

ROOF AND WINDOW REPLACEMENTS
AT
60 BRANT STREET, TORONTO

FOR

CITY OF TORONTO
TORONTO SHELTERS AND SUPPORT SERVICES (TSSS)

ISSUED FOR TENDER
30 APRIL 2026

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1 General

1.1 DESCRIPTION OF WORK INCLUDES

.1 Work under this Contract covers the following:

Work includes, but is not limited to:

- Roof replacement.
- Window replacement.
- Interior refurbishment including localized replacement of ceiling finish at areas showing signs of water damage.
- Temporary relocation and reinstallation of mechanical units to facilitate roof replacement.
- Phasing and expedition of work to minimize impact on occupants and maintain intended operation of the building (including heating/cooling/ventilation), as further outlined in the documents.

1.2 RELATED SECTIONS

SECTION

01 11 00	Summary of Work
01 14 00	Work Restrictions
01 21 00	Allowances
01 25 00	Alternatives and Substitutions
01 26 00	Contract Modification Procedures
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01 91 00	General Commissioning Requirements

1.3 CONTRACTS

.1 Construction Work under single Construction Agreement Contract and Supplemental Conditions if applicable.

1.4 GENERAL REQUIREMENTS

.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.

- .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. The Consultant assumes no liability to act as an arbiter to establish subcontract limits between Sections or Divisions of Work.
- .3 Specifications, Schedules and Drawings are complementary and items mentioned or indicated on one may not be mentioned or indicated on the others.
- .4 Contractor shall be responsible for materials, products, operations, or methods mentioned in the specifications or indicated on the drawings and shall provide to 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 Work related to Heritage Steel Windows, including but not limited to restoration of window frames, glazing replacement and paint finishes to be performed by a contractor with not less than five (5) years experience in heritage restoration work.
- .5 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.
- .6 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.

1.5 WORK SEQUENCE

- .1 Cooperation with The Owner in scheduling operations to minimize conflict and to facilitate The Owner's ongoing usage.
- .2 All of the Work is to proceed to the schedule submitted by the awarded Construction Manager (hereby referred to as the Contractor or GC) and accepted by the Owner. The Contractor's schedule will recognize the following restrictions:
 - .1 The Contractor must perform their activities respecting the requirements set forth in the specifications Division 01 - Section 01 11 00 “Summary of Work” and will safeguard the operations of The Owner. All services are to be left in good repair and operating while the Work is undertaken.
 - .2 Safe access through the intended Project access route and fire/emergency routes must be maintained. Throughout the construction period, the Contractor is to include for any hoarding, covered walkway, etc., necessary for this purpose. The construction activities are to be scheduled so as to minimize any complete shutdown of the manufacturing/production and delivery areas.

1.6 CONTRACTOR'S USE OF PREMISES

- .1 The Contractor shall maximize use of premises as much as possible to allow for:
- .2 Assume full responsibility for protection from construction hazards of The Owner's staff at all times when they are on the site.
- .3 Assume full responsibility for the protection of the existing buildings, systems and services, and utilities from damage due to the Work of the Contractor or any

Subcontractors employed on the site. After obtaining the approval of the Consultant, make good all damage to Owner's satisfaction and at no cost to Owner.

- .4 Site storage:
 - .1 Allocate an area on site within the limits of the Work acceptable to The Owner for storage of Products brought to the site by all trades. Materials and equipment to be stored on site in storage containers (i.e. C Can Containers) or on site in a weatherproof storage enclosure.
 - .2 Do not encumber site with materials or equipment items are stored on site.
 - .3 Keep storage area tidy at all times and do not use other parts of the property for storage.
 - .4 Assume full responsibility for protection and safekeeping of products stored on premises.
 - .5 Move any stored products or equipment which interfere with operations of The Owner at no cost to the Owner.
- .5 Refer to Section 01 14 00 for additional work restrictions relevant to the Work.

1.7 DOCUMENTS AT THE SITE

- .1 Keep the following documents on Site, stored securely and in good order and available to The Owner and Consultant in hard copy:
 - .1 Current Contract Documents, including Drawings, Specifications and addenda.
 - .2 Change Orders, Change Directives, and Supplementary Instructions.
 - .3 Reviewed Shop Drawings, Product data and samples.
 - .4 Field test reports and records.
 - .5 Construction progress schedule.
 - .6 Meeting minutes.
 - .7 Manufacturer's certifications.
 - .8 Permits, inspection certificates and other documents required by authorities having jurisdiction.
 - .9 Current as-built drawings.
 - .10 Material Safety Data Sheets (MSDS) for all controlled Products.

1.8 OCCUPANCY AND USE OF PREMISES

- .1 The Contractor and all Subcontractors are expected to understand that all areas of the building remain occupied during the Work and that the Work is to be executed in such a manner as to provide the minimum interference with the partial use of the premises by the occupants, and the maximum safety of the occupants during the Work. The Contractor and all Subcontractors will take reasonable measures for the control of noise during working hours.
- .2 The Contractor shall maintain normal building operation and traffic flow, with minimum inconvenience from noise and dust to the tenants of the facilities.
- .3 The Contractor shall organize the work at each facility so as to minimize any disruption in the ordinary use of the facility by the tenants, ensure minimum interference with the occupation, use and enjoyment of the facility by the tenants and minimize any reduction in comfort at the facility.

- .4 All noise and vibration generating operations, such as jack hammering, drilling, compacting and the use of other such equipment, that will interfere with the occupied portions of the building shall be confined to the hours as stipulated in Section 01 14 00.
- .5 The Work shall be confined to the area defined on the drawings except that services connections, sanitary and storm connections, and certain portions of landscaping, hard paving and curb work shall be executed on Municipal property under regulations of authorities having jurisdiction
- .6 It is essential that the existing building be maintained weather tight at all times. The Contractor shall therefore furnish all temporary protection, enclosures, tarpaulins, etc., as may be required to weatherproof any openings made by the Work. The Contractor and all Subcontractors must seal off or temporarily dam all open roof edges, etc. to prevent any water present on existing roof areas, from entering the occupied floor(s).
- .7 The Contractor is to ensure that throughout the duration of the construction, the Owner's power requirements must not be affected by the service of the construction. Provide at minimum, 14 business day advance notice there is any planned utilities shut down in accordance with requirements of Section 01 14 00.

1.9 SETTING OUT

- .1 Be responsible for setting out the Work. Prior to setting out the Work, verify dimensions and elevations shown on the Contract Documents and report to Consultant any unsatisfactory conditions that may adversely affect the proper completion of the Work.
- .2 Accurately set out the Work from levels and lines. Where Work of this Contract is dependent upon grades and elevations of existing structures or facilities, such grades or elevations shall take precedence over those determined by reference to established elevations. Advise Consultant of any discrepancies.
- .3 During any activity of the Work, layout and check all features, including but not limited to the following:
 - .1 Establish and maintain temporary bench marks set required to perform the Work..
 - .2 Provide general dimensions, lines and elevations required to perform the Work.

1.10 BUILDING DIMENSIONS

- .1 Report any inconsistencies, ambiguities, discrepancies, omissions, and errors between Site conditions and Contract Documents to 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 Consultant.
- .2 Check all dimensions at the site before fabrication and installation commences and report discrepancies to the Consultant.
- .3 Where dimensions are not available before fabrication commences, ensure that dimensions required are agreed upon between the parties concerned.
- .4 Prior to commencing work, ensure that clearances required by jurisdictional authorities can be maintained.
- .5 Ensure that the necessary job dimensions are taken and Subcontractors are coordinated for the proper execution of the Work. Assume complete responsibility for the accuracy and completeness of all dimensions, and for coordination of all elements of the Project.

- .6 Verify that the Work, as it proceeds, is executed in accordance with dimensions and positions indicated which maintain levels and clearance to adjacent Work, as set out by requirements of the Contract Documents, and ensure that Work installed in error is rectified without extra cost to the Owner before construction continues.
- .7 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.
- .8 Check and verify dimensions referring to Work and interfacing of services. Dimensions, when pertaining to the Work of other Sections (Subcontractors), shall be verified with the Section (Subcontractor) concerned. Ensure that Subcontractors performing various Sections cooperate for the proper performance of the Work.
- .9 Do not scale directly from the Drawings. If there is ambiguity or lack of information, immediately inform Consultant. Any change through the disregarding of this clause shall be the responsibility of the Contractor.
- .10 All details and measurements of any Work which is to fit or conform to Work installed shall be taken at the site.
- .11 Leave areas clear where space is indicated to be reserved for future equipment, including access to such future equipment.
- .12 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 as recommended by equipment manufacturer.

1.11 EXISTING SITE CONDITIONS

- .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. Claims for additional costs will not be entertained with respect to conditions which could reasonably have been ascertained by an inspection prior to tender closing.
- .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.

1.12 SUPPLEMENTARY DEFINITIONS

- .1 In the Specifications, references such as "shown on the Drawings", "specified", "scheduled", "called for" and the like shall be deemed to include work required by any of the Contract Documents.
- .2 In the Specifications the expression Section(s) is synonymous with Subcontractor(s) if the context permits. The expression "all Sections" shall be deemed to include the Contractor.

1.13 EXAMINATION

- .1 Each Section (Subcontractor) shall examine surfaces prepared by other Sections (Subcontractors) which affect its work and shall ensure that defects are corrected. Commencement of Work shall imply acceptance of prepared Work.

- .2 All Sections (Subcontractors) shall check and verify with the Contractor all dimensions, especially those pertaining to work of more than just their Section (Subcontractors work).
- .3 All details and measurements of any work which is to fit to, or conform with, work already installed by other Sections (Subcontractors, shall be taken at the job site by the Sections (Subcontractors) concerned.

1.14 SUPPLY AND/OR INSTALLATION

- .1 Unless the word “only” suffixes “supply” or “install” or other variations of those words according to the Section wherein they are used, it is the express intent of this Contract that “supply and install” is implied.
- .2 Unless otherwise specified, Work shall be installed in accordance with the manufacturer’s printed directions and recommendations.

1.15 SATISFACTION / APPROVAL

- .1 The expression “to the satisfaction or approval of The Owner” shall be implied throughout the Specifications in regard to all materials and workmanship.
- .2 “Submit for approval” means that the item in question is to be submitted to The Owner for approval and that a written acceptance of it is authorization for its use in the Work shall be obtained before it is incorporated in the Work. Sections (Subcontractors) shall submit items for approval to The Owner via the Contractor.
- .3 The terms “approved”, “review”, “reviewed”, “accepted”, “acceptance”, “acceptable”, “satisfactory”, “selected”, “directed”, “instructed”, “required”, “submit”, “permitted”, “approved alternative”, “approved equal”, or similar words or phases are used in standards or elsewhere in Contract Documents, it shall be understood, that words “by (to) The Owner” follow, unless context provides otherwise.
- .4 The term ‘or approved alternate’ or similar language following a list of products, systems, or manufacturers used in the Contract Documents shall be construed to mean approved by Consultant. Specified products to be Base Bid. Contractor to follow substitution procedures specified in this Section for submitting proposed products, systems, and manufacturers and obtain Consultant’s approval of the same prior to proceeding with ordering proposed products and systems or engaging manufacturers. Contractors who purchase products and systems or engage manufacturers prior to Consultant’s review and acceptance do so at their own risk.
- .5 An “approved method” means that which has the manufacturer’s recommendation or which is generally accepted as good trade practice.

1.16 EXISTING SERVICES

- .1 The Contractor is responsible for ensuring all “Existing Services” (including but not limited to structural elements, water pipes, drains, electrical cables and fixtures, communications cables and fixtures, security cables and fixtures, HVAC ducting, cables and fixtures, etc.) are not interrupted and / or damaged by the construction work. The Contractor must take all precautions to ensure that services buried underground or contained in a floor or contained in other elements are identified on the drawings provided by The Owner and have been clearly identified on the Work Site.
- .2 The Owner will not be liable for any loss, damage, delay or claim whatsoever resulting or arising from the absence in whole or part of services not shown on drawings.

1.17 EMERGENCIES

- .1 Notify The Owner's Project Team immediately should an emergency arise on the Site, including personal injuries and accidents. This notification shall be by telephone or email immediately after the occurrence.
- .2 Provide an incident report including complete details on extent of emergency, cause and the action being taken.

1.18 FIELD MARKING

- .1 Do not use wick pen to mark face of products to be installed in the Work. Such pen marks will show through applied paint or vinyl coatings and the like in due course. The Contractor will be held responsible and required to remedy such defects, classified as "latent defects" regardless of when they occur.

1.19 SECURITY

- .1 Be responsible for security of all areas affected by Work of this Contract until taken over by The Owner. Take steps to prevent entry to the Work by unauthorized persons and guard against theft, fire and damage by any cause. Provide safe and secure access to and egress from existing premises at all times.
- .2 Take acceptable precautions to guard Work site, premises, materials and the public during and after working hours due to the Work of this Contract.

END OF SECTION

1 General

1.1 NORMAL BUSINESS HOURS

- .1 The building is occupied and is to be considered “fully operational”, 24 hours per day, 7 days per week.
- .2 Normal working hours are from 9am-5pm, Monday to Friday. Any work proposed outside of these hours must be approved in advance by the Owner with a minimum of 7-days prior written notice.
 - .1 Written notice shall include a summary of the proposed work, including proposed start time/duration and impacts on base building operations and systems.
- .3 Except as permitted in item 1.2 below, at the end of each working day the building shall be returned to a “fully operational” condition, including but not limited to all functioning building services (life safety, power, water, heating, cooling).

1.2 REMOVAL, RELOCATION AND REINSTALLATION OF EXISTING EQUIPMENT

- .1 Existing rooftop equipment to be relocated during roof replacement – refer to drawings.
 - .1 Existing air handling unit ‘ERV-1’ and fluid cooler ‘FC-1’ shall be relocated to allow unobstructed access to area of work, structural support to be provided during temporary storage.
 - .2 Refer to drawings for temporary removal of all other rooftop equipment.
- .2 Contractor shall assume responsibility for work involved in the temporary relocation of rooftop equipment, including but not limited to:
 - .1 Providing equipment required for removal and reinstallation.
 - .2 Coordinating transportation and off-site storage for equipment, if required.
 - .3 Any temporary shoring required, include roof support/reinforcing during relocation of equipment.
 - .4 Maintaining specified interior temperature as indicated in **Section 01 51 00**.
- .3 A minimum of (14) days notice is required prior to the shutdown of above noted rooftop equipment.

1.3 SCHEDULING THE WORK

- .1 Contractor shall schedule the Work to minimize disruption to normal building operations.
 - .1 Work shall be scheduled to minimize shutdown duration of existing rooftop equipment.
- .2 Site mobilization shall not commence until all materials/products/systems necessary for the completion of Work are in the Contractor’s possession.

1.4 PROJECT DELIVERIES

- .1 All deliveries are to be communicated in advance to The Owner’s Staff for coordination purposes. Contractor shall be responsible for receiving all deliveries within previously agreed location and times.

1.5 NOISY, PAINTING, GLUING, SUBSTANCES WITH VOC'S AND / OR STRONG ODOURS AND TARING (SEALANTS, ROOFING, ETC.)

- .1 The Contractor shall minimize any reduction in comfort at the facility.

1.6 PARKING

- .1 On site parking is not provided.
- .2 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.

1.7 SITE PROTECTION

- .1 Dust barriers must be used at all times during dusty work. Poly sheet dust barriers are to be sealed tight to floor and ceiling and / or to the filter mediums on return air grills etc.
- .2 Clean up after all work must be performed immediately and the area(s) are to be left in a clean and safe manner. Failure to clean properly may result in the Contractor being charged for cleaning services obtained by the Building Management and the Building Management may terminate the Contractor's access.

1.8 ADVANCE NOTIFICATION

- .1 Fourteen (14) business days advance notification is required for any work affecting the building occupants such as the following:
 - .1 Mold remediation (removal) work / asbestos abatement (removal) work.
 - .2 Scanning and core drilling.
 - .3 Notification of start time for painting.
 - .4 Notification of any building system shutdown (i.e. power, water, etc.).
 - .5 Notification of any loss of use area (i.e. resident room, washroom shutdown, lunchroom, etc.).

1.9 BREAKER PANELS

- .1 Electrical panels must not be touched without first informing and obtaining written permission from Consultant and the Building Management.
- .2 Whenever electrical power is shut off the Contractor must "Lock Out" and "Tag Out" any electrical panels or electrical breakers affected.
- .3 Panel schedules to be updated each time a change to it is made.

1.10 DOORS

- .1 For security purposes the building doors are to be close at all times.
 - .1 Exit doors must not be propped open for any reason.
 - .2 All fire doors must be kept closed at all times.

1.11 PROTOCOL FOR SCANNING, CORE DRILLING

- .1 Prior to starting the scan work the contractor hired to carry out the work must provide a copy of their health and safety plan to The Owner.

- .2 The plan must include a copy any of required license(s), a description of the process to be used and any information needed to design safety limits of the work zone. In addition, the plan must include a process to protect the work zone from inadvertent entry, a list of potential hazards that may be encountered by the workers, training and / or instruction that the workers have received to address the hazards and a contingency plan in case of an emergency.
- .3 X-Raying is not allowed without prior authorization.

1.12 CORE DRILLING

- .1 If dry core drilling will be performed appropriate dust control measure must be identified and used. If wet core drilling will be performed, water control measures must be identified and must be used.
- .2 Before commencing the core drilling operation, the Contractor must ensure that it is safe to start drilling. The area must be secured, dust controls are in place, the equipment is set up as intended by the manufacturer, and all safety devices are present and functioning. The location selected to perform the core drilling must be appropriate and will not impact on the structural integrity of the building. The intended path of the coring unit must be free of all embedded power or communication wires, conduits, rebar, pipes and / or structures that could be damaged or disabled.
- .3 All sources of asbestos are not to be disturbed. If this is not possible, the appropriate precautions must be taken to prevent the asbestos from becoming airborne which may include the use of either, a type 1, type 2 or type 3 process to comply with the asbestos designated substance regulations O. Reg 838 as am. O. Reg 510/92.
- .4 All coring debris must be cleaned up and disposed of and the site returned to its original state after the coring is completed.
- .5 If the coring debris contains asbestos, it must be cleaned up following the requirements of the designated substance specifications included in the Contract Documents.

1.13 DESIGNATED SUBSTANCES

- .1 Handling and removal of any designated substances shall follow all applicable legislative requirements. Refer to project specific Designated Substances Report.

1.14 MAINTAINING LIFE SAFETY SYSTEMS IN OCCUPIED FACILITIES

- .1 Maintain operational life safety systems and public access to exits in occupied areas during all stages of the Work.
- .2 Determine nature and exact locations of existing fire and smoke sensors prior to the commencement of the Work. Avoid direct or indirect jarring while working in adjacent areas and exercise caution to avoid triggering these devices.
- .3 Be responsible for costs incurred by Owner on account of false fire alarms activated as a result of the execution of the Work, without adequate precautions.

1.15 PROJECT CONDITIONS, GENERAL

- .1 Most of the project will be performed during regular business hours in an operational residence. Areas will be occupied during normal business hours. At end of each shift, broom clean and leave areas clean and in normal working condition.
- .2 All items removed shall be replaced / returned / reinstalled during same shift.

- .3 The Contractor shall not be responsible for moving furniture and equipment in areas of Work unless specifically specified in the Scope of Work. The Contractor shall be responsible for repairs or replacements of any damaged furniture.
- .4 The Contractor shall cooperate / coordinate with moving contractors retained by Owner, and / or agencies.

1.16 CONTINUITY OF SERVICE

- .1 Where equipment and systems are normally required to operate through the course of the Work, notify The Owner at least 2 weeks prior to the necessary interruption of mechanical or electrical service throughout course of Work
- .2 Keep duration of interruptions to a minimum not to exceed 4 hours. Interruptions lasting longer than 4hrs will require approval from the Owner.

