. Where 'S' hooks are used with chain, they shall be No. 6 type with open strength of 82 kg (180 lbs.) minimum. Attachment of chain at both ends of support shall develop full strength of chain.
- .12 Support outlet boxes, junction boxes, conduit and the like, mounted on exposed steel deck roofing by means of self-tapping minimum #10 gauge screws, secured through bottom member of deck corrugation. Do not pierce top of steel deck.

3.6 PAINTING

- .1 Hangers, support framing and all equipment fabricated from ferrous metals which are not protected with zinc or other suitable corrosion-resistant finish shall have at least one coat of a corrosion-resistant paint applied before shipment or immediately on arrival at the site.
- .2 After installation, touch up all scratches, chips, other damage and defects in paint, using zinc chromate primer or paint or special enamels as necessary to match the original.
- .3 Finish and colour of all equipment shall be coordinated to provide uniform appearance.
- .4 Painting of conduits and supports and other exposed surface work will be done under Painting Section except as noted. Install materials in time to be painted together with mounting surfaces.
- .5 Do not paint over nameplates.
- .6 Refer to other Sections for special paint finishes of equipment.

3.7 NAMEPLATES & SCHEDULES

- .1 Identify electrical equipment supplied under this Division with 3 mm thick black laminated plastic nameplate to indicate equipment controlled to provide instruction or warning. Fasten each plate with two chrome plated screws. Lettering shall be 6 mm high for small devices such as control stations and at least 13 mm high for all other equipment. Submit a list of proposed nameplates for approval before manufacture.
- .2 Provide panelboards with typewritten schedules identifying outlets and equipment controlled by each branch circuit including existing panels being changed. Protect schedules with non-flammable clear plastic.
- .3 Identify junction boxes, pull boxes, cover plates, conduits and the like, provided for future extension, indicating their function (e.g. power, fire alarm, communication).
- .4 Verify room names and numbers prior to listing on nameplates and schedules.

3.8 BRANCH CIRCUIT WIRING & FEEDER CABLES

- .1 Provide branch circuit wiring, conduits and feeders as required for Lighting, Power and Auxiliary Systems. Separate conduit systems shall be provided for feeder, lighting and power systems, for exit light system and auxiliary communication systems.

3.9 CONDUIT, RACEWAYS AND WIREWAYS

- .1 Wire and cable shall be installed in conduit as follows:

Rigid galvanized steel conduit with threaded IPS fittings to be used:
 1. Where noted and required by regulations.
 2. Where subject to mechanical damage.
 3. For all exposed conduit work.
- .2 Conduit embedded in concrete or buried below grade floors shall be CSA approved rigid PVC type.
- .3 Electrical metallic tubing (EMT) may be used in place of rigid conduit in dry locations subject to governing regulations, embedded in masonry walls, and concealed above suspended ceilings. Connectors shall be provided with factory-installed insulated throats.
- .4 Use flexible metallic conduit for connections to chain suspended and recessed fixture drops, motors and similar equipment to prevent transmission of vibration. A code-gauge green grounding conductor shall be provided for all such connections. Use "Sealtite" conduit with Hubbell-Kellum Sealtite conduit strain relief grips for all such connections at motors.
- .5 Fasten every conduit and cable to structure by means of approved conduit clamps or clips. Wire lashing is not acceptable.

- .6 Conceal conduits and wiring except where noted. Run exposed conduits parallel to building lines and to other conduits. Provide every empty conduit with a pull rope (3 mm polypropylene rope) and identify to designate its function (Power, Telephone, Fire Alarm and the like).
- .7 Where conduit is installed in concrete slabs, obtain general approval, prior to commencing the work, on both maximum dimension and cross-overs which may be used therein.
- .8 Install conduits in such a manner as to conserve head room and interfere as little as possible with free use of space through which they pass. Obtain approval for routing of same. Keep conduits at least 150 mm clear high temperature work.
- .9 Conduits installed at the roof level of exposed structures, shall be run tight to roof deck, above purlins and beams.
- .10 Conduit and cables for electrical work in demountable type and drywall type partitions shall enter from above, from a junction box concealed in the ceiling above and shall comprise a flexible conduit connection.
- .11 All branch wiring shall be provided with a separate code gauge supplementary grounding conductor run in each conduit or duct, terminating at ground block at panelboards.
- .12 Run conduit exposed in mechanical equipment rooms, electrical rooms, fan rooms, and the like, and installed after mechanical and other equipment is completed. Install fixtures, outlets, starters, etc., to clear and to suit application.
- .13 Wiring, boxes, conduit fittings, etc., in hazardous areas shall conform to the Ontario Electrical Code, covering explosion-proof areas. Provide conduit seals where required by these regulations.
- .14 Provide housekeeping curbs around exposed conduits feeding panels, disconnect switches, starters, etc. penetrating floors in front of walls.