END OF SECTION

1 General

1.1 CASH ALLOWANCES

- .1 Refer to the Construction Agreement Contract Paragraph GC 6.1 Cash Allowances
- .2 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.
- .3 Progress payments on accounts of Work authorized under cash allowances shall be included in the Consultant's monthly certificate for payment.
- .4 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 Sub-contract work.
- .5 Supply only allowances shall include:
 - .1 Net cost of products.
 - .2 Delivery to Site.
 - .3 Applicable taxes and duties, excluding HST.
- .6 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.
 - .6 The amount of each cash allowance does not include Contractor's overhead and profit, and other related costs, which shall be included in the Contract Price and not in the cash allowance.
- .7 Inspection and testing allowances shall include:
 - .1 Net cost of inspection and testing services.
 - .2 Applicable taxes and duties, excluding HST.
- .8 Other costs related to work covered by cash allowances are not covered by the allowance but shall be included in the Contract Price.
- .9 Where costs under a cash allowance exceed the total cumulative amount of all allowances, the Contractor will be compensated for any excess incurred and substantiated plus an allowance for overhead and profit as set out in the Contract Documents.
- .10 The Owner, through Consultant, may request Contractor to identify potential Suppliers or Subcontractors, as applicable, and to obtain at least three competitive prices for each cash allowance item.
- .11 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.
- .12 The Owner, through the Consultant, will determine by whom and for what amount each cash allowance item will be performed. Obtain The Owner's prior written approval in the form of a Cash Allowance Disbursement Authorization (CADA) before entering into a

subcontract, amending an existing subcontract, or performing own forces work included in a cash allowance. Upon issuance of the CADA, the Contractor's responsibilities for a cash allowance item shall be the same as for work of the Contract.

- .13 Where the actual cost of the Work under any cash allowance exceeds the amount of the allowance, any unexpended amounts from other cash allowances shall be reallocated, at the Consultant's direction, to cover the shortfall, and, in that case, there shall be no additional amount added to the Contract Price for overhead and profit. Only where the actual cost of the Work under all cash allowances exceeds the total amount of all cash allowances shall the Contractor be compensated for the excess incurred and substantiated, plus an amount for overhead and profit on the excess only, as set out in the Contract Documents.
- .14 The "Cash Allowances" expected and the amount of each allowance is listed on the Rate Bid Form included in the Bid package.

END OF SECTION

1 General

1.1 ALTERNATIVES AND SUBSTITUTIONS

- .1 Refer to the Rate Bid Form included in the Bid package - Alternate Prices.
- .2 Requests for substitutions will not be accepted prior to the Notification of Award. Where the Specifications include the "or approved alternate" of "equivalent" clauses, substitutions will be considered by The Owner and Consultant provided that:
 - .1 The materials and / or products specified are not available.
 - .2 Substitute products to those specified, which are brought to the attention of, and considered by Project Team after the Contract Award as "equivalent" to those specified will result in a credit to the Contract Price.
 - .3 Substitute products to those specified which are brought to the attention of, and considered by Project Team after the Contract Award as "superior" to those specified will result in a change to the Contract Price.
 - .4 The proposed substitutions have been investigated and complete data are submitted in accordance with the Specifications. Proposed substitutions to show the material and product names and complete data and specifications and state what difference, if any, will be made to the Contract Price for each substitution, should it be accepted.
 - .5 Data relating to changes in the Contract Schedule, if any, and relation to other Work have been submitted.
 - .6 Same warranty is given for the substitution as for the original product specified.
 - .7 All claims are waived for additional costs related to the substitution which may subsequently arise. Installation of the accepted substitution is coordinated 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.
 - .8 Should the proposed substitution be accepted either in part or in whole, the Contractor will assume full responsibility when the substitution affects any other work or work of other Sections (Subcontractors). Drawing changes required as a
 - .9 result of the substitution will be executed by the Consultant at the Contractor's expense.
 - .10 Proposed substitutions must satisfy all design conditions and other specified requirements. Properties included but not limited to the following as applicable, will be considered:
 - .1 Physical dimension requirements must satisfy the space limitations,
 - .2 Static and dynamic weight limitations,
 - .3 Structural properties,
 - .4 Audible noise levels,
 - .5 Vibration generation,
 - .6 Interchangeability of parts and / or components,
 - .7 Accessibility for maintenance,
 - .8 Possible removal or replacement,
 - .9 Colours,

- .10 Textures,
- .11 Compatibility with other materials, products, assemblies and components.
- .3 Substitutions to methods or process described in the Specifications or drawings, may be proposed for the consideration of the Consultant.
- .4 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;
 - .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 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;
 - .4 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.
- .5 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.
 - .3 Contractor fails to order a specified Product or order a Product by a specified manufacturer in adequate time to meet Contractor's construction schedule
- .6 Do not substitute products or methods or processes into the Work unless such substitutions have been specifically approved for the Work by the Consultant.
- .7 Approved substituted products shall be subject to Consultant's sole discretion. Approved substituted products shall only be installed after receipt of the Consultant's written approval.
- .8 The cost of changes in the Work of a Contractor necessitated by the use of proposed material and / or product substitution is to be borne by the Contractor proposing the substitution.
- .9 The Contract Price will be adjusted accordingly to any and all credits arising from the substitutions mentioned above.

1.2 SUBMISSION REQUIREMENTS FOR PROPOSED SUBSTITUTIONS

- .1 Include with each proposed Substitution the following information:
 - .1 Identification of the Substitution, including product name and manufacturer's name, address, telephone numbers, and web site.
 - .2 Reason(s) for proposing the Substitution.
 - .3 A statement verifying that the Substitution will not affect the Contract Price and Contract Time or, if applicable, the amount and extent of a proposed increase or decrease in Contract Price and Contract Time on account of the Substitution.
 - .4 A statement verifying that the Substitution will not affect the performance (or warrant) of other parts of the Work.
 - .5 Manufacturer's Product literature for the Substitution, including material descriptions, compliance with applicable codes and reference standards, performance and test data, compatibility with contiguous materials and systems, and environmental considerations.

- .6 Product samples as applicable.
- .7 A summarized comparison of the physical properties and performance characteristics of the specified Product and the Substitution, with any significant variations clearly highlighted.
- .8 Availability of maintenance services and sources of replacement materials and parts for the Substitution, as applicable, including associated costs and time frames.
- .9 If applicable, estimated life cycle cost savings resulting from the Substitution.
- .10 Details of other projects and applications where the Substitution has been used.
- .11 Identification of any consequential changes in the Work to accommodate the Substitution and any consequential effects on the performance of the Work as a whole. A later claim for an increase to the Contract Price or Contract Time for other changes in the Work attributable to the Substitution will not be considered.

1.3 METHODS OR PROCESSES SUBSTITUTIONS

- .1 The Contractor may suggest, for the consideration of the Project Team, substitutions to methods or processes described in the Specifications and / or shown on the Drawings. Any application for such substitutions must indicate how such substitutions are advantageous to the Owner or to the better fulfillment of the Contract. There shall be no obligation on the parties concerned to accept any such suggestions. Requests for alternatives must be made in duplicate and be accompanied by catalogue cuts, specifications and methods of installation.
- .2 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.
- .3 The Contractor will be responsible for substitutions to methods or processes concerning such work, and the warranty covering all parts of the Work shall not be affected.
- .4 The cost of all changes in the work of other Sections (Subcontractors) necessitated by the use of substituted methods or processes, is to be borne by the Section (Subcontractor) proposing the substitution.
- .5 Said methods or processes must fit into the space allotted for the specified methods or processes.

1.4 CREDITS ARISING FROM SUBSTITUTIONS

- .1 Any and all credits arising from the substitutions mentioned will be credited to the Contract and the Contract Price will be adjusted accordingly.

1.5 RELATED CHANGES

- .1 The Contractor will advise Subcontractors and suppliers and make all necessary changes to the related Work occasioned by Owner's acceptance of alternatives.

END OF SECTION

1 General

1.1 MODIFICATIONS TO CONTRACT

- .1 Supplemental Instruction: As issued by the Consultant, consistent with the intent of the Contract Documents, and will not involve an adjustment in Contract Price or Contract Time.
- .2 Proposed Change: As issued by the Consultant, will notify the Contractor of an impending or proposed change to the Work, and will require submission of a quotation from the Contractor and all affected Subcontractors for each item noted. Submit quotation within the time period stipulated on the form, and indicate separate line item for labour and materials in each case. Work outlined in a Proposed Change must not proceed without the issuance of a Change Order signed by The Owner.
- .3 Change Directive: Will be issued by the Consultant where an immediate response is required to an on-site condition. This form will authorize the Contractor to proceed with the change, with the stipulation that accurate accounts of costs be recorded, and may contain an upset cost, as agreed upon in advance by The Owner and the Contractor.
- .4 Change Order: Will be issued by the Consultant upon review and approval of quotations for a Proposed Change, or a Change Directive, and authorizes the Contractor to proceed with the change(s) proposed. A Change Order will amend the Contract Price, and/or the Contract Time.
- .5 Extras shall not be granted due to the Contractor's unfamiliarity with the site or due to the Contractor's lack of thorough investigation prior to bid submission.
- .6 Any additions to the Work under this contract shall conform to all construction standards and conditions laid out herein, whether or not such conditions are expressly stated in The Owner's acceptance of the addition(s).
- .7 The Contractor shall not proceed with Work in addition to the Contract Documents until the formal change process has been completed.
- .8 Any request for additional time submitted with a Change Order shall be substantiated with supporting documentation and analysis, such as time impact analysis and critical path analysis. The Contractor shall establish how the critical path has shifted. The Contractor shall also submit a recovery plan demonstrating how the Contractor will recover the schedule.

1.2 CHANGE ORDER PROCEDURES

- .1 Upon issuance by the Consultant to the Contractor of a proposed change in the Work, and unless otherwise requested in the proposed change or unless otherwise agreed:
 - .1 Submit to the Consultant a fixed price quotation for the proposed change in the Work within 5 days after receipt of the proposed change in the Work.
 - .2 If requested in the proposed change, provide a detailed breakdown of the price quotation including the following to the extent applicable, with appropriate supporting documentation:
 - .1 Estimated labour costs, including hours and applicable hourly rates based on the accepted schedule of labour rates.
 - .2 Estimated Product costs, including Supplier quotations, estimated quantities and unit prices.
 - .3 Estimated Construction Equipment costs.
 - .4 Enumeration of all other estimated costs included in the price quotation.
 - .5 Estimated credit amounts for labour and Products not required on account of the proposed change.
 - .6 Where applicable, Subcontractor quotations, also including a detailed

breakdown of all of the above.

- .7 Include in the quotation the increase or decrease to the Contract Time, if any, for the proposed change, stated in number of days.
- .8 Include in the quotation the number of days for which the quotation is valid.
- .2 The quotation will be evaluated by the Consultant and The Owner and, if accepted by The Owner, be documented in the form of a signed Change Order.

1.3 FEES FOR OVERHEAD AND PROFIT – CHANGE ORDERS

- .1 Refer to the Construction Agreement Contract Paragraph GC 7.2 Change Order.

1.4 CHANGE DIRECTIVE PROCEDURES

- .1 Refer to the Construction Agreement Contract Paragraph GC 7.3 Change Directive.

1.5 FEES FOR OVERHEAD AND PROFIT – CHANGE DIRECTIVES

- .1 Refer to the Construction Agreement Contract Paragraph GC 7.3 Change Directive.

END OF SECTION

1 General

1.1 SCHEDULE OF VALUES

- .1 Prior to the first application for payment, submit for Consultant's review an initial schedule of values. Modify the initial schedule of values if and as requested by Consultant. Obtain Consultant's written acceptance of the initial schedule of values prior to the first application for payment.
- .2 Together with the first and all subsequent applications for payment, submit updated versions of the schedule of values to indicate the values, to the date of application for payment, of work performed and Products delivered to Place of the Work.
- .3 Provide the schedule of values in an electronic spreadsheet format acceptable to the Consultant.
- .4 A work breakdown structure that is sufficiently detailed and comprehensive to facilitate Consultant's evaluation of applications for payment at an appropriate level of detail.
- .5 Provisions for approved Change Orders [allowances,] [unit price work] [and] [assignable contracts] so that the breakdown amounts indicated in the schedule of values aggregate to the current total Contract Price. Also provide for indicating the estimated value of Change Directives within the schedule of values, separately from the current total Contract Price.
- .6 For each item in the work breakdown structure, provide as a minimum the following information, under headings as indicated:
 - .1 Performed to Date: The value of Work performed and Products delivered to Place of the Work up to the date of the application for payment, stated as a percentage of the Contract Price and in dollars.
 - .2 Previously Performed: The value of Work performed and Products delivered to the Place of the Work for which payment has been previously certified, stated in dollars.
 - .3 Current Period: The value of Work performed and Products delivered to Place of the Work for which Contractor is currently applying for payment, stated in dollars.
 - .4 Balance to Complete: The value of Work not yet performed and Products not yet delivered to Place of the Work, stated in dollars.

1.2 CASH FLOW PROJECTION

- .1 Prior to the first application for payment submit, for *Consultant's* review, a forecast of approximate monthly progress payments for each month of the *Contract Time*.
- .2 Submit revised cash flow forecasts when required due to significant changes in rate of progress of the *Work* or significant changes in the *Contract Price*.

1.3 WORKERS' COMPENSATION CLEARANCE

- .1 Submit proof of workers' compensation clearance with each application for payment.

1.4 STATUTORY DECLARATIONS

- .1 Submit a statutory declaration in the form of CCDC 9A – Statutory Declaration of Progress Payment Distribution by Contractor with each application for payment except the first.

END OF SECTION

1 General

1.1 COORDINATION

- .1 Coordination of the work of all Sections of the specifications as required to complete the Project is the responsibility of the Contractor.
- .2 Cooperation:
 - .1 Provide forms, templates, anchors, sleeves, inserts and accessories required to be fixed to or inserted into work and set in place or instruct separate Sections (Subcontractors) as to their locations.
 - .2 Supply items to be "Built-In" as and when required together with templates, measurements, shop drawings and other related information and assistance.
 - .3 Pay the cost of extra work and make up time lost as a result of failure to provide necessary information and items to be "Built-In" in adequate time.
- .3 Coordination:
 - .1 Ensure that Subcontractors cooperate with each other including Other Contractors employed by The Owner, so that Work will be carried out expeditiously and will be satisfactory in all respects at completion.
 - .2 Ensure that Subcontractors examine Contract Documents with particular emphasis to work of other Sections which may affect the performance of their own work.
 - .3 Ensure Subcontractors cooperate with other Sections whose work attaches to or is affected by their own work, and ensure that minor adjustments are made to make adjustable work fit to fixed work.
 - .4 Ensure that Subcontractors requiring foundations or openings to be left for the installation of their Work furnish the necessary information to the Sections concerned in ample time so that proper provisions can be made.
 - .5 Pay particular attention to applied fireproofing requirements. Coordinate work to remove/reinstate services that may impede the application of continuous applied fireproofing to the required thickness for the scheduled fire resistance rating.
 - .6 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 the Owner.
 - .7 Ensure that items to be "Built-In" are supplied as and when required by Sections (Subcontractors) building in the items together with templates, measurements or shop drawings and other related information and assistance.
 - .8 Ensure coordination of products supplied in metric and imperial units into the overall layout.
 - .9 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 their responsibility to provide and maintain the specified warranties.
 - .10 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, Sub-trades required for, and make up time lost as result of, failure to comply with this requirement, at no additional cost to the Owner.
- .11 Coordinate with removals/installations specified in other Divisions and Other Contracts.
 - .12 Properly coordinate the work of the various Sections and trades 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.
 - .13 In case of damage to active services or 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.
 - .14 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 Owner's Project Team and Consultant for review before the commencement of Work.
- .4 Other Contractors:
- .1 The Contractor is responsible to correlate and coordinate all work with that of Other Contractors having separate contracts with The Owner in order to complete the Work as expeditiously as possible.
 - .2 Prior to commencement of work, ensure that all Sections (Subcontractors) are fully conversant with the extent of the work, the conditions and materials on the project, the schedule of completion, restrictions to safety, and access.
 - .3 Inform all Sections (Subcontractors) that each is responsible for checking all Sections of the specification for work pertaining to their Section (Subcontractor's work).
- .5 Authorities and inspectors:
- .1 City Inspector: Coordinate and cooperate with City Inspector as required to review specific site work to meet Building Permit requirements.
- .6 Administrative Coordination:
- .1 Coordinate work of this section to ensure information and material are promptly provided to ensure orderly and expeditious progress of the work, and to comply with schedule for completion.

END OF SECTION

1 General

1.1 SUMMARY

- .1 This Section specifies Contractor's responsibilities for preparation and submission of schedules and other documentation related to tracking construction progress.
- .2 The purpose of submitting progress schedules is to:
 - .1 Inform Owner and Consultant of actual progress versus planned progress, and
 - .2 Provide assurance that scheduling issues are being proactively identified and addressed in a timely manner, and that planned progress is being maintained as closely as possible.

1.2 CONSTRUCTION PROGRESS SCHEDULE

- .1 Format and Content:
 - .1 Prepare schedule in the form of a Critical Path Method (CPM) Gantt chart using Microsoft Project or equivalent software as agreed.
 - .2 Provide a work breakdown structure identifying key activities, work packages, and major milestones, including long delivery Products, inspection and testing activities, preparation and review of mock-ups, Owner decisions for cash allowances, shutdown or closure activities, delivery of Owner supplied Products, Owner performed work, demonstration and training activities, and similar items, at a sufficient level of detail to effectively manage construction progress.
 - .3 Indicate milestone dates for Ready-for-Takeover and Substantial Performance of the Work.
- .2 Submission:
 - .1 Submit initial schedule to *Owner* and *Consultant* within 15 *Working Days* after *Contract* award via email as .pdf file.
 - .2 Submit updated progress schedule monthly to Owner and Consultant, indicating actual and projected start and finish dates with report date line and progress, critical path, float, and baseline comparison to current progress.

1.3 SUBMITTALS SCHEDULE

- .1 Format and Content:
 - .1 Prepare schedule identifying all required *Shop Drawing*, *Product* data, and sample submissions, including samples required for testing.
 - .2 Prepare schedule in electronic format.
 - .3 Provide a separate line for each required submittal, organized by *Specifications* section names and numbers, and further broken down by individual *Products* and systems as required.
 - .4 For each required submittal, show planned earliest date for initial submittal, earliest date for return of reviewed submittal by *Consultant* and latest date for

return of reviewed submittal without causing delay.

- .5 Allow time in schedule for resubmission of submittals, should resubmission be necessary.
- .2 Submission:
 - .1 Submit initial schedule to Consultant within 15 Working Days after Contract award via email.
 - .2 Submit updated submittals schedule monthly to Owner and Consultant.

1.4 SCHEDULE MANAGEMENT

- .1 A schedule submitted as specified and accepted by Consultant shall become the baseline schedule and shall be used as the baseline for updates.
- .2 At each regular progress meeting, review and discuss current construction progress and submittals schedules with Consultant and Owner, including activities that are behind schedule and planned measures to regain schedule slippage in key areas on or near the critical path.
- .3 Activities considered behind schedule are those with start or completion dates later than the dates shown on the baseline schedule.

1.5 RECORDING ACTUAL SITE CONDITIONS ON AS-BUILT DRAWINGS

- .1 Obtain from *Consultant* an electronic copy of the construction *Drawings* for the purpose of creating as-built drawings. Record information in electronic form, clearly identifying as-built deviations from the originally obtained construction *Drawings*.
- .2 Clearly label each drawing as "AS-BUILT DRAWING". Record information concurrently with construction progress. Do not conceal *Work* until required information is recorded.
- .3 Record actual construction including:
 - .1 Measured depths of elements of foundation in relation to finish first floor datum.
 - .2 Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
 - .3 Measured locations of pipes, ducts, conduits, outlets, fixtures, access panels, and appurtenances, referenced to visible and accessible features of construction.
 - .4 Field changes of dimension and detail.
 - .5 Changes made by Change Orders and Supplemental Instructions
 - .6 References to Shop Drawings, where Shop Drawings show more detail.
- .4 Do not use as-built drawings for construction purposes.

1.6 PROGRESS PHOTOGRAPHS

- .1 Arrange for periodic digital photography to document and provide a photographic record of the progress of the *Work*.

- .2 Identify each photograph by project name and date taken.
- .3 Submission: Submit .jpg format files in standard resolution via project web site monthly.
- .4 Do not use progress or any other *Project* photographs for promotional purposes without *Owner's* written consent.

END OF SECTION

1 General

1.1 ADMINISTRATIVE

- .1 Submit specified submittals to Consultant for review. Submit with reasonable promptness and in orderly sequence so as to not cause delay in the Work. Failure to submit in ample time is not considered sufficient reason for an extension of Contract Time or for Product substitutions or other deviations from the Drawings and Specifications.
- .2 Where required by authorities having jurisdiction, provide submittals to such authorities for review and approval.
- .3 Do not proceed with Work affected by a submittal until review is complete.
- .4 Present Shop Drawings, Product data, and samples in SI metric units. Where items or information is not produced in SI Metric, converted values are acceptable.
- .5 Review submittals, provide verified field measurements where applicable, and affix Contractor's review stamp prior to submission to Consultant. Contractor's review stamp represents that necessary requirements have been determined and verified, and that the submittal has been checked and coordinated with requirements of the Work and Contract Documents.
- .6 Verify field measurements and that affected adjacent work is coordinated.
- .7 Submittals not meeting specified requirements will be returned with comments.
- .8 Reproduction of construction Drawings to serve as background for Shop Drawings is not permitted.
- .9 Do not propose Substitutions or deviations from Contract Documents via Shop Drawing, Product data and sample submittals. Proposed alternates must follow the procedures outlined in Section 01 25 00.

1.2 SHOP DRAWINGS AND PRODUCT DATA

- .1 Indicate Products, methods of construction, and attachment or anchorage, erection diagrams, connections, explanatory notes and other information necessary for completion of the Work.
- .2 Where Products attach or connect to other Products, indicate that such items have been coordinated, regardless of Section under which adjacent items will be supplied and Installed. Indicate cross-references to Drawings, Specifications and other already reviewed Shop Drawings.
- .3 Accompany submittals with a transmittal information including:
 - .1 Date.
 - .2 *Project* title and number.
 - .3 *Contractor's* name and address.
 - .4 Identification of each submittal item and quantity.
 - .5 Other pertinent data.
- .4 *Shop Drawing* submittals shall include:
 - .1 Date and revision dates.
 - .2 *Project* title and number.
 - .3 Name and address of:
 - .1 Subcontractor.
 - .2 Supplier.

- .3 Manufacturer.
- .4 *Contractor's* stamp, date, and signature of *Contractor's* authorized representative responsible for *Shop Drawing* review, indicating that each *Shop Drawing* has been reviewed for compliance with *Contract Documents* and, where applicable, that field measurements have been verified.
- .5 Details of appropriate portions of the *Work* as applicable:
 - .1 Fabrication.
 - .2 Layout, showing dimensions, including identified field dimensions, and clearances.
 - .3 Setting or erection details.
 - .4 Capacities.
 - .5 Performance characteristics.
 - .6 Standards.
 - .7 Operating weight.
 - .8 Wiring diagrams.
 - .9 Single line and schematic diagrams.
 - .10 Relationships to other parts of the *Work*.
- .6 *Product* data submittals shall include material safety data sheets (MSDS) for all controlled *Products*.
- .7 Submit electronic copy of *Shop Drawings* where specified in the technical *Specifications*
- .8 Submit electronic copy of *Product* data sheets or brochures where specified in the technical *Specifications*.
- .9 Where a submittal includes information not applicable to the *Work*, clearly identify applicable information and strike out non-applicable information.
- .10 Supplement standard information to include details applicable to *Project*.
- .5 Allow 5 *Working Days* for *Consultant's* review of each submittal and incorporate in submittals schedule specified in Section 01 32 00 – Construction Progress Documentation. Allow additional 3 *Working Days* where sub-*Consultant* review is required.
- .6 If upon *Consultant's* review no errors or omissions are discovered, or if only minor corrections are required as indicated, submittal will be returned and fabrication or installation of *Work* may proceed.
- .7 If upon *Consultant's* review significant errors or omissions are discovered, a so noted copy will be returned for correction and resubmission. Do not commence fabrication or installation.
- .8 *Consultant's* notations on submittals are intended to ensure compliance with *Contract Documents* and are not intended to constitute a change in the *Work* requiring change to the *Contract Price* or *Contract Time*. If *Contractor* considers any *Consultant's* notation to be a change in the *Work*, promptly notify *Consultant* in writing before proceeding with the *Work*.
- .9 Resubmit corrected submittals through same procedure indicated above, before any fabrication or installation of the *Work* proceeds. When resubmitting, notify *Consultant* in writing of any revisions other than those requested by *Consultant*.

1.3 SAMPLES

- .1 Submit samples for *Consultant's* review in triplicate where specified in the technical *Specifications*. Label samples as to origin, *Project* name, and intended use.
- .2 Deliver samples prepaid to *Consultant's* business address.
- .3 Notify *Consultant* in writing of any deviations in samples from requirements of *Contract Documents*.
- .4 Where a required colour, pattern or texture has not been specified, submit full range of available *Products* meeting other specified requirements.
- .5 *Consultant* selection from samples is not intended to change the *Contract Price* or *Contract Time*. If a selection would affect the *Contract Price* or *Contract Time*, notify *Consultant* in writing prior to proceeding with the *Work*.
- .6 Resubmit samples as required by *Consultant* to comply with *Contract Documents*.
- .7 Reviewed and accepted samples will establish the standard against which installed *Work* will be reviewed.

END OF SECTION

1 General

1.1 REFERENCE STANDARDS

- .1 "Reference standards" means consensus standards, trade association standards, guides, and other publications expressly referenced in Contract Documents.
- .2 Where an edition or version date is not specified, referenced standards shall be deemed to be the latest edition or revision issued by the publisher at the time of bid closing. However if a particular edition or revision date of a specified standard is referenced in an applicable code or other regulatory requirement, the regulatory referenced edition or version shall apply.
- .3 Reference standards establish minimum requirements. If Contract Documents call for requirements that differ from a referenced standard, the more stringent requirements shall govern.
- .4 If compliance with two or more reference standards is specified and the standards establish different or conflicting requirements, comply with the most stringent requirement. Refer uncertainties to Consultant for clarification.
- .5 Within the Specifications, reference may be made to the following standards writing, testing, or certification organizations by their acronyms or initialisms:
 - .1 AA - Aluminum Association
 - .2 ACI - American Concrete Institute
 - .3 AISC - American Institute of Steel Construction
 - .4 ANSI - American National Standards Institute
 - .5 ASME - American Society of Mechanical Engineers
 - .6 ASTM - American Society for Testing and Materials
 - .7 AWMAC - Architectural Woodwork Manufacturers Association of Canada
 - .8 AWPA - American Wire Producers Association
 - .9 CaGBC - Canadian Green Building Council
 - .10 CGSB - Canadian General Standards Board
 - .11 CISC - Canadian Institute of Steel Construction
 - .12 CPCI - Canadian Prestressed Concrete Institute
 - .13 CSA - Canadian Standards Association
 - .14 CSSBI - Canadian Sheet Steel Building Institute
 - .15 CWB – Canadian Welding Bureau
 - .16 ICEA - Insulated Cable Engineers Association
 - .17 IEEE - Institute of Electrical and Electronics Engineers
 - .18 IGMAC – Insulating Glass Manufacturers Association of Canada
 - .19 LEED - Leadership in Energy and Environmental Design
 - .20 MPP – Master Painters Institute
 - .21 MSS - Manufacturers Standardization Society of the Valve and Fittings Industry
 - .22 NAAMM - National Association of Architectural Metal Manufacturers
 - .23 NEMA - National Electrical Manufacturers Association
 - .24 NFPA - National Fire Protection Association

- .25 NHLA - National Hardwood Lumber Association
- .26 NLGA - National Lumber Grades Authority
- .27 SSPC – The Society for Protective Coatings
- .28 TTMAC - Terrazzo, Tile and Marble Association of Canada
- .29 ULC - Underwriters' Laboratories of Canada

1.2 INDEPENDENT INSPECTION AND TESTING AGENCIES

- .1 Except as otherwise specified, Owner will retain and pay for independent inspection and testing agencies to inspect, test, or perform other quality control reviews of parts of the Work.
- .2 Retain and pay for inspection and testing that is for Contractor's own quality control or is required by regulatory requirements.
- .3 Section 01 21 00 – Allowances specifies a cash allowance for independent inspection and testing services to be retained and paid for by Contractor. Cash allowance excludes any inspection and testing that is for Contractor's own quality control or is required by regulatory requirements.
- .4 Employment of inspection and testing agencies by Contractor or Owner does not relieve Contractor from responsibility to perform the Work in accordance with Contract Documents.
- .5 Allow and arrange for inspection and testing agencies to have access to the Work, including access to off site manufacturing and fabrication plants.
- .6 For inspection and testing required by Contract Documents or by authorities having jurisdiction, provide Consultant and inspection and testing agencies with timely notification in advance of required inspection and testing.
- .7 Submit test samples required for testing in accordance with submittals schedule specified in Section 01 32 00 – Construction Progress Documentation.
- .8 Provide labour, Construction Equipment and temporary facilities to obtain and handle test samples on site.

1.3 INSPECTION AND TESTING AGENCY REPORTS

- .1 For inspection and testing required by *Contract Documents* or by regulatory requirements, and performed by *Contractor* retained inspection and testing agencies, submit to *Consultant* copies of reports. Submit within 3 days after completion of inspection and testing.
- .2 For inspection and testing performed by *Owner* retained inspection and testing agencies, copies of inspection and testing agency reports will be provided to *Contractor*.

1.4 MOCK-UPS

- .1 Prepare mock-ups of *Work* as specified in the technical *Specifications*. If a mock-up location is not indicated in the *Drawings* or *Specifications*, locate where directed by *Consultant*.
- .2 Modify mock-up as required until *Consultant* approval is obtained.
- .3 Approved mock-ups establish an acceptable standard for the *Work*.
- .4 Protect mock-ups from damage until the *Work* they represent is complete.
- .5 Unless otherwise specified in the technical *Specifications*, approved mock-ups forming part of the *Work* may remain as part of the *Work*.
- .6 Remove mock-ups only when the *Work* they represent is complete or when otherwise directed by *Consultant*.

END OF SECTION

1 General

1.1 TEMPORARY WORK

- .1 Accept responsibility for all temporary structures and comply with applicable rules and regulations. Pay all taxes and all other charges.
- .2 The expression "provide" shall be deemed to include the provision, installation and finishing, maintenance, servicing and removal of the work described. All Work damaged by temporary installations shall be repaired and made good at no expense to the Owner.

1.2 TEMPORARY UTILITIES - GENERAL

- .1 Provide temporary utilities as specified and as otherwise necessary to perform the Work expeditiously.
- .2 Remove temporary utilities after use.

1.3 TEMPORARY WATER SUPPLY

- .1 Separate from water required for fire protection with adequate pressure at every floor, except hose extensions which shall be provided by Subcontractors requiring them.
- .2 Water supply shall be potable, available from existing service. Be responsible for the careful and reasonable use of any Owner supplied water.
- .3 If large quantity of water is required for the Work, a water meter shall be provided to monitor Contractor's water usage. Provide proof to Consultant of no drop in water pressure in water supply for affected tenant (s) (i.e. Contractors using hydrodemolition method to remove concrete in a project or similar instances).

1.4 TEMPORARY HEATING AND VENTILATION

- .1 *Contractor* may connect to and use *Owner's* existing supply of natural gas for temporary use during construction, subject to existing available volume and pressure. Usage at no cost to *Contractor*.
- .2 Vent construction heaters in enclosed spaces to the outside or use flameless type of construction heaters.
- .3 Provide temporary heat for the *Work* as required to:
 - .1 Facilitate progress of *Work*.
 - .2 Protect the *Work* against dampness and cold.
 - .3 Prevent moisture condensation on surfaces, freezing, or other damage to finishes or stored *Products*.
 - .4 Maintain specified minimum ambient temperatures and humidity levels for storage, installation and curing of *Products*.
 - .5 Maintain interior temperature of minimum 21 degrees C from October 1 to May 15.
 - .6 After building is enclosed, maintain interior temperature of minimum 20 degrees C.
- .4 Provide temporary ventilation for the *Work* as required to:
 - .1 Prevent accumulations of fumes, exhaust, vapours, gases and other hazardous, noxious, or volatile substances in enclosed spaces, as required to maintain a safe work environment meeting applicable regulatory requirements.
 - .2 Ensure that hazardous, noxious, or volatile substances do not migrate to *Owner* occupied spaces.
 - .3 Ventilate temporary sanitary facilities.

- .4 New permanent building heating and ventilation systems may be used during construction, at Contractor's option. If used during construction:
 - .1 Owner will pay utility costs resulting from the use of permanent systems.
 - .2 Operate systems in a non-wasteful and energy efficient manner. Be responsible for any system damage.
 - .3 Just prior to *Substantial Performance of the Work*, replace filters, and perform other required maintenance to ensure systems are in as near as new condition as possible. Refer also to Division 15 requirements.
 - .4 Ensure that systems manufacturers' warranties do not commence until the date of *Substantial Performance of the Work* or, if manufacturers' warranties do commence earlier when systems are put into use, arrange for necessary extension of manufacturers' warranties or provide equivalent coverage under *Contractor's* warranty.

1.5 TEMPORARY COOLING

- .1 If base building cooling is rendered inoperable during the cooling season (From June 1 to September 30, or when interior temperature exceeding 25 degrees C), provide temporary cooling to maintain normal building operations.

END OF SECTION

1 General

1.1 CONSTRUCTION FACILITIES - GENERAL

- .1 Provide temporary construction facilities as necessary for performance of the *Work* and in compliance with applicable regulatory requirements.
- .2 Maintain temporary construction facilities in good condition for the duration of the *Work*.
- .3 Remove temporary construction facilities from *Place of the Work* when no longer required.

1.2 CONSTRUCTION PARKING

- .1 Parking at the *Place of the Work* is not provided. Contractor will be responsible for securing parking, according to their own requirements.

1.3 VEHICULAR ACCESS

- .1 Provide and maintain adequate access to Place of the Work.
- .2 Existing roads at Place of the Work may be used for access to Place of the Work, provided Contractor assumes responsibility for any damage caused by construction traffic, and prevents or promptly cleans up any mud tracking or material spillage.

1.4 SANITARY FACILITIES

- .1 The Contractor will not be granted access to a dedicated sanitary facility within the existing building. It shall be the Contractor's responsibility to provide their own temporary sanitary facilities and remove said temporary facilities at the conclusion of the work.

1.5 FIRE PROTECTION

- .1 Provide and maintain temporary fire protection systems and equipment during construction. Contractor shall provide firewatch as required; costs for firewatch shall be included in base bid price.

1.6 ELEVATORS

- .1 Permanent elevators may be used by construction personnel and for transporting Products, at *Contractor's* option. If used during construction:
 - .1 Provide protective coverings for finish surfaces of cars and entrances.
 - .2 Just prior to *Substantial Performance of the Work*, perform required maintenance to ensure elevators are in as near as new condition as possible.
 - .3 Ensure that elevator manufacturer's warranty does not commence until the date of *Substantial Performance of the Work* or, if manufacturer's warranty does commence earlier when elevators are put into use, arrange for necessary extension of manufacturer's warranty or provide equivalent coverage under *Contractor's* warranty.

END OF SECTION

1 General

1.1 BARRIERS AND ENCLOSURES - GENERAL

- .1 Provide temporary barriers and enclosures necessary to protect the public and building occupants and to secure *Place of the Work* during performance of the *Work*.
- .2 Comply with applicable regulatory requirements.
- .3 Maintain temporary barriers and enclosures in good condition for the duration of the *Work*.
- .4 Remove temporary barriers and enclosures from *Place of the Work* when no longer required.

1.2 FENCING

- .1 Erect temporary security and safety site fencing, minimum 1.8m high, using self-supporting wire fence sections enclosing applicable portions of site as necessary to maintain safety and security. Maintain site fencing in good repair until removed.

1.3 WEATHER ENCLOSURES

- .1 Provide weather tight enclosures to unfinished door and window openings, tops of shafts and other openings in floors and roofs.
- .2 Provide weather enclosures to protect floor areas where walls are not finished and to enclose work areas that require temporary heating.
- .3 Design weather enclosures to withstand wind pressure and snow loading requirements.

1.4 DUST TIGHT PARTITIONS

- .1 Provide dust tight wood stud and plywood and/or steel stud and gypsum board partitions to localize interior building areas from dust and noise generating activities.
- .2 Erect, maintain, and relocate partitions as required to facilitate construction operations and *Owner's* operational requirements.

1.5 EXIT ROUTES

- .1 Maintain required access to exiting within the building.
- .2 If exit routes are temporarily altered during the *Work*, Contractor shall have proposed modifications reviewed/approved by the Authority Having Jurisdiction.
- .3 Provide temporary signage to the satisfaction of the Authority Having Jurisdiction for any modified exit routes.

1.6 FIRE ROUTES

- .1 Maintain fire access routes, including overhead clearances, for use by emergency response vehicles.

1.7 PROTECTION OF BUILDING FINISHES

- .1 Provide necessary temporary barriers and enclosures to protect [existing and] completed or partially completed finished surfaces from damage during performance of the *Work*.

END OF SECTION

1 General

1.1 TEMPORARY CONTROLS - GENERAL

- .1 Provide temporary controls as necessary for performance of the *Work* and in compliance with applicable regulatory requirements.
- .2 Maintain temporary controls in good condition for the duration of the *Work*.
- .3 Remove temporary controls and *Construction Equipment* used to provide temporary controls from *Place of the Work* when no longer required.

1.2 DUST AND PARTICULATE CONTROL

- .1 Implement and maintain dust and particulate control measures in accordance with applicable regulatory requirements.
- .2 Execute *Work* by methods that minimize dust from construction operations and spreading of dust on site or to adjacent properties.
- .3 Provide temporary enclosures to prevent extraneous materials resulting from sandblasting or similar operations from contaminating air beyond immediate work area.
- .4 Cover or wet down dry materials and rubbish to prevent blowing dust and debris. Provide dust control for temporary roads.
- .5 Use appropriate covers on trucks hauling fine, dusty, or loose materials.

1.3 DEWATERING

- .1 Provide temporary drainage and pumping as necessary to dewater excavations, trenches, foundations, and other parts of the *Work*. Maintain such areas free of water arising from groundwater or surface run-off, as required to keep them stable, dry, and protected from damage due to flooding.
- .2 Maintain standby equipment necessary to ensure continuous operation of dewatering system.
- .3 Do not pump water containing suspended materials or other harmful substances into waterways, sewers or surface drainage systems. Treat or dispose of such water in accordance with applicable regulatory requirements

1.4 SITE DRAINAGE

- .1 Maintain grades to ensure proper site drainage.
- .2 Prevent surface water runoff from leaving the site.
- .3 Prevent precipitation from infiltrating or from directly running off stockpiled materials. Cover stockpiled materials with an impermeable liner during periods of work stoppage including at end of each *Working Day*.
- .4 Control surface drainage from cuts and fills, from borrow and waste disposal areas, from stockpiles, staging areas, and other work areas as required to prevent erosion and sedimentation.
- .5 Control surface drainage by ensuring that gutters are kept open and water is not directed across or over pavements or sidewalks, except through pipes or properly constructed troughs. Ensure that runoff from unfinished areas is intercepted and diverted to suitable outlets.

1.5 EROSION AND SEDIMENT CONTROL

- .1 Minimize amount of bare soil exposed at one time. Stabilize disturbed soils as quickly as practical to minimize erosion. Remove accumulated sediment resulting from construction

activity from adjoining surfaces, drainage systems, and watercourses, and repair damage caused by soil erosion and sedimentation.