3.10 WIRE & CABLE

- .1 Wire and cable shall not be installed at temperatures below 20°C unless "minus 40" type is used. Wiring to heating equipment shall be rated 90°C minimum, the ampacity of which shall be limited to 75°C value.
- .2 Conductors used for all auxiliary systems (e.g. Fire Alarm) shall be tagged and/or colour-coded, and where applicable shall agree with manufacturer's wiring diagrams.
- .3 Minimum wire size for power wiring shall be No. 12 AWG gauge unless specified otherwise. Minimum wire size for "Common" neutral conductors shall be No. 10 AWG. Control wiring shall be #14 AWG red insulation. Maximum voltage drop between furthest outlet of any circuit, when fully energized, and panel to which it is connected shall not exceed two percent except for electric heating circuits which shall not exceed one percent.

- .4 Cables shall be terminated with moisture-proof connectors, clamped to sheet metal enclosure by a single non-ferrous locknut and grounding bushing.
- .5 Sheaths of multi-conductor cables shall be grounded at both cable ends.
- .6 Sheaths of single conductor cables shall be grounded at supply end only. Provide a Code Gauge Grounding Conductor with each feeder cable run.
- .7 Numbers of wires indicated for lighting and power, motor and motor control, alarm, signal, communications, and auxiliary systems is intended to show general scheme only. The required number and types of wires shall be installed in accordance with equipment manufacturer's diagrams and requirements, and with requirements of the installation, except that specification standards shall not be reduced.
- .8 Solderless connectors with nylon-jacketed "Vibration-proof" screw-on wire connectors ideal "Wing Nuts", rated 600 volts shall be used for joints in Branch Wiring.
- .9 Use compression joints and terminals for all control wiring; and all conductors #4 AWG and larger. Mechanical connections are acceptable at panelboards and circuit breakers where these are part of factory-assembly.
- .10 Wire or cables in feeders, sub-feeders and branch circuits shall be colour-coded in accordance with Ontario Electrical Safety Code. Each end of feeder terminations (e.g. in Switchboard, Panelboards, switches, splitters and the like) Code Phase A - Red, Phase B - Black, Phase C - Blue, Neutral – White.
- .11 Use C.G.E. Vulcan X-Link insulated cables for circuits protected by ground fault circuit interrupters.
- .12 Include in each conduit, tubing and raceway, a code gauge green supplementary grounding conductor which shall be connected to suitable ground bus in equipment.
- .13 Armoured or sheathed cables may be used only for wiring within demountable and dry wall type partitions and if additionally specified or detailed; however it shall not be directly buried in or below concrete slabs. Once out of the wall, the run shall not exceed 5'-0". All wiring after transition shall be run in conduits c/w junction boxes. No exposed run of BX cables in finished or unfinished areas will be acceptable.

3.11 OUTLET, JUNCTION, & PULL BOXES

- .1 Use suitable electrical boxes for terminations and junctions on conduit work. Install pull boxes where necessary to permit installation of conductors. Support pull boxes, outlet boxes, panels and other cabinets independently of conduit.
- .2 Provide each light switch, wall receptacle and other device with an outlet box of suitable dimensions and a faceplate. Outlet boxes shall be adapted to their respective locations.
- .3 "Thruwall" and "Utility" type boxes shall not be used.

- .4 Electrical boxes and panels shall be CSA approved, code-gauge sheet metal, galvanized or with suitable protective treatment. Secure covers with screws or bolts.
- .5 Outlet boxes shall not be installed "Back-to-Back" in walls; separate by a minimum of 150 mm.
- .6 Use "Masonry Type" outlet boxes for flush installation in masonry walls as detailed on standard Detail Drawings attached hereto. Standard sectional boxes, 1004, 1104 and the like, shall not be used.
- .7 Install surface mounted devices, in cast conduit fittings, with threaded hubs and suitable stainless steel faceplates.
- .8 Main pull and junction boxes (excluding obvious outlet boxes) shall be clearly identified by painting the outside of the cover in accordance with the following schedule:
 - Lighting Yellow
 - Power Blue
 - Fire Alarms Red
 - Telephone Cream
 - Control Brown
 - Intercom & Sound Green
- .9 In addition, each box shall be identified with a system and service designator of logic reference to the service.