- .2 Provide and maintain appropriate temporary measures such as silt fences, straw bales, ditches, geotextiles, drains, berms, terracing, riprap, temporary drainage piping, sedimentation basins, vegetative cover, dikes, and other measures that may be required to prevent erosion and migration of silt, mud, sediment, and other debris.
- .3 Do not disturb existing embankments or embankment protection.
- .4 Periodically inspect erosion and sediment control measures to detect evidence of erosion and sedimentation. Promptly take corrective measures when necessary.
- .5 If soil and debris from site accumulate in ditches or other low areas, remove accumulation and restore area to original condition.

1.6 POLLUTION CONTROL

- .1 Take measures to prevent contamination of soil, water, and atmosphere through uncontrolled discharge of noxious or toxic substances and other pollutants, potentially causing environmental damage.
- .2 Be prepared, by maintaining appropriate materials, equipment, and trained personnel on site, to intercept, clean up, and dispose of spills or releases that may occur. Promptly report spills and releases that may occur to:
 - .1 authority having jurisdiction,
 - .2 person causing or having control of pollution source, if known, and
 - .3 *Owner and Consultant.*
- .4 Contact manufacturer of pollutant, if known and applicable, to obtain material safety data sheets (MSDS) and ascertain hazards involved and precautions and measures required in cleanup or mitigating actions.
- .5 Take immediate action to contain and mitigate harmful effects of the spill or release.

END OF SECTION

1 General

1.1 GENERAL

- .1 Provide *Products* that are not damaged or defective, and suitable for purpose intended, subject to specified requirements. If requested by *Consultant*, furnish evidence as to type, source and quality of *Products* provided.
- .2 Unless otherwise specified, maintain uniformity of manufacture for like items throughout.
- .3 Permanent manufacturer's markings, labels, trademarks, and nameplates on *Products* are not acceptable in prominent locations, except where required by regulatory requirements or for operating instructions, or when located in mechanical or electrical rooms.

1.2 PRODUCT AVAILABILITY AND DELIVERY TIMES

- .1 Promptly upon Contract award and periodically during construction, review and confirm *Product* availability and delivery times. Order *Products* in sufficient time to meet the construction progress schedule and the *Contract Time*.
- .2 If a specified *Product* is no longer available, promptly notify *Consultant*. *Consultant* will take action as required.
- .3 If delivery delays are foreseeable, for any reason, promptly notify *Consultant*.
 - .1 If a delivery delay is beyond *Contractor's* control, *Consultant* will provide direction.
 - .2 If a delivery delay is caused by something that was or is within *Contractor's* control, *Contractor* shall propose actions to maintain the construction progress schedule for *Consultant's* review and acceptance.

1.3 STORAGE, HANDLING, AND PROTECTION

- .1 Store, handle, and protect *Products* during transportation to *Place of the Work* and before, during, and after installation in a manner to prevent damage, adulteration, deterioration and soiling.
- .2 Comply with manufacturer's instructions for storage, handling and protection.
- .3 Store packaged or bundled *Products* in original and undamaged condition with manufacturer's seals and labels intact. Do not remove from packaging or bundling until required in *Work*.
- .4 Comply with the requirements of the workplace hazardous materials information system (WHMIS) regarding use, handling, storage, and disposal of hazardous materials, including requirements for labeling and the provision of material safety data sheets (MSDS).
- .5 Store *Products* subject to damage from weather in weatherproof enclosures.
- .6 Store sheet *Products* on flat, solid, supports and keep clear of ground. Slope to shed moisture.
- .7 Remove and replace damaged *Products*.

END OF SECTION

1 General

1.1 SURVEYOR QUALIFICATIONS

- .1 If required, engage a registered land surveyor, licensed to practice in *Place of the Work*.

1.2 SUBMITTALS

- .1 Submit name and address of registered land surveyor performing survey work.
- .2 Submit to *Owner* and *Consultant* the survey of the *Work* prepared and issued by a registered land surveyor on completion of the building footings and foundations and on completion of the *Work*.

1.3 SURVEY REFERENCE POINTS

- .1 Locate and confirm permanent reference points prior to starting site work. Preserve and protect permanent reference points on site during construction.
- .2 Do not change or relocate reference points without prior written notice to *Consultant*.
- .3 Report to *Consultant* when a reference point is lost or destroyed, or requires relocation because of necessary changes in grades or locations. Require registered land surveyor to replace reference points in accordance with original survey.

1.4 SURVEY REQUIREMENTS

- .1 Establish sufficient permanent benchmarks on site, referenced to established benchmarks by survey control points.
- .2 Confirm that existing survey reference points are in accordance with *Owner's* survey and property limits.
- .3 Establish initial lines and levels for building layout.
- .4 Maintain a complete, accurate log of control and survey work as it progresses. Record locations with horizontal and vertical data in project record documents.

1.5 EXISTING UTILITIES AND STRUCTURES

- .1 Before commencing excavation, drilling or other earthwork, establish or confirm location and extent of all existing underground utilities and structures in work area.
- .2 Promptly notify *Consultant* if underground utilities, structures, or their locations differ from those indicated in *Contract Documents* or in available project information. *Consultant* will provide appropriate direction.
- .3 Record locations of maintained, re-routed and abandoned utility lines.

1.6 VERIFICATION OF EXISTING CONDITIONS

- .1 Where work specified in any Section is dependent on the work of another Section or Sections having been properly completed, verify that work is complete and in a condition suitable to receive the subsequent work. Commencement of work of a Section that is dependent on the work of another Section or Sections having been properly completed, means acceptance of the existing conditions.
- .2 Verify that ambient conditions are suitable before commencing the work of any Section and will remain suitable for as long as required for proper setting, curing, or drying of *Products* used.
- .3 Ensure that substrate surfaces are clean, dimensionally stable, cured and free of contaminants.
- .4 Notify *Consultant* in writing of unacceptable conditions.

END OF SECTION

1 General

1.1 SUMMARY

- .1 Except where otherwise specified in technical *Specifications* or otherwise indicated on *Drawings*, comply with requirements of this Section.

1.2 MANUFACTURER'S INSTRUCTIONS

- .1 Install, erect, or apply *Products* in strict accordance with manufacturer's instructions.
- .2 Notify *Consultant*, in writing, of conflicts between *Contract Documents* and manufacturer's instructions where, in *Contractor's* opinion, conformance with *Contract Documents* instead of the manufacturer's instructions may be detrimental to the *Work* or may jeopardize the manufacturer's warranty.
- .3 Do not rely on labels or enclosures provided with *Products*. Obtain written instructions directly from manufacturers.
- .4 Provide manufacturer's representatives with access to the *Work* at all times. Render assistance and facilities for such access so that manufacturer's representatives may properly perform their responsibilities.

1.3 CONCEALMENT

- .1 Conceal pipes, ducts, and wiring in floors, walls and ceilings in finished areas:
 - .1 after review by *Consultant* and authority having jurisdiction, and
 - .2 where locations differ from those shown on *Drawings*, after recording actual locations on as-built drawings.
- .2 Provide incidental furring or other enclosures as required.
- .3 Notify *Consultant* in writing of interferences before installation.

1.4 FASTENINGS - GENERAL

- .1 Provide metal fastenings and accessories in same texture, colour and finish as adjacent materials.
- .2 Prevent electrolytic action and corrosion between dissimilar metals and materials by using suitable non-metallic strips, washers, sleeves, or other permanent separators to avoid direct contact.
- .3 Use non-corrosive fasteners and anchors for securing exterior work [and in spaces where high humidity levels are anticipated].
- .4 Space anchors within individual load limit or shear capacity and ensure they provide positive permanent anchorage.
- .5 Keep exposed fastenings to a minimum, space evenly and install neatly.
- .6 Do not use fastenings or fastening methods that may cause spalling or cracking of material to which anchorage is made.

1.5 FASTENINGS - EQUIPMENT

- .1 Use fastenings of standard commercial sizes and patterns with material and finish suitable for service.
- .2 Bolts shall not project more than one diameter beyond nuts.

1.6 FIRE RATED ASSEMBLIES

- .1 When penetrating fire rated walls, ceiling, or floor assemblies, completely seal voids with fire-stopping materials, smoke seals, or both, in full thickness of the construction element as required to maintain the integrity of the fire rated assembly.

1.7 LOCATION OF FIXTURES, OUTLETS AND DEVICES

- .1 Consider location of fixtures, outlets, and devices indicated on *Drawings* as approximate.
- .2 Locate fixtures, outlets, and devices to provide minimum interference, maximum usable space, and as required to meet safety, access, maintenance, acoustic, and regulatory, including barrier free, requirements.
- .3 Promptly notify *Consultant* in writing of conflicting installation requirements for fixtures, outlets, and devices. If requested, indicate proposed locations and obtain approval for actual locations.

1.8 PROTECTION OF COMPLETED WORK AND WORK IN PROGRESS

- .1 Adequately protect parts of the *Work* completed and in progress from any kind of damage.
- .2 Promptly remove, replace, clean, or repair, as directed by *Consultant*, work damaged as a result of inadequate protection.
- .3 Do not load or permit to be loaded any part of the *Work* with a weight or force that will endanger the safety or integrity of the *Work*.

1.9 REMEDIAL WORK

- .1 Notify *Consultant* of, and perform remedial work required to, repair or replace defective or unacceptable work. Ensure that properly qualified workers perform remedial work. Coordinate adjacent affected work as required.

END OF SECTION

1 General

1.1 REQUEST FOR CUTTING, PATCHING AND REMEDIAL WORK

- .1 Submit written request in advance of cutting, coring, or alteration which affects or is likely to affect:
 - .1 Structural integrity of any element of the Work.
 - .2 Integrity of weather-exposed or moisture-resistant elements.
 - .3 Efficiency, maintenance, or safety of any operational element.
 - .4 Visual qualities of sight-exposed elements.
 - .5 Work of *Owner* or other contractors.
 - .6 Warranty of *Products* affected.
- .2 Include in request:
 - .1 Identification of *Project*.
 - .2 Location and description of affected work, including drawings or sketches as required.
 - .3 Statement on necessity for cutting or alteration.
 - .4 Description of proposed work, and *Products* to be used.
 - .5 Alternatives to cutting and patching.
 - .6 Effect on work of *Owner* or other contractors.
 - .7 Written permission of affected other contractors.
 - .8 Date and time work will be executed.

1.2 PRODUCTS

- .1 Unless otherwise specified, when replacing existing or previously installed Products in the course of cutting and patching work, use replacement Products of the same character and quality as those being replaced.
- .2 If an existing or previously installed Product must be replaced with a different Product, submit request for substitution in accordance with Section 01 25 00 - Substitution Procedures.

1.3 PREPARATION

- .1 Inspect existing conditions in accordance with Section 01 71 00 - Examination and Preparation.
- .2 Provide supports to ensure structural integrity of surroundings; provide devices and methods to protect other portions of the *Work* from damage.
- .3 Provide protection from elements for areas that may be exposed by uncovering work.

1.4 EXISTING UTILITIES

- .1 When breaking into or connecting to existing services' utilities, execute the *Work* at times directed by local governing authorities, with a minimum of disturbance to the *Work*, pedestrian and vehicular traffic, and ongoing Owner operations.
- .2 Maintain excavations free of water.
- .3 Keep duration of interruptions to a minimum.
- .4 Carry out interruptions after regular working hours of occupants, preferably on weekends, unless Owner's prior written approval is obtained.
- .5 Protect and maintain existing active services. Record location of services, including depth, on as-built drawings.
- .6 Construct or erect barriers in accordance with Section 01 56 00 - Temporary Barriers and Enclosures as required to protect pedestrian and vehicular traffic.

1.5 CUTTING, PATCHING, AND REMEDIAL WORK

- .1 Coordinate and perform the *Work* to ensure that cutting and patching work is kept to a minimum.
- .2 Perform cutting, fitting, patching, and remedial work [including excavation and fill,] to make the affected parts of the *Work* come together properly and complete the *Work*.
- .3 Provide openings in non-structural elements of the *Work* for penetrations of mechanical and electrical work.
- .4 Perform cutting by methods to avoid damage to other work
- .5 Provide proper surfaces to receive patching, remedial work, and finishing.
- .6 Perform cutting, patching, and remedial work using competent and qualified specialists familiar with the *Products* affected, in a manner that neither damages nor endangers the *Work*.
- .7 Do not use pneumatic or impact tools without *Consultant's* prior approval.
- .8 Ensure that cutting, patching, and remedial work does not jeopardize manufacturers' warranties.
- .9 Refinish surfaces to match adjacent finishes. For continuous surfaces refinish to nearest intersection. For an assembly, refinish entire unit.
- .10 Fit work to pipes, sleeves, ducts, conduit, and other penetrations through surfaces with suitable allowance for deflection, expansion, contraction, acoustic isolation, and firestopping.
- .11 Maintain fire ratings of fire rated assemblies where cutting, patching, or remedial work is performed. Completely seal voids or penetrations of assembly with firestopping material to full depth or with suitably rated devices.

END OF SECTION

1 General

1.1 REGULATORY REQUIREMENTS

- .1 Comply with applicable regulatory requirements when disposing of waste materials.
- .2 Obtain permits from authorities having jurisdiction and pay disposal fees where required for disposal of waste materials and recyclables.

1.2 GENERAL CLEANING REQUIREMENTS

- .1 Provide adequate ventilation during use of volatile or noxious substances. Do not rely on building ventilation systems for this purpose.
- .2 Use only cleaning materials recommended by manufacturer of surface to be cleaned, and as recommended by cleaning material manufacturer.
- .3 Prevent cross-contamination during the cleaning process.
- .4 Notify the *Consultant* of the need for cleaning caused by *Owner* or other contractors.

1.3 PROGRESSIVE CLEANING AND WASTE MANAGEMENT

- .1 Maintain the *Work* in a tidy and safe condition, free from accumulation of waste materials and construction debris.
- .2 Provide appropriate, clearly marked, containers for collection of waste materials and recyclables. Location of containers to be agreed with *Owner*.
- .3 Remove waste materials and recyclables from work areas, separate, and deposit in designated containers at end of each *Working Day*. Collect packaging materials for recycling or reuse.
- .4 Remove waste materials and recyclables from *Place of the Work* at regular intervals.
- .5 Clean interior building areas prior to start of finish work and maintain free of dust and other contaminants during finishing operations.
- .6 Schedule cleaning operations so that resulting dust, debris and other contaminants will not fall on wet, newly finished surfaces nor contaminate building systems.

1.4 FINAL CLEANING

- .1 Before final cleaning, arrange a meeting at *Place of the Work* to determine the acceptable standard of cleaning. Ensure that *Owner*, *Contractor* and cleaning company are in attendance.
- .2 Remove from *Place of the Work* surplus *Products*, waste materials, recyclables, *Temporary Work*, and *Construction Equipment* not required to perform any remaining work.
- .3 Remove dust from lighting reflectors, lenses, lamps, bulbs, and other lighting surfaces.
- .4 Vacuum clean and dust exposed wall, floor, and ceiling surfaces, behind grilles, louvres and screens, above suspended ceiling tiles.
- .5 Clean mechanical, electrical, and other equipment. Replace filters for mechanical equipment if equipment is used during construction.
- .6 Remove waste material and debris from crawlspaces and other accessible concealed spaces.

- .7 Remove stains, spots, marks, and dirt from exterior facades.
- .8 Clean exterior and interior window glass and frames.
- .9 Clean and sweep roofs, clear roof drains and downspouts.

1.5 WASTE MANAGEMENT AND DISPOSAL

- .1 Dispose of waste materials and recyclables at appropriate municipal landfills and recycling facilities in accordance with applicable regulatory requirements.
- .2 Do not burn or bury waste materials at Place of the Work.
- .3 Do not dispose of volatile and other liquid waste such as mineral spirits, oil, paints and other coating materials, paint thinners, cleaners, and similar materials together with dry waste materials or on the ground, in waterways, or in storm or sanitary sewers. Collect such waste materials in appropriate covered containers, promptly remove from Place of the Work, and dispose of at recycling facilities or as otherwise permitted by applicable regulatory requirements.
- .4 Cover or wet down dry waste materials to prevent blowing dust and debris.

END OF SECTION

1 General

1.1 READY-FOR-TAKEOVER

- .1 The prerequisites to attaining Ready-for-Takeover of the Work are described in the General Conditions of the Contract.

1.2 INSPECTION AND REVIEW BEFORE READY-FOR-TAKEOVER

- .1 Contractor's Inspection: Before applying for the Consultant's review to establish Ready-for-Takeover of the Work:
 - .1 Ensure that the specified prerequisites to Ready-for-Takeover of the Work are completed.
 - .2 Conduct an inspection of the Work to identify defective, deficient, or incomplete work.
 - .3 Prepare a comprehensive and detailed list of items to be completed or corrected.
 - .4 Provide an anticipated schedule and costs for items to be completed or corrected.
- .2 Consultant's Review: Upon receipt of the Contractor's application for review, together with the Contractor's list of items to be completed or corrected, the Consultant will review the Work. The Consultant will advise the Contractor whether or not the Work is Ready-for-Takeover and will provide the Contractor with a list of items, if any, to be added to the Contractor's list of items to be completed or corrected. Provide the Consultant with a copy of the Contractor's revised list.
- .3 Maintain the list of items to be completed or corrected and promptly correct or complete defective, deficient and incomplete work. The Contractor's inspection and Consultant's review procedures specified above shall be repeated until the Work is Ready-for-Takeover and no items remain on the Contractor's list of items to be completed or corrected.
- .4 When the Consultant determines that the Work is Ready-for-Takeover, the Consultant will notify the Contractor and the Owner in writing to that effect.

1.3 PREREQUISITES TO FINAL PAYMENT

- .1 After Ready-for-Takeover of the Work and before submitting an application for final payment in accordance with the General Conditions of Contract:
 - .1 Correct or complete all remaining defective, deficient, and incomplete work.
 - .2 Remove from the Place of the Work all remaining surplus Products, Construction Equipment, and Temporary Work.
 - .3 Perform final cleaning and waste removal necessitated by the Contractor's work performed after Ready-for-Takeover, as specified in Section 01 74 00 – Cleaning and Waste Management.

1.4 PARTIAL USER OCCUPANCY

- .1 If partial Owner occupancy of a part of the Work is required before the date of Ready-for-Takeover of the entire Work of the Contract, the provisions of this Section shall apply, to the extent applicable, to that part of the Work that the Owner intends to occupy.

1.5 SUBSTANTIAL PERFORMANCE OF THE WORK

- .1 The prerequisites to, and the procedures for, attaining substantial performance of the Work, or similar such milestone as provided for in the lien legislation applicable to the Place of the Work, shall be:
 - .1 independent of those for attaining Ready-for-Takeover of the Work, and
 - .2 in accordance with the lien legislation applicable to the Place of the Work.

END OF SECTION

1 General

1.1 OPERATION AND MAINTENANCE MANUAL

- .1 Prepare a comprehensive operation and maintenance manual, in the language of the Contract, using personnel qualified and experienced for this task.
- .2 Submit an initial draft of the operation and maintenance manual for *Consultant's* review. If required by *Consultant's* review comments, revise manual contents and resubmit for *Consultant's* review. If required, repeat this process until *Consultant* accepts the draft manual in writing.
- .3 Submit final version to *Owner* in electronic format.

1.2 OPERATION AND MAINTENANCE MANUAL FORMAT

- .1 Provide electronic copy of manual in PDF format.
- .2 Provide electronic copy of Shop Drawings within manual in PDF format.

1.3 OPERATION AND MAINTENANCE MANUAL – GENERAL CONTENT

- .1 Table of contents for each volume.
- .2 Introductory information including:
 - .1 Date of manual submission.
 - .2 Complete contact information for *Consultant*, subconsultants, *Contractor and Sub Contractors*, with names of responsible parties.
 - .3 Schedule of *Products* and systems indexed to content of volume.
- .3 For each *Product* or system, include complete contact information for *Subcontractors*, *Suppliers* and manufacturers, including local sources for supplies and replacement parts.
- .4 *Product* Data: mark each sheet to clearly identify specific products, options, and component parts, and data applicable to installation. Delete or strike out inapplicable information. Supplement with additional information as required.
- .5 Reviewed *Shop Drawings*.
- .6 Permits, certificates, letters of assurance and other relevant documents issued by or required by authorities having jurisdiction.
- .7 Warranties.
- .8 Operating and maintenance procedures, incorporating manufacturer's operating and maintenance instructions, in a logical sequence.
- .9 Training materials as specified in Section 01 79 00 - Demonstration and Training.