3.12 ACCESS DOORS & ACCESS MARKERS

- .1 Supply access doors for installation under the work of other Division where electrical equipment requiring maintenance or adjustment or inspection is located above ceilings, within walls or behind furring; except ceilings of lay-in removable panel type.
- .2 Access doors shall be 12 gauge hinged metal Stelpro Ltd. or equal #722 flush type, minimum size 300 mm x 300 mm (12" x 12") "Reach-in" 300 mm x 600 mm (12" x 24") "Crawl-in", with prime coat finish, concealed hinges, screwdriver lock and plaster key. Access doors in finished masonry or drywall construction shall be #722 less plaster key. Access doors shall be #726 in acoustic tile ceilings; #704 in drywall ceiling and #726E in plaster ceilings.
- .3 Access doors in fire rated ceiling assemblies, all fire rated walls, duct shaft or in corridor walls shall be UL, ULC or WHI listed 1-1/2 hour fire rated access doors equal to LeHage #L1010 or Acudor #150B with screwdriver lock.
- .4 Where lay-in removable panel ceilings requiring hold-down clips are used, access doors are not required but panels shall be secured with accessible hold-down clips and marked with Buildemup #6 RH brass paper fasteners inserted through acoustic panel and bent over. Paint heads with blue enamel before installation.

- .5 Obtain approval for sizes and locations.

3.13 ELECTRIC WORK FOR OTHER DIVISIONS

- .1 Examine Architectural and Mechanical (Plumbing, Heating, Ventilating and Air Conditioning) plans and specifications to determine extent of electrical work in connection with these Divisions which is to be done under the work of the Electrical Division.
- .2 In general, all loose motor starters and associated controls for mechanical equipment will be supplied under Division 16 for installation and connection to both source and load side of the equipment.
- .3 Co-ordinate the exact location and verify characteristics of electrical provisions for the work of the Mechanical Division.
- .4 Coordinate locations of starters, motors and associated equipment with the work of the Division 15 Mechanical Trade Sections to ensure proper location of equipment. The exact locations of conduit terminations at Mechanical units shall be determined from equipment manufactures' approved shop drawings. Conduits must be installed to enter only in the locations designated by equipment manufactures.
- .5 Provide safety switches required for disconnection of remotely controlled motors, and where required at motors by C.E.C. regulations whether shown on the drawings or not. Where required at fan motors, they shall be concealed in the fan housing if possible.
- .6 Provide for the 120 volt mechanical equipment where noted, all necessary wiring and connections including wiring and installation of starters, thermostats, aquastats, speed controllers and time switches controlling equipment.
- .7 Where motor starters, switches and the like, are grouped together, a suitable 19 mm (3/4") thick plywood panelboard shall be provided to which all such equipment shall be secured. Provide all necessary angle iron supports for support of panelboard and paint entire assembly with two coats of fire retardant type enamel acceptable to Building Inspection Department.
- .8 Provide weatherproof un-fused safety disconnect switches, fastened to exterior of roof mounted units, to approval.
- .9 Connect high temperature thermostats "Firestats" provided in ductwork by Division 15, to exhaust fan systems, to provide fan shutdown on activation.

3.14 GROUNDING – GENERAL

- .1 Ground all electrical systems in accordance with provisions of the Ontario Electrical Code.
- .2 Provide a grounding electrode in accordance with Section 10 of the Canadian Electrical Code.

- .3 Install grounding conductors to permit the shortest and most direct path from equipment to ground. Install grounding conductors in rigid galvanized conduit with both conductor and conduit bonded at both ends. Provide bonding jumpers with approved clamps to maintain ground continuity of metallic raceway systems at all expansion joints.
- .4 Ground connections to grounding conductors shall be accessible for inspection and made with approved solderless connectors bolted to the equipment of structure to be grounded. Clean contact surface prior to making connections to ensure proper metal to metal contact. Connections shall be of the type that grounds both conduit and conductor, and cap screws, bolts, nuts and washers shall be silicon bronze.

3.15 FIREPROOFING & SEALING

- .1 Make watertight seal at sleeves and other openings through floors above grade. Sleeves to extend minimum 25 mm (1 inch) above finished floors.
- .2 Provide Fireproofing protection of openings through floors and fire rated walls. Refer to Architectural Drawings for rated surfaces.
- .3 Caulk spaces between conduit, cables, bus ducts, raceways, and cable trays with "Cerafibre" 2300 F packing to Building Department approval. Pack and seal both sides of openings with Electrovert "Flameseal" putty, minimum thickness 25 mm (1"). Install in accordance with Electrovert Instruction Bulletin #3601.

END OF SECTION