1.4 OPERATION AND MAINTENANCE MANUAL - EQUIPMENT AND SYSTEMS CONTENT

- .1 Each Item of Equipment and Each System: include description of unit or system and component parts. Give function, normal operation characteristics, and limiting conditions. Include performance curves, with engineering data and tests, and complete nomenclature and commercial number of replaceable parts.

- .2 Panel Board Circuit Directories: provide electrical service characteristics, controls, and communications.
- .3 Include installed colour coded wiring diagrams.
- .4 Operating Procedures: include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.
- .5 Maintenance Requirements: include routine procedures and guide for trouble-shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
- .6 Provide servicing and lubrication schedule, and list of lubricants required.
- .7 Include manufacturer's printed operation and maintenance instructions.
- .8 Include sequence of operation by controls manufacturer.
- .9 Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
- .10 Provide installed control diagrams by controls manufacturer.
- .11 Provide Contractor's coordination drawings, with installed colour coded piping diagrams.
- .12 Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.
- .13 Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.
- .14 Include testing and balancing reports.
- .15 Include additional content as specified in technical Specifications sections.

1.5 OPERATION AND MAINTENANCE MANUAL - PRODUCTS AND FINISHES CONTENT

- .1 Include *Product* data, with catalogue number, options selected, size, composition, and colour and texture designations. Provide information for re-ordering custom manufactured *Products*.
- .2 Instructions for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.
- .3 Include an outline of requirements for routine and special inspections and for regular maintenance to ensure that on-going performance of the building envelope will meet the initial building envelope criteria.
- .4 Include additional content as specified in technical *Specifications* sections.

1.6 OPERATION AND MAINTENANCE MANUAL - WARRANTIES CONTENT

- .1 Separate each warranty with index tab sheets keyed to Table of Contents listing.
- .2 List each warrantor with complete contact information.
- .3 Verify that documents are in proper form and contain full information. Ensure that warranties are for the correct duration and are in *Owner's* name.

1.7 CONTRACTOR'S AS-BUILT DRAWINGS

- .1 Contractor shall obtain a PDF copy of construction Drawings for the purpose of creating as-built drawings. Record information and maintain as-built drawings in orderly and legible condition.

1.8 PROJECT RECORD DRAWINGS

- .1 Contractor shall transfer all information marked up on the as-built drawings during the progress of the *Work* to a master set of record drawing files provided by *Consultant*, in CAD format.
- .2 Mark revised drawings as "RECORD DRAWINGS".
- .3 Submit completed record drawings in electronic form to *Owner*.

1.9 SPARE PARTS, MAINTENANCE MATERIALS, AND SPECIAL TOOLS

- .1 Supply spare parts, maintenance materials, and special tools in quantities specified in technical *Specifications* sections.
- .2 Ensure spare parts and maintenance materials are new, not damaged nor defective, and of same quality, manufacturer, and batch or production run as installed *Products*.
- .3 Provide tags for special tools identifying their function and associated *Product*.
- .4 Deliver to and store items at location directed by *Owner* at *Place of the Work*. Store in original packaging with manufacturer's labels intact and in a manner to prevent damage or deterioration.
- .5 Catalogue all items and submit to *Consultant* an inventory listing organized by *Specifications* section. Include *Consultant* reviewed inventory listing in operation and maintenance manual.

END OF SECTION

1 General

1.1 SUMMARY

- .1 Demonstrate and provide training to *Owner's* personnel on operation and maintenance of equipment and systems prior to scheduled date of *Ready-for-Takeover of the Work*.
- .2 *Owner* will provide list of personnel to receive training and will coordinate their attendance at agreed upon times.
- .3 *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.
- .4 Obtain and submit to *Owner*, letters from manufacturers of equipment and systems indicating that their technical representatives have inspected and tested equipment and systems installed and have approved methods of installation, connections and operation.
- .5 Coordinate and schedule demonstration and training provided by *Subcontractors* and *Suppliers*.

1.2 SUBMITTALS

- .1 Submit proposed dates, times, durations, and locations for demonstration and training of each item of equipment and each system for which demonstration and training is required. Allow sufficient time for training and demonstration for each item of equipment or system, or time as may be specified in technical *Specifications*.
- .2 *Consultant* and *Owner* will review submittal and advise *Contractor* of any necessary revisions.
- .3 Submit report(s) within 5 *Working Days* after completion of demonstration and training:
 - .1 identifying time and date of each demonstration and training session,
 - .2 summarizing the demonstration and training performed, and
 - .3 including a list of attendees.
- .4 Submit video record of demonstration and training together with report.

1.3 PREREQUISITES TO DEMONSTRATION AND TRAINING

- .1 Testing, adjusting, and balancing has been performed in accordance with *Contract Documents*.
- .2 Equipment and systems are fully operational.
- .3 Copy of completed operation and maintenance manual is available for use in demonstration and training.
- .4 Conditions for demonstration and training comply with requirements specified in technical *Specifications*.

1.4 DEMONSTRATION AND TRAINING

- .1 Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, and maintenance of each item of equipment and system.
- .2 Review operation and maintenance manual in detail to explain all aspects of operation

and maintenance.

- .3 Prepare and insert additional information in operation and maintenance manual if required.

END OF SECTION

1 General

1.1 SUMMARY

- .1 The Contractor must provide all labour, materials, products, equipment and services for commissioning of all building systems to ensure building is operating according to requirements of Contract Documents.

1.2 CONTRACTOR RESPONSIBILITIES

- .1 Prepare each system ready for commissioning. Verify systems installation is complete and in operation.
- .2 Coordinate commissioning with and assist commissioning agency.
- .3 Perform and document verification, performance testing, adjusting, and balancing operations.
- .4 Cooperate with commissioning agency and provide access to equipment and systems.
- .5 Provide personnel and operate systems at designated times, and under conditions required for proper commissioning.
- .6 Make instruments available to commissioning agency to facilitate spot checks during commissioning.
- .7 Participate in commissioning meetings.
- .8 Complete commissioning forms as requested by commissioning agency.
- .9 Correct deficiencies identified in commissioning process.
- .10 Incorporate commissioning data into operation and maintenance manual.
- .11 Ensure that commissioning agency participates in demonstration and training as specified in Section 01 79 00 – Demonstration and Training.

END OF SECTION

1 General

1.1 SUMMARY

- .1 Review drawings, site conditions, and other specification sections to ascertain the extent and nature of work of this section.
- .2 The Work of this Section includes, but is not limited to the following:
 - .1 Demolish and removal of the following where indicated on the Drawings:
 - .1 Asphalt
 - .2 Concrete slabs;
 - .3 Wood framing;
 - .4 Drywall/steel stud partitions/assemblies
 - .5 Interior finishes and trims
 - .6 Doors, frames and associated hardware;
 - .7 Building mechanical & electrical systems
 - .8 Roofing and roof ballast
 - .9 Exterior mechanical equipment and cap weather tight.
 - .2 Disconnect/cap existing service in areas of demolition.
 - .3 Trace, demolish and remove decommissioned mechanical and electrical services found during demolition. Remove decommissioned services to the area of demolition to the source, leaving no buried services in walls and floors, unless otherwise approved by written notice from the Owner.
 - .4 Dispose of demolished materials except where required to be salvaged or reused.
 - .5 Refer to demolition notes indicated on all disciplines Drawings.
- .3 Drawings contain details that suggest directions for solving some of the major demolition and removal requirements for this project; Contractor is required to develop these details further by submitting a demolition plan prepared by a professional engineer employed by the Contractor.

1.2 REFERENCE STANDARDS

- .1 American National Standards Institute (ANSI):
 - .1 ANSI A10.8-2011, Scaffolding Safety Requirements
- .2 Canadian Standards Association (CSA):
 - .1 CSA S350- M1980 (R2003), Code of Practice for Safety in Demolition of Structures.
- .3 National Fire Protection Association (NFPA):
 - .1 NFPA 241-09, Standard for Safeguarding Construction, Alteration, and Demolition Operations
- .4 Provincial Legislation:
 - .1 Legislation specific to Authority Having Jurisdiction for work governed by this Section.

1.3 DEFINITIONS

- .1 Demolish: Detach items from existing construction and legally dispose of them off site, unless indicated to be removed and salvaged or removed and reinstalled.
- .2 Remove and Salvage: Detach items from existing construction and deliver them to Owner ready for reuse.
- .3 Remove and Reinstall: Detach items from existing construction, prepare them for reuse, and reinstall them where indicated.
- .4 Existing to Remain: Existing items of construction that are not removed and that are not otherwise indicated as being removed, removed and salvaged, or removed and reinstalled.

1.4 EXAMINATION

- .1 Visit and examine the site and note all characteristics and irregularities affecting Work of this Section. Submit a pre-demolition inspection report. Ensure the Owner of premises being inspected is represented at inspection.
- .2 Where appropriate prepare a photographic or video record of existing conditions, particularly of existing work scheduled to remain.
- .3 Where applicable, examine adjacent tenancies not part of the scope of work. Determine extent of protection required to areas and related components not subject to demolition.

1.5 SUBMITTALS

- .1 Provide required information in accordance with Division 01.
- .2 Action Submittals: Provide the following submittals before starting any work of this Section:
 - .1 Prepare schedule in conjunction with overall project schedule, and outline proposed methods in writing. Obtain approval before commencing demolition work, and indicate the following:
 - .1 Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity
 - .2 Interruption of utility services
 - .3 Coordination for shutoff, capping, and continuation of utility services

1.6 QUALITY ASSURANCE

- .1 Conform to requirements of all authorities having jurisdiction.
- .2 Comply with applicable requirements of CSA S350-M "Code of Practice for Safety in Demolition of Structures".
- .3 Work of this Contract shall be executed by an approved company having a minimum of five (5) years continuous experience and able to deploy adequate equipment and skilled personnel to complete work expediently in an efficient and orderly manner.
- .4 Perform cutting and coring, where applicable, by a firm specializing in this type of work, able to produce evidence of successful completion of similar work over a period of at least five (5) years immediately prior to date of contract.
- .5 Apply for, secure, arrange and pay for all permits, notices and inspections necessary for proper execution and completion of work in this Section.
- .6 Professional Engineer Qualifications: Procure the services of a professional engineer who is experienced in providing relevant engineering services to perform the following:
 - .1 Review portions of the Work requiring structural performance, prepare plan of action, engineer temporary shoring and bracing, and Provide site administration and inspection for work of this Section.

1.7 PROTECTION

- .1 Prevent movement or settlement of adjacent work. Provide and place bracing or shoring and be responsible for safety and support of such work. Be liable for any such movement or settlement, and any damage or injury caused.
- .2 Cease operations and notify Consultant if safety of any adjacent work or structure appears to be endangered. Take all precautions to support the structure. Do not resume operations until reviewed with the Consultant.
- .3 Prevailing weather conditions and weather forecasts shall be considered. Demolition work shall not proceed when weather conditions constitute a hazard to the workers and site.
- .4 Prevent damage of surrounding vegetation by construction. Install tree protection barriers to trees that are scheduled to remain.
- .5 Prevent debris from blocking surface drainage inlets and mechanical and electrical systems which remain in operation.
- .6 Temporarily suspended work that is without continuous supervision shall be closed to prevent entrance of unauthorized persons.

1.8 REMAINING AND ADJACENT STRUCTURES

- .1 Do not interfere with, encumber, endanger or create nuisance, from any cause due to demolition work, to public property or any adjacent attached and/or detached structures in possession of Owner or others, which are to remain, whether occupied or unoccupied during this work.
- .2 Make good damage to such structures resulting from work under this Section at no cost to Owner. Make good adjacent building surfaces damaged by work of this Section.

1.9 PROTECTION OF SERVICES AND STRUCTURES

- .1 Take necessary precautions to guard against movement, settlement or collapse of existing adjacent utility services, public property and/or structures, whether to remain or not. If these or other unforeseen conditions develop, take immediate emergency measures, report to Consultant, confirm in writing, and await instructions before proceeding with any further related demolition work.
- .2 Prior to saw cutting or core drilling of existing concrete slabs, use ground penetrating radar (GPR) to detect utilities and structural reinforcing. Concrete X-Rays can be used when access to both sides of concrete slab is accessible for placement of required x-ray film.

1.10 EXISTING SERVICES

- .1 Prior to start of demolition disconnect all electrical service lines in the areas to be demolished. Post warning signs on all electrical lines and equipment which must remain energized to serve other areas during period of demolition. Disconnect electrical service lines in demolition areas to the requirements of local authority having jurisdiction.
- .2 In each case, notify the affected utility company in advance and obtain approval where required before commencing with the work on main services.
- .3 Arrange with utility companies for locating of such services and for disconnection of existing services owned by utility companies and which will be disconnected by said utility companies, provided such services do not interfere with adjacent tenancy operators.
- .4 Remove sewer and water lines where required within existing building as deemed necessary, and cap to prevent leakage, in accordance with authorities having jurisdiction.
- .5 Existing services are to be maintained where required for normal tenant operation during regular hours of operation and/or as deemed necessary by Owner.

1.11 DECOMMISSIONED SERVICES

- .1 Remove fully decommissioned electrical and mechanical service lines, plumbing, ducting, fixtures and all fasteners and supports for decommissioned items.
 - .1 Remove sewer and water lines where required within existing building as deemed necessary, and cap to prevent leakage, in accordance with authorities having jurisdiction.
- .2 Patch and repair surfaces affected by this selective demolition to match existing adjacent surfaces, as approved by the Consultant.

1.12 EXISTING WARRANTIES

- .1 Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials so as not to void existing warranties.

2 Products

2.1 DEBRIS, SALVAGED MATERIAL AND EQUIPMENT DISPOSAL

- .1 All materials and or equipment salvaged from demolition work becomes property of demolition Contractor unless designated otherwise.
- .2 At no cost to Owner repair or replace material and/or equipment scheduled to remain which is damaged by demolition work. Do not sell any salvaged material or equipment directly from project site.
- .3 Remove waste debris continually and entirely from project site during demolition work. Do not load vehicles transporting such debris beyond their safe capacity or in a manner which might cause spillage on public or private property. If spillage does occur, clean up immediately to prevent traffic hazards or nuisance.

2.2 PROTECTION

- .1 Temporary Protection:
 - .1 Erect temporary hoarding protection, to enclose openings in exterior walls, and/or provide security to partially occupied interior spaces, as indicated in Division 01.
 - .2 Erect temporary dust screens to prevent dust and debris to enter areas of the building which are not scheduled for demolition. Remove temporary dust screens when no longer required.

2.3 REPAIR MATERIALS

- .1 Use repair materials identical to existing materials:
 - .1 If identical materials are unavailable or cannot be used for exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible.
 - .2 Use a material whose installed performance equals or surpasses that of existing material.
 - .3 Comply with material and installation requirements specified in individual Specification Sections.
- .2 Floor Patching and Levelling Compounds: Cement based, trowelable, self-levelling compounds compatible with specified floor finishes; as indicated in Section 03 35 00.
- .3 Concrete Unit Masonry: Lightweight concrete masonry units, and mortar, cut and trimmed to fit existing opening to be filled. Provide standard hollow core units, square end units and bond beam units as indicated on drawings.

- .4 Gypsum Board Patching Compounds: Joint compound to ASTM C475, bedding and finishing types thinned to provide skim coat consistency to patch and prepare existing gypsum board walls ready for new finishes in accordance with Section 09 29 00.
- .5 Fireproofing: Patch and repair all fireproofing damaged during demolition of adjacent surfaces with compatible fireproofing materials. Provide test reports from fireproofing manufacture warranting installation, adhesion and compatibility between existing and new fireproofing materials.

2.4 EXISTING MATERIALS

- .1 Items to be retained for re-use in new construction include, but are not limited to the following:
 - .1 Confirm with Consultant any materials that appear to be in re-usable condition prior to disposal.
 - .2 Confirm with Consultant any materials scheduled for re-use that are not in re-usable condition prior to installation.

3 Execution

3.1 GENERAL

- .1 Exercise caution in dismantling, disconnecting of work adjacent to existing work designated to remain.
- .2 Carry out demolition in a manner to cause as little inconvenience to the adjacent properties as possible.
- .3 Carry out demolition in an orderly and careful manner.
- .4 Demolition by explosives is not permitted.
- .5 Selling or burning of materials on site is not permitted.
- .6 Sprinkle exterior debris with water to prevent dust. Do not cause flooding, contaminated run-off or icing. Do not allow waste material, rubbish, and windblown debris to reach and contaminate adjacent properties.
- .7 Lower waste materials in a controlled manner; do not drop or throw materials from heights.
- .8 At end of each day's work, leave in safe condition so that no part is in danger of toppling or falling.

3.2 PREPARATION

- .1 Although possible (with additional precautions), openings through existing concrete columns and beams are generally not permitted; the structural engineer must be contacted for such proposed openings for specific additional requirements.
- .2 For all openings to be located through existing structural components, the following requirements for coring or sawcutting openings through existing reinforced concrete floor slabs, roof slab and shear walls for mechanical and electrical services must be followed:
 - .1 Prior to installation of openings, a testing agency is to be engaged to accurately scan the areas of the proposed openings to locate existing reinforcing steel, electrical conduit and cast-in mechanical services (i.e. pipes). Electromagnetic scanning or ground-penetrating radar are acceptable methods of scanning for these purposes. Note that x-ray technology will not be permitted as this will be an occupied building during construction.
 - .2 During/after conducting the scanning procedures, the testing agency is to clearly and accurately mark the surfaces of the concrete elements identifying individual existing reinforcing bars and electrical/mechanical services.

3.3 SAFETY AND SECURITY

- .1 Maintain security of the building at all times during demolition work.
- .2 Provide and maintain fire prevention equipment and alarms accessible during demolition.

3.4 ACCESS ROUTES

- .1 Restrict operations to designated access routes.
- .2 Do not obstruct roads, parking lots, sidewalks, hydrants and the like.

3.5 SELECTIVE DEMOLITION

- .1 Provide necessary shoring and supports to assure safety of structure prior to cutting and coring.
- .2 Where practical, sawcut and remove material as required.
- .3 Where sawcutting is not appropriate, use suitable hand tools.
- .4 Demolish, cut-out and remove from site all other work noted on drawings or required to permit new construction.
- .5 Do not allow water to accumulate or flow beyond work area. Provide receptacles and mop-up as work proceeds.
- .6 Fill all openings in concrete block walls with concrete masonry units, coursing to match existing, prepare ready to receive new finishes to match existing.
 - .1 Provide bond beams in new openings cut into existing concrete masonry unit walls.
 - .2 Provide finished end masonry units to patch and repair for new jamb sections in existing concrete masonry unit walls.
- .7 Fill all openings in gypsum board walls with gypsum board and steel framing to match existing, skim coat to make wall smooth and even.
- .8 Demolish existing flooring and wall finishes, and adhesive remnants as follows:
 - .1 Floor and wall substrate shall be smooth, free from ridges and depressions, and adhesive remnants that could telegraph through new flooring and wall finishes.
- .9 Demolish completely all ceiling panels and grid as indicated.
- .10 Patch and repair all walls, floor and ceilings damaged during demolition with material matching adjacent walls, prepare ready for new finishes.
 - .1 Prepare existing surfaces schedule to receive new finish by grinding, filling, over-coating, stripping, washing, etching, shot blasting or other chemical or mechanical means, as required to ensure satisfactory installation of new finish.

3.6 PATCHING AND REPAIRING

- .1 Floors and Walls:
 - .1 Where walls or partitions that are demolished extend from one finished area into another, patch and repair floor and wall surfaces in the new space.
 - .2 Provide an level and smooth surface having uniform finish colour, texture, and appearance.
 - .3 Remove existing floor and wall coverings and replace with new materials, if necessary, to achieve uniform colour and appearance.
 - .4 Patch with durable seams that are as invisible as possible.
 - .5 Provide materials and comply with installation requirements specified in other Sections of these Specifications.

- .6 Patch any existing areas adjoining / adjacent to new construction in good workmanship, filling and finishing gaps between finishes to allow new work to blend seamlessly with existing work.
- .7 Where patching occurs in a painted surface, apply primer and intermediate paint coats over patch and apply final paint coat over entire unbroken surface containing patch. Provide additional coats until patch blends with adjacent surfaces.
- .8 Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.
- .2 Exterior Walls:
 - .1 Where existing doors and/or windows are schedule to be removed during demolition, patch and repair exterior walls using similar wall construction techniques as adjacent wall construction. Ensure compatibility between insulation, air barrier and vapour retarder, providing continuous air and vapour control and wall R-Value between existing and new construction. Provide exterior and interior finish materials, matching existing adjacent materials, to provide an even-plane surface of uniform appearance.
- .3 Parging:
 - .1 Patch and repair existing parging damaged or spalling, in areas identified on the Drawings, using single-component, sand/cement blend designed for coating or parging vertical surfaces.

3.7 EQUIPMENT

- .1 The Testing Agency shall provide and operate all necessary equipment for conducting accurate scans of existing reinforced concrete components for which openings are required.
- .2 Equipment and methodology to be capable of scanning concrete elements to a maximum of 400 mm thickness.

3.8 EXCESSIVE DEMOLITION

- .1 Where excessive demolition occurs, be responsible for cost of replacing such work.
- .2 Consultant shall determine extent of such 'over-demolition' and method of rectification.

3.9 COMPLETION

- .1 Leave project site as directed, reasonably clean and presentable, free from above grade debris, any salvaged material and/or equipment except those designated to remain.
- .2 Maintain access to exits clean and free of obstruction during removal of debris.

END OF SECTION

1 General

1.1 SUMMARY

- .1 Provide all labour, material, equipment, and supervision to remove and replace damaged and/or deteriorated clay brick masonry, mortar and reinforcement, anchorage, and accessories in quantities identified in bid documents and as directed by the Consultant.
- .2 Localized re-pointing of the mortar joints in the area of work in quantities identified in bid documents and as directed by the Consultant. Mortar replacement required for brick replacement is not part of this item.

1.2 REFERENCE STANDARDS

- .1 All referenced Standards are latest editions referenced by the Building Code in the Place of the Work, or latest editions if not referenced by Code.
- .2 Ontario Building Code
- .3 CSA S304 Design of Masonry Structures
- .4 CSA A370 Connectors for Masonry
- .5 CSA A371 Masonry Construction for Buildings
- .6 CSA A179 Mortar and Grout for Unit Masonry
- .7 CSA A82 Fired Masonry Brick Made from Clay or Shale
- .8 CSA G30.18 Carbon Steel Bars for Concrete Reinforcement
- .9 ASTM C216 Standard Specification for Facing Brick (Solid
- .10 Masonry Units Made From Clay or Shale)
- .11 ASTM C652 Standard Specification for Hollow Brick (Hollow
- .12 Masonry Units Made From Clay or Shale)
- .13 Technical Note No. 20, Cleaning Brick Masonry, Brick Industry Association (BIA).

1.3 QUALITY ASSURANCE

- .1 Source Quality Control:
 - .1 Clay Brick Units: Prior to delivery, submit to Consultant letter from manufacturer attesting that the bricks comply with the specified grade, type, and class.
- .2 Field Quality Control:
 - .1 Employ only qualified experienced journeyman masons for placing units. The execution of all phases of the work including mortar mixing is to be under the direct supervision of a journeyman mason.
 - .2 Perform masonry work in accordance with CSA A371 except where specified otherwise.
 - .3 Perform masonry reinforcing and tying in accordance with CSA A371 and CSA S304 unless specified otherwise.
 - .4 Installer Qualifications: Company specializing in performing the work of this section with minimum three (3) years documented experience on projects of similar size and complexity.
 - .5 Use single masonry contractor for all masonry work.

1.4 EXISTING CONDITIONS

- .1 Before commencing masonry work, verify the site conditions will allow construction of masonry within required limitations for wall heights, wall thicknesses, openings, bond, anchorage, lateral support, and compressive strengths of masonry units and mortars.
- .2 The Contractor shall make allowances in his bid for the removal and replacement of extra bricks around bricks to be replaced to facilitate installation. No extras shall be entertained after tender for the removal and reinstallation or any preparation work required to accommodate the replacement of damaged and/or deteriorated brick.
- .3 Before commencing masonry work, investigate for evidence of previous repairs, cracks, moisture, and dampness beyond the area designated for replacement reporting any findings to the Consultant.
- .4 The Contractor shall provide all required support to safely support all the loads.
- .5 The decision to locally replace and repoint the existing masonry is based on cracked and deteriorated mortar joints, and loose and spalled brick. Immediately inform the Consultant should any other masonry deterioration be detected during the execution of the work that is unrelated to these defects.
- .6 Study mortar pointing styles and develop a method for reproducing them, submit sample for review by the Consultant and Owner before starting work.

1.5 ALTERNATIVES

- .1 Obtain the Consultant's review before changing the manufacturer's brands or supply sources of mortar materials during the entire contract or other methods of mixing mortar specified elsewhere in this specification.

1.6 SUBMITTALS

- .1 Submittals to be made in accordance with Division 1 requirements..
- .2 Samples:
 - .1 Submit five(5) brick samples of each brick specified. Colours and textures are to represent the full range of shading typically shipped in the specified colour. Any variations in texture are to be represented. Note that any variants beyond the accepted sample range, i.e. darker than the darkest sample, lighter than the palest sample, are not to be installed in the repair area. Colours are intended to match existing and be representative of the final installed product.
 - .2 Submit two (2) samples of each back-up brick.
 - .3 Submit duplicate samples of each type of connector, accessory, and flashing.
- .3 Supply in original cartons using cushioning materials between units. Attach label identifying:
 - .1 Project Name
 - .2 Description of Contents: name of manufacturer, trade name of product, generic description of contents.

1.7 PRE-INSTALLATION CONFERENCE

- .1 Convene one (1) week before starting work of this section.
- .2 Review conditions of installation, installation procedures, mock-ups, and coordination of work with related sections.
- .3 Contractor to provide minutes of the mock-up for distribution to all parties.

1.8 MOCK-UP

- .1 Replace a section of masonry within work area identified in contract drawings. The mock-up is to be a minimum of 1,200 mm x 1,200 mm displaying mortar joint pointing using representative mortar colour to match existing.
- .2 Allow 24 hours for review of mock-up by Consultant before proceeding with the remainder of the repair work and repointing. Revise the mock-up as directed by the Consultant.
- .3 Construct mock-up where directed. Modify the mock-up at no additional cost to the contract as may be required to meet design and performance requirements.
- .4 When accepted by the Consultant, mock-up shall demonstrate the minimum standard for this work.
- .5 Mock-up may remain as finished part of the Work.

1.9 DELIVERY, STORAGE, HANDLING

- .1 Deliver materials to job site in dry condition in manufacturer's original protective packaging and store on a dry level area.
- .2 Keep materials dry until use. Store under waterproof cover on pallets or plank platforms held off ground by means of plank or timber skids.
- .3 Handle and store all mortar materials to prevent contamination by foreign materials, and damage from freezing or excessively high temperature.
- .4 Isolate masonry units from contact with ground and other materials until laid to prevent staining.
- .5 Ensure that moisture content of brick masonry units is maintained within specified limits from time of shipment from plant to completion of Work.
- .6 Cover masonry unit stockpiles when work is not in progress to prevent exposure to weather.
- .7 Handle and store masonry units to prevent soiling and damage.
- .8 Deliver products to the place on site or as directed by the Contractor, and to meet installation schedule.
- .9 If material is stored on suspended slabs, make sure the slab is not overloaded.
- .10 Stored bagged products, such as lime, cement, and metal accessories, in dry waterproof sheds.

1.10 ENVIRONMENTAL REQUIREMENTS

- .1 Comply with requirements of CSA A371.
- .2 Protect freshly laid masonry from drying too rapidly, by means of waterproof, non-staining coverings.
- .3 Maintain dry beds for masonry and use dry masonry units only. Do not wet masonry units in winter.
- .4 For masonry work which will be done below 5°C, measure temperatures of masonry material prior to use; maintain temperatures as close as possible for mortar batches; ensure mortar temperature on mortar boards does not exceed 50°C; use dry masonry units; lay masonry on unfrozen surfaces free from snow and ice; use windbreaks when laying masonry not protected by enclosures; provide a high-low registering thermometer where directed on site.
- .5 When mean air temperature will, over a 24-hour period, go below 5°C but not below 0°C, conduct masonry work as for normal temperatures except heat water or sand to produce

mortar temperatures between 5°C and 50°C. Protect entire constructed masonry by enclosing within weatherproof membrane for 48 hours.

- .6 When mean air temperature will, over a 24-hour period, go below 0°C but not below -4°C, conduct masonry work as for normal temperatures except heat water and sand to produce mortar temperatures between 5°C and 50°C and maintain temperature of mortar boards above 0°C. Protect entire constructed masonry by enclosing within weatherproof membrane for 48 hours.
- .7 When mean air temperature is below -4°C, conduct laying of masonry in enclosures heated to maintain air temperature above 0°C. Conduct masonry work as for normal temperatures except heat water and sand to produce mortar temperatures between 5°C and 50°C and heat units if necessary so that temperature of units at time of laying is minimum -7°C. Maintain enclosure in position for 48 hours and maintain air temperature within enclosure at minimum 0°C.
- .8 When mean air temperature will, over a 24-hour period, go above 38°C (or 32°C with a 3.6 m/s wind), maintain mortar and grout at a temperature between 21°C and 49°C and limit spread of mortar bed to 1.22 m (4 ft.) Place units within one minute of spreading mortar. Provide shade and air breaks as required.

1.11 PROTECTION

- .1 Brace brick walls as necessary to resist wind pressure and other lateral forces during construction.
- .2 Keep masonry dry using waterproof, non-staining coverings that extend over walls and down sides sufficient to protect walls from wind driven rain, until masonry work is completed and protected by flashings or other permanent construction. Ensure that coverings are secured to resist wind loads.
- .3 The Contractor shall maintain the stability and water tightness of the structure at all times.

1.12 SITE CONDITIONS FOR MORTAR

- .1 Heat Materials as Follows: To produce mortar temperature between 5°C and 50°C.
 - .1 When air temperature is between 5°C and 0°C, heat either sand or water to produce specified mortar temperature.
 - .2 When air temperature is below 0°C, heat both sand and water to produce specified mortar temperature.
 - .3 Do not heat water or sand above 50°C.
- .2 Produce mortar batches subsequent to the first with a temperature variance of no more than 6°C.

1.13 WARRANTY

- .1 The Contractor shall submit a warranty of the work of this section covering a period of not less than the duration specified in the Division 1 warranties section.
- .2 Defective work shall include, but is not limited to, cracking, crumbling, loss of adhesion, loss of cohesion, discolouration, premature deterioration, and out-of-plane movement.

2 Products

2.1 CLAY BRICK MASONRY UNITS

- .1 Burned Clay Brick: To CSA A82 and as follows:
 - .1 Grade: SW or MW for face brick not exposed to weather and for back-up brick in concealed locations.

- .2 Type: FBS
- .3 Size: Standard nominal size. To match existing
- .4 Colour and Texture: To match existing. Do colour and texture blending prior to delivery.
- .5 Solid Brick: Where necessary to avoid exposing brick cores.

2.2 MASONRY CONNECTORS

- .1 Select any suitable conventional or non-conventional type as defined by CSA A370, and as follows:
 - .1 Corrosion Protection: Level II.
 - .2 Maximum unsupported length of connectors in cavity shall not exceed that permitted by CSA A370 or recommended by connector manufacturer, whichever is the smaller dimension.
 - .3 Connectors selected shall accommodate differential vertical movement of 8 mm between masonry veneer and structural backup.

2.3 FASTENERS FOR MASONRY CONNECTORS

- .1 Design Criteria: Capable, when installed in specified substrates, of meeting requirements of CSA A370.
- .2 Corrosion Resistance: To requirements of CSA A370.
- .3 Screws: Steel, hex washer head, to suit substrate.
- .4 Provide fastener types as follows:
 - .1 Masonry and Standard Aggregate Concrete: Screws.
 - .2 Wood Studs: Screws.

2.4 MORTAR MATERIALS

- .1 Mortar Materials: To CSA A179.
- .2 Portland Cement: To CSA A3000, Type 10.
- .3 Hydrated Lime: To CSA A179, Type S.
- .4 Mortar Aggregate: Washed, clean, sharp, free of organic materials, and conforming to CSA A82.56.
- .5 Water: Potable and free of deleterious matter, acids, and alkalis.
- .6 Admixtures for mortar shall not be used without written approval from Consultant.
- .7 Pointing Mortar: Premixed, to requirements of this Section, colour to match existing, all aggregate passing 1.18 mm sieve.

2.5 MORTAR MIXING AND PROPORTIONING

- .1 Mix mortar in accordance with CSA A179, using maximum amount of water consistent with workability. Provide minimum compressive strength after 28 days of 5 MPa (Type N) mortar for all masonry construction.
- .2 Provide gauging equipment and ensure that shovel count is accurate.
- .3 Use mechanical mixer of one sack minimum capacity for large batches, mechanically mixing for not less than 3 minutes and not more than 5 minutes. Hand mixing may be used for small batches.

- .4 Use mortar within 1.5 hours of mixing when air temperature is 25°C or higher, and within 2.5 hours when air temperature is less than 25°C.
- .5 Do not use anti-freeze compounds to lower the freezing point of mortar.
- .6 Do not re-temper mortar.

2.6 ACCESSORY MATERIAL

- .1 Control Joint Fillers: Preformed rubber, neoprene, or polyvinylchloride; size and profile to suit intended application.
- .2 Cavity Weeps/Vents: Preformed plastic 100 mm long.
- .3 Masonry Cleaning Compounds: Compatible with masonry unit, and acceptable to unit manufacturer for use on their product.

3 Execution

3.1 EXAMINATION AND PREPARATION

- .1 Examine work of other Sections upon which work of this Section is dependent. Should discrepancies be found that affect the proper performance of the work of this section, do not commence work until such discrepancies have been resolved. Report any defects in writing to the Consultant.
- .2 Visually review all surfaces of the exterior wall zones identified in the contract documents to locate targeted repair areas.
- .3 Establish all lines, levels, coursing, and ensure coordination with other trades as required.
- .4 Provide waterproof protection over construction surfaces at mixing areas to prevent deposit of mortar and mortar materials on them.
- .5 Ensure surfaces to receive new mortar are cleaned of all laitance, grease, oil, and previous mortar where required.
- .6 No new mortar is to be applied until the surface preparation has been inspected and accepted by the Consultant.
- .7 Ensure all damaged and/or deteriorated brick and mortar have been removed, including all dust and fragments.
- .8 Remove any additional brick in good condition, as required to accommodate the installation of the new bricks. Bricks in good condition that are damaged during removal are to be replaced at no cost.
- .9 The Contractor shall be responsible to replace all fixtures to original location and condition if removed to facilitate the required brick wall repairs.
- .10 Protect adjacent finished materials from damage due to masonry work.
- .11 Seal and protect all openings, doors, windows, and adjacent areas to minimize the potential for damage and the spread of dust, water, or other materials into the building or adjacent sidewalks and properties.
- .12 Brace all openings to remain plumb.
- .13 Construct cavity walls using techniques that will minimize mortar dropping in cavity space. This may require the use of batten boards to catch mortar droppings. No mortar shall bridge cavity space or plug cavity vents at bottom of cavity.
- .14 Examine contract documents and coordinate installation of masonry with related sections so that this work can be performed with a minimum of cutting and patching.

3.2 REPLACEMENT OF DETERIORATED MORTAR

- .1 Remove unsound or defective mortar patches in the Contract area as directed by the Consultant.

- .2 Mortar is defective when it is cracked, spalled, chalked, or otherwise crumbling.
- .3 The Contractor shall notify the Consultant in writing of any other mortar joint deterioration identified prior to commencing with any repair work. The Consultant shall provide written instructions to complete any repair work.
- .4 The Consultant shall review the locations of deteriorated mortar with the Contractor prior to commencing with repairs.
- .5 Tools used for cutting out of the mortar joints shall be narrower than the joint.
- .6 Cutting out of the joint shall be performed using:
 - .1 Handheld rotary saws or a grinder or wheel with a vacuum bag.
- .7 The joints shall be cleaned back for the full specified depth. All mortar shall be removed on the masonry surfaces to a square surface of existing mortar at the back of the joint.
- .8 All loose particles in the mortar joints shall be removed with compressed air and left open for review by the Consultant.
- .9 The depth of the raking shall be carried out to at least twice the width of the joint to a minimum depth of 1" (25 mm) measured from the face of the masonry unit and beyond the existing depth of repointing.
- .10 Consultant Review:
 - .1 The Contractor shall provide access, permit inspection, correct any defects, and obtain written comment of all raked joints prior to commencing with the pointing.
- .11 Where mortar is found to be defective beyond the specified raking depth, the Contractor shall continue raking until solid mortar is encountered. Remove all loose mortar, dirt, and other undesirable material.
- .12 Be aware that additional raking beyond specified depths will be necessary and that voiding can be expected. Back pointing will be required at these locations prior to re-pointing.
- .13 If masonry unseats or the bond is broken, remove the unit and reset in accordance with the work outlined in this section.
- .14 The Contractor shall take all reasonable precautions in order to prevent damage to the masonry units resulting from the removal process.
- .15 Such damage to the masonry includes, but is not limited to, the widening of the joints, nicks, gouges, and chipped or scratched surfaces from the cutting out tools due to improper workmanship.
- .16 The Contractor shall replace or repair all damaged units to the satisfaction of the Consultant with no change in the contract price or schedule.
- .17 Obtain the Consultant's written acceptance of raked out and back pointed work prior to commencing with the pointing operation.
- .18 Immediately prior to pointing, thoroughly wet the joints in order to control absorption. Verify with environmental requirements. Prior to pointing, the joints should be wet, water shall be soaked into the masonry and mortar, but with no standing water.

- .19 Fill all bed and head joints with pointing mortar; compact joints firmly to ensure positive adhesion to all inner surfaces.
- .20 At initial set, finish neatly the joints to match the existing pointing style.
- .21 Keep the work area clean; remove all droppings as the work proceeds, and again at the end of each day.
- .22 Prevent the mortar from being placed or smeared onto the front face of the stone or masonry to minimize the potential for staining on the faces during the pointing.
- .23 Cut out and replace all mortar joints that dry prematurely and are lighter than the surrounding joints and/or have shrinkage cracks.

3.3 REPLACEMENT OF DETERIORATED BRICK MASONRY UNITS

- .1 The Contractor shall mark the location of masonry to be removed for verification by the Consultant prior to commencing with the removal process.
- .2 The brick is damaged or deteriorated when it is cracked, chipped, spalled, or the outer face is hollow.
- .3 Should the amount of deteriorated brick rise above 5% of the contract quantity, the Contractor must stop all work and notify the Consultant immediately. The Contractor must obtain written review from the Consultant prior to replacing amounts of brick totalling above 5% of the contract quantity.
- .4 The Contractor shall maintain the stability and water tightness of the structure at all times.
- .5 Localized Brick Replacement (areas with less than four bricks to be replaced):
 - .1 Bond, coursing, and jointing to match the existing.
 - .2 Immediately prior to placing the masonry, thoroughly wet the adjacent substrates in order to control absorption. Verify with environmental requirements.
 - .3 Allow water to soak into the masonry, leaving no standing water but remaining wet. Should the surfaces dry prior to pointing, the substrates should be wet.
 - .4 Set the brick in a full bed of mortar, true to line, and level with the adjacent units.
 - .5 All wedges must be pre-soaked prior to placing masonry units. All wedges should be removed when the mortar has dried prior to pointing.
 - .6 Avoid bridging of airspace between veneer and back-up wall by beveling back edge of bed joint.
 - .7 Tool the mortar joints flush to match the existing.
- .6 Rebuilding Areas of Brickwork:
 - .1 Meet or exceed requirements of CSA A371.
 - .2 Build masonry plumb, level, and true to line, with vertical joints in proper alignment.
 - .3 Lay masonry in running bond to meet specified requirements of CSA Standards, unless otherwise specified.
 - .4 Layout coursing and bond to achieve correct coursing heights, and continuity of bond above and below openings with minimum of cutting.
 - .5 Remove laitance, loose rust, scale, and other foreign materials from supporting bed surfaces to ensure bonding.
 - .6 Use only dry and unfrozen materials.
 - .7 Where mortar has started to harden at units requiring repositioning, remove and replace with fresh mortar.
 - .8 Joints:

- .1 Make joints of uniform thickness with vertical joints plumb over each other.
- .2 Form tooled concave joints wherever exposed to view, whether behind cabinets, fitments, and wall accessories.
- .3 Ensure that no mortar protrudes from joints on wall surfaces to which insulation will be applied.
- .9 Install special units as may be required to form corners, returns, offsets, reveals, and indents without cut ends being exposed and without losing bond pattern or module.
- .10 Fit masonry closely against electrical and plumbing outlets so that collars, plates, and covers will overlap and conceal all cuts.
- .11 Use chipped and blemished units only where concealed. Do not use defective or broken units.
- .12 Distribute masonry units of varying textures to avoid spotty appearance over wall surfaces exposed to view. Do not use units that contrast too greatly with overall range. Remove masonry units of non-matching colour variation. Replace with conforming units at no additional cost to the Owner.
- .13 Where replacing in excess of four bricks in one area, install masonry ties to bond facing with back-up wythes of masonry.
- .14 The ties should be randomly installed in rebuilt areas except where areas are sufficiently large for the ties to be set every 600 mm horizontally and vertically with staggered centres.
- .15 Drill entry hole into the block backup and drive the tie into position in accordance with the Manufacturer's recommended embedment length and hole diameter.
- .16 Ensure that the ties are solidly set in the back-up wythe.

3.4 TOLERANCES

- .1 Comply with tolerances as required and recommended in CSA A371.

3.5 INSTALLATION OF MASONRY CONNECTORS

- .1 Install masonry connectors in accordance with CSA A370.
- .2 Comply with fastener manufacturer's recommendations for edge distance in applicable substrates. Do not fasten into mortar joints of masonry backup.
- .3 Install top row of masonry connectors not more than one-half of typical tie spacing below top of veneer panels.
- .4 Ensure that connectors installed over or through sheathing are adequately fastened to studs or other structural framing.

3.6 INSTALLATION OF ACCESSORIES

- .1 Control Joints: Install continuous control joint fillers as indicated on drawings. Seal joints with compatible sealant over the joint filler.
- .2 Expansion Joints: Kept free of mortar, ready to receive a back-up rod and sealant.
- .3 Cavity Vents:
 - .1 Install vents in vertical joints immediately over flashing and near tops of walls, in exterior wythes of cavity wall construction to match existing.

3.7 ADJUSTMENT AND CLEANING

- .1 Point all voids in brick faces.
- .2 Cut out defective mortar joints and repoint.

- .3 Clean brick with brushes and as otherwise recommended by the supplier to remove mortar and stains.
- .4 Remove mortar droppings that adhere to the exposed face of a unit with a wooden paddle after being allowed to dry and harden. Remove remaining mortar with a stiff fibre brush.
- .5 Do not use wire brushes for cleaning.
- .6 Should specified cleaning methods be insufficient, proceed with other methods only with prior review and acceptance by Consultant.
- .7 Protect adjacent materials and Work from damage while cleaning.
- .8 Ensure that all efflorescence and mortar deposits are removed from surfaces.
- .9 Exercise particular care during construction to prevent mortar smears on the face of the brick masonry.
- .10 Remove efflorescent salts by dry brushing followed by flushing with clean water.

3.8 CLEAN-UP

- .1 Remove all debris resulting from the work of this section.

END OF SECTION

1 General

1.1 SUMMARY

- .1 Supply and install all miscellaneous metal work indicated on drawings and not included in the work of other Sections in addition to items listed in this Section.
- .2 Section includes the supply and installation of decorative steel railings, complete with intermediate stanchions, as detailed on the Drawings for use in the following locations:
 - .1 Guardrail/Handrails at ramps/stairs;
 - .2 Counter support (legs and frame)
 - .3 Corner guards

1.2 RELATED REQUIREMENTS

- .1 Read carefully all other Sections and review drawings to determine extent of metal work supplied and installed, or installed by others.
- .2 Be responsible for co-ordinating this section with all related sections.

1.3 REFERENCE STANDARDS

- .1 American Society for Testing and Materials (ASTM):
 - .1 ASTM A53/A53M-12, Standard Specification for Pipe, Steel, Black and Hot Dipped, Zinc Coated, Welded and Seamless
 - .2 ASTM A325-10, Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
 - .3 ASTM A653/A653M-11, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
 - .4 ASTM C939-10, Standard Test Method for Flow of Grout for Preplaced Aggregate Concrete (Flow Cone Method)
 - .5 ASTM A1011/A1011M-12b, Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with improved Formability, and Ultra-High Strength
 - .6 ASTM C1107/C1107M-11, Standard Specification for Packaged Dry, Hydraulic Cement Grout (Nonshrink)
- .2 Canadian Standards Association (CSA):
 - .1 CSA G40.20-04/G40.21-04 (R2009), General Requirements for Rolled or Welded Structural Quality Steel / Structural Quality Steel
 - .2 CAN/CSA-G164-M92 (R2003), Hot Dip Galvanizing or Irregularly Shaped Articles
 - .3 CSA-S16-09, Design of Steel Structures
 - .4 CSA-S136-07, North American Specification for the Design of Cold Formed Steel Structural Members
 - .5 CSA W47.1-09, Certification of Companies for Fusion Welding of Steel
 - .6 CSA W55.3-08, Certification of Companies for Resistance Welding of Steel and Aluminum
 - .7 CSA W59-03 (R2008), Welded Steel Construction (Metal Arc Welding)
- .3 Canadian General Standards Board (CGSB):
 - .1 CAN/CGSB-1.181-99, Ready-Mixed Organic Zinc-Rich Coating
 - .2 CAN/CGSB-51.32-M77, Sheathing, Membrane, Breather Type

- .3 CGSB 31-GP-105Ma, Zinc Phosphate Conversion Coatings for Paint Base
- .4 The Society for Protective Coatings (SSPC):
 - .1 SSPC1 Solvent Cleaning - 2004
 - .2 SSPC2 Hand Tool Cleaning - 2004
 - .3 SSPC-3 Power Tool Cleaning - 2004
 - .4 SSPC-6 Commercial Blast Cleaning - 2007

1.4 QUALITY ASSURANCE

- .1 All Codes and Standards referred to in this Specification shall be current editions including all latest revisions and addenda.
- .2 Conform to requirements of CSA-S16, Design of Steel Structures and CAN/CSA-S136, Cold Formed Steel Structural Members.
- .3 Architectural metals work shall be of the highest architectural quality, free of scratches, pitting, roughness, marring, discolouration, staining and other imperfections.
- .4 Work of this Section to be executed by firm thoroughly conversant with laws, by-laws and regulations which govern, and capable of workmanship of best grade of modern shop and field practice known to recognized manufacturer's specializing in this work.
- .5 Work of this Section shall be executed by workers especially trained and experienced in this type of work. Have a full time, senior, qualified representative at the site to direct the work of this Section.
- .6 Where required by authorities having jurisdiction, have work of this Section designed by a professional engineer licensed to design structures and registered in the Province of the Work.

1.5 SUBMITTALS

- .1 Provide submittals in accordance with Division 01, bearing stamp or seal and signature of the Professional Engineer responsible for the design of the work of this Section.
- .2 Shop Drawings:
 - .1 Make thorough examination of drawings and details, determine the intent, extent, and materials, and be fully cognizant of requirements when preparing shop drawings.
 - .2 Submit shop drawings showing and describing in detail all work of this Section including large scale detail of members and materials, of connection and interfacing with work of other Sections, jointing details, and of anchorage devices, dimension, gauges, thicknesses, description of materials, metal finishing, as well as other pertinent data and information.
 - .3 Digital files of design drawings shall not be used in the preparation of shop drawings.

1.6 STORAGE, DELIVERY, HANDLING AND PROTECTION

- .1 Coordinate deliveries to comply with construction schedule and arrange ahead for strategic off the ground, under cover storage locations. Do not load any area beyond the design limits.
- .2 Adequately protect and crate all components against damage, dirt, disfigurement and weather during delivery and storage. Damaged materials shall not be used and shall be replaced by approved material.
- .3 Cover and protect the work of other Sections in the area of work from damage. Make good all damage to the satisfaction of the Consultant.

- .4 Protect the installed work of this Section and on completion the work shall be examined and damage shall be remedied to the complete satisfaction of the Consultant.

2 Products

2.1 PERFORMANCE REQUIREMENTS

- .1 Delegated Design: Engage a qualified professional engineer, to design stairs and railings, including attachment to building construction.
- .2 Structural Performance: Railings, including attachment to building construction, shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
 - .1 Handrails and Top Rails of Guards:
 - .1 Uniform load of 50 lbf/ft. (0.73 kN/m) applied in any direction.
 - .2 Concentrated load of 200 lbf (0.89 kN) applied in any direction.
 - .3 Uniform and concentrated loads need not be assumed to act concurrently.
 - .2 Infill of Guards:
 - .1 Concentrated load of 50 lbf (0.22 kN) applied horizontally on an area of 1 sq. ft. (0.093 sq. m).
 - .3 Infill load and other loads need not be assumed to act concurrently.

2.2 MATERIALS

- .1 Structural Steel Sections and Steel Plate: New stock (not weathered or rusted); to conform to CAN/CSA-G40.21, Grade 300W (44W) and Grade 350W (50W) for wide flange shapes.
- .2 Hollow Structural Sections (HSS): New stock; to conform to CAN/CSA-G40.21, Grade 350W (50W), Class C, stress relieved.
- .3 Sheet Steel (Structural Quality): Conforms to ASTM A1011/A1011M.
- .4 Sheet Steel (Commercial Quality): Conforms to ASTM A653/A653M, stretcher levelled or temper rolled.
- .5 Tube: Conforms to ASTM A53.
- .6 Galvanized Sheet Steel (Commercial Quality): Galvanized coating G90 (Z275) in accordance with ASTM A653/A653M, minimized spangle, stretch levelled or temper rolled. Specially treat by phosphate conversion process conforming to CGSB 31-GP-105Ma ready to receive prime paint finish.
- .7 Steel Pipe: Hot-dip galvanized, zinc coated, welded and seamless type steel pipe conforming to ASTM A53/A53M.
- .8 Aluminum Plate and Sheet: ASTM B209M, Alloy 6061-T6.
- .9 Aluminum Extrusions: ASTM B221M, Alloy 6063-T6.
- .10 Non-Shrink Grout: Premixed, high strength, maximum bearing, impact resistant, non-shrink non-metallic aggregate grout having minimum 76 Mpa 28 day compressive strength and conforms to ASTM C939 and ASTM C1107/C1107M, 'Embeco Premixed Grout' by Master Builders Technologies Ltd., or 'Tartan Grout Iron' by Webster & Sons Ltd., or 'Sika Grout 212 HP' by Sika Canada Inc., or approved equivalent.
- .11 Galvanizing: All uncoated steel specified to be galvanized shall be galvanized after fabrication by the hot dip process according to CAN/CSA-G164, with minimum coating of 2 oz./sq.ft. Galvanize after all welding is complete. Welding of galvanized material will

- not be permitted. Specially treat by phosphate conversion process conforming to CGSB 31-GP-105Ma ready to receive prime paint finish.
- .12 Primer Paint: CISC/CPMA 2-75.
 - .13 Bolts, Nuts, Washers: Conforms to ASTM A325.
 - .14 Welding Materials: Conforms to CSA W59.
 - .15 Metal Filler: Polyester based type.
 - .16 Painting:
 - .1 Shop Applied Structural Steel Primer: Steel Spec Universal Primer (B50RV6227 Red), by Sherwin Williams Company of Canada Ltd., or approved equivalent. Apply a minimum of 2 mils dft./coat. Grey coloured primer is acceptable.
 - .2 Zinc Rich Paint For Touch-up of Galvanized Metals: Ready mixed, zinc-rich primer conforming to CAN/CGSB-1.181, Sealtight Galvafrid Zinc-Rich Coating by W.R. Meadows of Canada Limited or Zinc Clad No. 5 Organic Zinc Rich Primer by Sherwin Williams Company of Canada Ltd., or approved equivalent.
 - .3 Touch-up Primer (On Site): Procryl Universal Acrylic Primer by Sherwin Williams Company of Canada Ltd, or approved equivalent. Touch-up primer shall be no less than 3 mil dft.
 - .4 Refer to Section 09 90 00, and coordinate with the above.
 - .17 Isolation Coating: Acid and alkali resistant bituminous paint.
 - .18 Building Paper: Conforms to CAN/CGSB-51.32.
 - .19 Butyl Tape: Extruded, high grade, macro-polyisobutylene tape of size, width and shore hardness to suit conditions.

2.3 FABRICATION

- .1 Fit and assemble work in shop where possible. Execute work according to details and reviewed shop drawings.
- .2 Take measurements at the building for work which is to fit or be connected to steel or concrete before commencing fabrication.
- .3 Where shop fabrication is not possible, make trial assembly in shop.
- .4 Do all welding in accordance with requirements of CSA W59, CSA W55.3 and CSA W47.1 including all supplements. Weld stainless steel electric arc process. Grind welds smooth and flush with surface of parent metal, where exposed to view and where specifically indicated on drawings. Welds shall be continuous seam welds unless specified otherwise. Maintain sharp arises.
- .5 Fit joints and intersecting members accurately in true planes, square, plumb, straight with tight joints and intersections.
- .6 Provide adequate reinforcing, fastenings, anchors, accessories required for fabrication and erection of work of this Section. Such items occurring on or in an exterior wall or slab shall be hot-dip galvanized. Make thread dimensions such that nuts and bolts will fit without rethreading or chasing threads.
- .7 Fabricate, drill and tap members to accommodate attachments, anchorage and work of other Sections where located and directed by them.
- .8 Exposed steel surfaces shall be smooth and free from imperfections such as warping, buckling, weld marks, burrs, rust and scale.
- .9 Gauges and sizes of metal shall be adequate for various conditions.
- .10 Make exposed metal fastenings and accessories of same material, texture, colour and finish as base metal on which they occur unless otherwise shown or specified. Keep

exposed fastenings to an absolute minimum evenly spaced and neatly laid out. Make fastenings of permanent type unless otherwise indicated.

2.4 SHOP PAINTING AND PROTECTION

- .1 As per SSPC2 Hand Tool Clean and SSPC1 Solvent Clean, clean welds by wire brushing and wash down with clean water, to remove the chemical residues left by the electrodes, prior to painting.
- .2 Prepare steel as per SSPC-3 Power Tool Cleaning for Interior or SSPC-6 Commercial Blast Cleaning for exterior members. Remove rust, mill scale, oil, dirt, and other foreign matter before commencing shop painting.
- .3 Apply shop coat of primer to all surfaces except areas requiring field welding. Apply by brush, working paint well into surfaces, interstices and cavities.
- .4 Primer is to be free of runs, sags, or other collections of primer due to dipping of members into primer.
- .5 Steel work shall be painted under cover, and shall remain under cover, until the paint protection is dry.
- .6 Prime field welded areas after erection and touch up shop coat where damaged and barred by erection and handling.
- .7 Prime steel with two full coats of paint in strict accordance with paint manufacturer's directions.
- .8 Give the parts which are inaccessible after assembly two coats of primer coat paint, of different colours, when members are noted to be painted.

2.5 HOT DIP GALVANIZING

- .1 Hot dip galvanize, after fabrication, steel metal fabrication items. Straighten shapes and assemblies true to line and plane after galvanizing. Repair damaged galvanized surfaces with brush or spray-applied anti-corrosion coating containing 92-95% zinc, in accordance with manufacturer's printed directions.
 - .1 Members exposed to elements when in final location.
 - .2 Members embedded on exterior side of exterior walls.
 - .3 Members imbedded in concrete.
 - .4 Members specified in this Section or indicated on Drawings.
- .2 Hot-dip galvanize members in accordance with CAN/CSA G164 and requirements of the following ASTM standards, with minimum coating weights or thicknesses as follows, unless otherwise indicated that high performance organic finish is required:
 - .1 Rolled, Pressed and Forged Steel Shapes, Plates, Bars and Strips: ASTM A123/A123M; average weight of zinc coating of actual surface
 - .1 4.8 mm (3/16") and less member thickness: 600 g/sq.m.
 - .2 6 mm (1/4") and heavier members: 640 g/sq.m.
 - .2 Iron and Steel Hardware: ASTM A153/A153M; minimum weight of zinc coating, in gram per square meter of surface, in accordance with Table 1 for the various classes of materials used in the Work.

3 Execution

3.1 GENERAL

- .1 Verify at site that the Work to receive the work of this Section is free of irregularities detrimental to the installation and performance of the work and that it is located correctly and at proper levels before delivery and installation.

- .2 Erection: To meet specified requirements of CAN/CSA-S16.
- .3 Bearing Plates and Anchors: Standard.
- .4 Anchors: Anchors to structural concrete shall be approved inserts set into concrete or approved self-drilling expansion insets drilled and placed afterwards.

3.2 INSTALLATION

- .1 Assemble and erect work plumb, true, square, straight, level and accurate to sizes detailed, to reviewed shop drawings, free from distortion and defects detrimental to appearance and performance.
- .2 Isolate metals where necessary to prevent corrosion due to contact between dissimilar metals and between metals and masonry, concrete or plaster. Use bituminous paint or butyl tape.
- .3 Supply adequate instructions, templates, and if necessary, supervise installation of the fastenings or accessories requiring to be built-in by other Sections of the Work.

3.3 SCHEDULES

- .1 Where items are required to be built into masonry, concrete or other work, supply such items to respective Sections with all anchors and accessories for building in.
- .2 Itemized List: Supply and install metal work listed below unless specifically designated to be supplied only. Each item shall be as shown on drawings and as detailed on reviewed shop drawings.
- .3 Miscellaneous Steel Framing, Channels, Angles, Plates and Brackets: As required and indicated on drawings.
- .4 Metal grating: refer to structural drawings.
- .5 Guardrails and Handrails:
 - .1 Guardrail at Ramp/Stair (exterior):
 - .1 Galvanized steel guardrail, complete with top and bottom rail, intermediate stanchions and vertical pickets.
 - .1 Continuous 43mm diameter handrail c/w rounded end caps on 10mm diameter stand offs
 - .2 Mounting: grouted into new metal stair.
 - .3 Finish: hot dip galvanized.
 - .2 Handrail at Ramp/Stair (exterior)
 - .1 Continuous 43mm diameter handrail c/w rounded end caps on 10mm diameter stand off with 75mm diameter mounting plate.
 - .2 Mounting: mounting plate anchored into new guardrail.
 - .3 Finish: hot dip galvanized.
- .6 Counter supports:
 - .1 L-angle legs with bottom plate and horizontal L-angle arms to support countertops as detailed.
- .7 Loose Lintels:
 - .1 Provide and install loose lintels if not by structural steel.
 - .2 Finish: Hot-dip galvanized after fabrication.
- .8 Corner Guards

- .1 Stainless steel corner guards at exterior corners of GWB framed walls throughout ground floor corridor.
 - .1 2" x 2" x 48" L, 16gauge, allow for 12no
- .9 Other Miscellaneous Metal Components:
 - .1 As required and indicated on drawings.
 - .2 Finish: Prime paint for interior components, ready for finishing by Section 09 90 00 and hot-dip galvanized after fabrication for exterior components.

END OF SECTION

1 General

1.1 SUMMARY

- .1 Supply all labour, materials, equipment, services and perform all operations required to complete all rough carpentry work to the full intent of the drawings and as herein specified.

1.2 REFERENCE STANDARDS

- .1 American Society for Testing and Materials (ASTM):
 - .1 ASTM A307-04e1, Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
 - .2 ASTM C954-00, Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs From 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness
 - .3 ASTM D6007-02 Standard Test Method for Determining Formaldehyde Concentration in Air from Wood Products Using a Small Scale Chamber
 - .4 ASTM D6330-98(2003) Standard Practice for Determination of Volatile Organic Compounds (Excluding Formaldehyde) Emissions from Wood-Based Panels Using Small Environmental Chambers Under Defined Test Conditions
 - .5 ASTM E1333-96(2002) Standard Test Method for Determining Formaldehyde Concentrations in Air and Emission Rates from Wood Products Using a Large Chamber
- .2 Underwriters Laboratories of Canada (ULC):
 - .1 CAN/ULC S102-18, Standard Method of Test for Surface Burning Characteristics of building Materials and Assemblies
- .3 American Wood Preservers Association (AWPA):
 - .1 AWPA Book of Standards, Latest edition
- .4 Canadian General Standards Board (CGSB):
 - .1 CAN/CGSB 71.26-M88, Standard for Adhesives for Field-gluing Plywood to Lumber Framing for Floor Systems.
- .5 Canadian Roofing Contractors Association (CRCA):
 - .1 Roofing Specifications
- .6 Canadian Standards Association (CSA):
 - .1 CSA B111-1974 (R2003), Wire Nails, Spikes and Staples
 - .2 CSA G164-M92 (R2003), Hot Dip Galvanizing of Irregularly Shaped Articles
 - .3 CSA O80 Series-97 (R2002), Wood Preservation
 - .4 CSA O86-01, Engineering Design in Wood
 - .5 CSA O112 Series-M1977(R2001), Adhesives for Wood
 - .6 CSA O121-M1978 (R2003), Douglas Fir Plywood
 - .7 CSA-O141-M91(R1999), Softwood Lumber.
 - .8 CSA O151-M1978(R2003), Canadian Softwood Plywood.
 - .9 CSA O325.0-92(R2003), Construction Sheathing
 - .10 CSA O437 Series 93 (R2003) OSB and Waferboard

- .11 CSA O452 Series 94 (R2001), Design Rated OSB
- .7 National Lumber Grading Association (NLGA):
 - .1 NLGA SPS2-2000 Special Products Standards on Machine Stress-Rated Lumber.
 - .2 NLGA Canadian Lumber Grading Rules

1.3 DELIVERY, STORAGE, HANDLING AND PROTECTION

- .1 Co-ordinate deliveries to comply with construction schedule and arrange ahead for off-the-ground, under cover storage location. Do not load any area beyond the design limits.
- .2 Materials shall be carefully checked, unloaded, stored and handled to prevent damage. Protect materials with suitable non-staining waterproof coverings.
- .3 Do not store seasoned materials under conditions that will cause their moisture content to increase.
- .4 Protect edges and corners of sheet materials from damage during handling and storage.
- .5 Store preservative-treated materials under cover, off the ground and protected from moisture.

2 Products

2.1 MATERIALS

- .1 Framing Lumber:
 - .1 Lumber for structural components shall be of species and grade specified, well seasoned, processed and stamped at same mill with appropriate grade markings.
 - .2 Conform to requirements of Standard Grading Rules for Canadian Lumber of National Lumber Grades Authority the (NLGA) with latest supplements, approved by the Canadian Lumber Standards Administrative Board.
- .2 Framing, Furring, Strapping, Blocking:
 - .1 Spruce, 122c, "Standard" light framing, except as otherwise specified.
- .3 Plywood Sheathing:
 - .1 Shall be 19mm (3/4") thick and/or thickness as indicated on drawings, exterior grade at exterior locations; Douglas Fir plywood, veneer core.
 - .2 Select Sheathing; Tight Face, un-sanded, "B" faces and conforming to CSA 0121-08.
- .4 Flooring Underlayment
 - .1 Panel underlayment shall be smooth enough so that the texture of the graining or particle placement in the panel will not show through the finished resilient flooring. The underlayment panels shall not contain any foreign substance or markings that may stain the resilient flooring after installation. Protective coatings that may be used on underlayment panels shall be non-staining and be compatible with adhesives used for installing resilient flooring.
 - .2 Shall be 10mm (3/8") thick and/or thickness as indicated on drawings. Acceptable products:
 - .1 Sanded, G1S, A Grade Face Veneer Douglas Fir Plywood to CSA 0121
 - .2 Underlayment grade plywood per American Plywood Association
- .5 Rough Hardware:

- .1 Provide rough hardware such as nails, spikes, staples, H-clips, bolts, nuts, washers, screws, clips, strap iron and including hardware for temporary enclosures.
- .2 Nails for plywood shall be annular or spiral type, all other nails shall be spiral type. All nails, spikes and staples shall conform to CSA B111.
- .3 All rough hardware shall be galvanized unless otherwise noted. Galvanizing shall conform to CAN/CSA-G164.
- .6 All Other Materials and Hardware:
 - .1 Shall be as noted on drawings.

2.2 PRESERVATIVE TREATED MATERIALS

- .1 Preservative Treated Lumber: Lumber graded and stamped in accordance with applicable grading rules and standards of associations or agencies approved to grade lumber by Canadian Lumber Standards Accreditation Board in accordance with CSA O80 Series -08.
 - .1 Preservative Treatment: A waterborne, micronized copper azole (MCA) system developed to provide long-term protection for wood exposed in exterior applications from fungal decay and termite attack.
 - .1 For use on exterior lumber above ground, in ground contact and in freshwater contact.
 - .2 Basis of Design Materials: MicroPro Sienna® Treated Wood by Koppers Performance Chemicals Inc.
 - .2 Species: Pine or Spruce-Pine
 - .3 Grade: No.2 or better structural posts and lumber, pieces may be grade stamped or shipment certified by letter of compliance.
 - .4 Grading authority: NLGA, paragraph 131CC
 - .5 Material having twisted grain or structural defects affecting integrity of lumber will not be acceptable for this project.
 - .6 Use only material with radius edges, minimum 6 mm.
 - .7 Kiln dry lumber materials to 8% moisture content or less.
- .2 Pressure Preservative Treated Plywood: Treated in accordance with CSA O80 Series -08 using micronized copper azole (MCA) preservative.
 - .1 Plywood or laminated materials shall be manufactured with exterior grade adhesives.
 - .2 After treatment, plywood shall be kiln dried to moisture content of 8% or less.

2.3 PRESSURE FIRE RETARDANT TREATED MATERIALS

- .1 Treat by pressure impregnation with fire-retardant chemicals in accordance with CSA O80 Series -08 to provide classification for flame spread of not more than 25, smoke developed of not more than 75 in accordance with CAN/ULC S102.
- .2 All fire retardant wood must comply with the requirements in AWPAC Standard C20 for lumber and C27 for plywood.
 - .1 AWPAC C20: Structural Lumber, Fire-Retardant Pressure Treatment, lumber materials shall only be of species listed. After treatment, lumber 50 mm or less in thickness shall be kiln dried to moisture content of 8% or less.
 - .2 AWPAC C27: Plywood, Fire-Retardant Pressure Treatment, plywood or laminated materials shall be manufactured with exterior grade adhesives. After treatment, plywood shall be kiln dried to moisture content of 8% or less.

- .3 All species to comply with CAN/ULC S102 for surface-burning characteristics and shall bear identification showing classification and type of fire retardant.
- .3 Each piece or bundle of fire-retardant treated material or panel to bear ULC inspection label or stamp attesting to FRS rating indicating flame spread, smoke developed, and fuel contributed classification meeting AWPA standard C20 and C27 for Type A Use.
- .4 Fire retardant chemicals used to treat lumber must comply with FR-1 of AWPA Standard P17 and shall be free of halogens, sulphates and ammonium phosphate.
- .5 Acceptable materials: Plywood and lumber materials treated by licensed applicators with fire retardant materials from the following:
 - .1 Dricon FRTW by Hickson Corporation.
 - .2 Pyro-Guard by Hoover Treated Wood Products Inc.
 - .3 D-Blaze by Chemical Specialties Inc.
 - .4 Or approved equivalent.

3 Execution

3.1 INSTALLATION - GENERAL

- .1 Consult with and co-operate with other Sections in advance and build-in or make provisions for installation of other work.
- .2 Provide and fit in place all furring, strapping, battens, nailers, sleepers, grounds and blocking required to provide adequate properly placed fixing for all wood finishes, fitments and as required for the work of others trades.
- .3 Blocking, strapping and other rough carpentry indicated shall not be regarded as complete or exact. Provide all rough carpentry work required, whether specifically shown or not.
- .4 Grounds shall be of a thickness to provide for application of finishes. Room side surfaces of grounds shall be plumb and in true plane throughout.
- .5 All nails shall be long enough so that at least half their length penetrate in to the second member. Splitting of wood members shall be minimized by staggering the nails in the direction of the grain and by keeping nails well in from edges.
- .6 Blocking shall be through-bolted to structure.
- .7 Anchor rough bucks to concrete or masonry with pairs of 3/16" (4.75mm) diameter x 2 1/4" (57mm) long Hilti Kwik Con+ anchors (minimum 1"/25mm embedment), at max 350mm O.C. Refer also to details.

3.2 WOOD BLOCKING, CANTS AND NAILERS

- .1 Provide wood blocking, cants and nailers, where shown to be required as detailed. Bolt securely in place.
- .2 Block under cants same thickness as installed roof insulation.
- .3 Check mechanical, electrical, architectural drawings and provide all blocking, cants, nailers etc. required.
- .4 Leave work ready for roofing work and prefinished sheet metal flashing installation.

3.3 PLYWOOD PANELS

- .1 Provide plywood panels required for electrical/telephone mounting of equipment and in other locations as indicated on drawings.

3.4 FLOORING UNDERLAYMENT

- .1 Install as per ASTM F1482 Standard Practice for Installation and Preparation of Panel Type Underlayment to receive Resilient Flooring.

3.5 PRESSURE PRESERVATIVE TREATED WOOD INSTALLATION

- .1 Comply with AWPA M4.
- .2 Re-treat surfaces exposed by cutting, trimming or boring with liberal brush application of preservative before installation. Allow first coating to fully soak into grain before applying second coating in accordance with manufacturer's instructions.
- .3 Remove with fine sandpaper, chemical deposits on treated wood to receive applied finish.
- .4 Use only hot-dipped galvanized, corrosion resistant nail or screw fasteners. Staples are not acceptable for installation of preservative treated materials.
- .5 Use water-borne preservative treated wood for:
 - .1 Wood in contact with masonry or concrete;
 - .2 Wood within 457mm (18") of grade;
 - .3 Wood decking and fence boards;
 - .4 Wood in contact with flashings;
 - .5 Wood in contact with waterproofing membranes, confirm compatibility with membrane manufacturer prior to application.
- .6 Use oil-borne preservative treated wood for:
 - .1 Wood in contact with the ground;
 - .2 Wood in contact with freshwater;
 - .3 Landscaping timbers;
 - .4 Retaining walls;
 - .5 Piers or docks;
 - .6 Pilings;
 - .7 Bases of utility poles;
 - .8 Bases of fence posts.

3.6 PRESSURE FIRE RETARDANT TREATED WOOD INSTALLATION

- .1 Field Cuts:
 - .1 Do not rip, mill or conduct extensive surfacing of fire retardant treated lumber, label will be voided. Only end cuts, drilling holes and joining cuts are permitted.
 - .2 All cuts on plywood will be considered end cuts.
 - .3 Fire-retardant lumber and plywood can be given a light sanding for cosmetic cleaning after treatment.
 - .4 Pre-cut to the greatest extent possible before treating.
- .2 Fire retardant treated plywood used in structural applications shall be graded or span-rated material.
- .3 Use only hot-dipped galvanized, corrosion resistant nail or screw fasteners. Staples are not acceptable for installation of fire-resistant treated materials.
- .4 Where humidity conditions are such that moisture may condense between hardware and treated wood, hardware shall be back-primed with a corrosive-inhibitive paint.

- .5 Back-prime at contact points and fasteners to prevent electrolysis when fire retardant framing members are used in metal buildings.

END OF SECTION

1 General

1.1 SUMMARY

- .1 This Section includes requirements for the supply and installation of cold applied SBS modified bituminous membrane roofing system (R1 and R2).
- .2 Section includes:
 - .1 Preparation of Metal Deck Surface
 - .2 Self Adhesive Vapour Retarder
 - .3 Roof Insulation Boards in adhesive
 - .4 Mineral Wool Cavity Wall Insulation Board at parapet walls
 - .5 Sprayed Foam Insulation at penetrations through Roof Assemblies
 - .6 Composite panel of asphaltic board and Base Sheet in adhesive
 - .7 Self-adhesive Base Sheet Flashing
 - .8 Cap Sheet Membrane and Cap Sheet Flashing in cold adhesive
 - .9 Accessories

1.2 REFERENCE STANDARDS

- .1 Canadian Roofing Contractors Association (CRCA):
 - .1 Roofing Specification Manual
- .2 American Society for Testing and Materials (ASTM):
 - .1 ASTM C1002-04, Steel Drill Screws for the Application of Gypsum Board
 - .2 ASTM C1396/C1396M-06a, Standard Specification for Gypsum Board
 - .3 ASTM D1621-10, Standard Test Method for Compressive Properties of Rigid Cellular Plastics
 - .4 ASTM D2842-06, Standard Test Method for Water Absorption of Rigid Cellular Plastics
 - .5 ASTM E96/96M-2010, Standard Test Methods for Water Vapor Transmission of Materials.
 - .6 ASTM E2178-2003, Standard Test Method for Air Permeance of Building Materials.
- .3 Canadian General Standards Board (CGSB):
 - .1 CGSB 37-GP-56M, Membrane, Modified, Bituminous, Prefabricated and Reinforced for Roofing
 - .2 CGSB 37-GP-64M, Mat Reinforcing, Fibrous Glass, for Membrane Waterproofing Systems and Built-up Roofing
 - .3 CAN/CGSB-37.5-M89, Cutback Asphalt Plastic Cement
 - .4 CAN/CGSB-37.28-M89, Reinforced, Mineral Colloid Type, Emulsified Asphalt for Roof Coatings and Waterproofing
 - .5 CGSB 37-GP-9Ma, Primer, Asphalt, Unfilled, for Asphalt Roofing, Dampproofing or Waterproofing
- .4 Canadian Standards Association (CSA):
 - .1 CSA A123.4-04, Bitumen for Use in Construction of Built-up Roof Coverings and Dampproofing and Waterproofing Systems

- .2 CSA B111-1974 (R2003), Wires, Nails, Spikes and Staples
- .3 CSA O151-M1978 (R2003), Canadian Softwood Plywood
- .5 Underwriters Laboratories Canada (ULC):
 - .1 CAN/ULC S107-03, Standard Methods of Fire Tests of Roof Coverings
 - .2 CAN/ULC S701-11, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering
 - .3 CAN/ULC S702-97, Thermal Insulation, Mineral Fibre, Boards for Buildings and ULC S702.2-03, Mineral Fibre Thermal Installation for Buildings, Part 2: Application Guidelines
 - .4 CAN/ULC S704-03, Standard for Thermal Insulation, Polyurethane and Polyisocyanurate, Boards, Faced
 - .5 CAN/ULC S770-2000, Determination of Long-Term Thermal Resistance of Closed-Cell Thermal Insulating Foams
- .6 Air Barrier Association of America (ABAA):
 - .1 ABAA 2011, Installer's Certification Program.
 - .2 ABAA 2012, Water-resistive Barrier Installation Guideline.
- .7 American Association of Textile Chemists and Colorists (AATCC)
 - .1 AATCC 42 2007, Water Resistance: Impact Penetration Test.

1.3 SUBMITTALS

- .1 Provide required information in accordance with Division 01.
- .2 Action Submittals: Provide the following submittals before starting any work of this Section:
 - .1 Product Data: Submit copies of membrane manufacturers current technical data sheets describing the physical properties and recommended installation procedures.
 - .2 Shop Drawings:
 - .1 Submit roof plan showing layout of sloped insulation, slopes to drains, location of drains, and scuppers at the edges of the building. Sloped insulation layout drawings to be reviewed by Consultant and stamped by Manufacturer, prior to installation.
 - .2 Submit membrane manufacturer's standard details that will be used for this project, indicate changes that must be made to make the details project specific for review by the Consultant.
 - .3 Informational Submittals:
 - .1 Certificates: Provide roofing system materials that are compatible with building vapour retarders specified in Division 07; submit a written declaration to the Consultant that roofing materials and components are compatible with wall air and vapour retarder membranes when requested by Consultant.
 - .2 Submit a report, certifying that the specified roofing system was tested in accordance with CSA A123.21-10, Standard test method for the dynamic wind uplift resistance of membrane-roofing systems. Test results shall demonstrate that the roofing system provides a Dynamic Uplift Resistance (DUR) of:
 - .1 Corner: -2.8kPa;

- .2 Edge: -1.3kPa;
- .3 Field: -0.9kPa.

1.4 MOCK-UPS

- .1 Provide mock-ups in accordance with Division 1.
- .2 Construct mock-ups for each form of construction and finish required to verify selections made under sample submittals and to demonstrate aesthetic effects and qualities of materials and execution before installing materials indicated in this Section.
- .3 Build mock-ups using exposed and concealed materials indicated for the completed Work.
- .4 Mock-up must demonstrate air barrier continuity between roof assembly and adjacent wall/parapet assembly.

1.5 QUALITY ASSURANCE

- .1 Obtain roofing membrane materials through one source from a single manufacturer and install using workers who are trained and approved by the roofing membrane manufacturer; maintain a full time experienced journeyman roofer, and at least one apprentice per crew on the Work at all times.
- .2 Roofing and sheet metal work will be performed in conformance with the roofing manufacturer's written recommendations using materials that meet the requirements of CAN/ULC S107 to obtain a Class A fire resistance rating; submit proof that roofing materials meet required performance when requested by the Consultant.
- .3 Conform to Roofing Specifications as published by Canadian Roofing Contractors Association (CRCA) as a reference.
- .4 Execute work of this section using an applicator approved by the membrane manufacturer, and capable of issuing a 10 year Performance Warranty.
- .5 Pre-installation Conference:
 - .1 Convene a pre-installation conference at the site, one week prior to commencing work of this Section to review preparation and installation procedures and coordinating and scheduling required with related work.
 - .2 Require attendance of parties directly affecting work of this Section, including, but not limited to, the Owner's representative, Consultant, Contractor, Roofing Applicator and job foreman and Roofing Manufacturer's Representative.
 - .3 Contact Consultant two weeks prior to pre-installation conference to confirm schedule.
 - .4 Record discussions of conference and decisions and agreements (or disagreements) reached, and furnish copy of record to each party attending. Review foreseeable methods and procedures related to roofing work, including the following:
 - .1 Tour, inspect and discuss condition of substrate, roof drains, roof drain final locations, curbs, penetrations and other preparatory work performed by other trades.
 - .2 Review structural loading limitations of deck and inspect deck for loss of flatness and for required mechanical fastening.
 - .3 Review roofing system requirements (drawings, specifications and other contract documents).
 - .4 Review required submittals, both completed and yet to be completed.

- .5 Review and finalize construction schedule related to roofing work and verify availability of materials, installer's personnel, equipment and facilities needed to make progress and avoid delays.
- .6 Review required inspections, testing, certifying and material usage accounting procedures.
- .7 Review weather and forecasted weather conditions, and procedures for coping with unfavourable conditions, including possibility of temporary roofing (if not a mandatory requirement).

1.6 DELIVERY, STORAGE AND HANDLING

- .1 All materials will be delivered and stored in conformance with manufacturers written requirements; they must remain in their original packaging, displaying the manufacturer's name, product name, weight, and reference standards, as well as all other indications or references considered standard.
- .2 Store materials in a dry and properly ventilated area, away from any welding flame or spark and sheltered from the elements or any harmful substance. Only materials destined for same-day use can be removed from this storage area. In cold weather, store materials in a heated area at a minimum temperature of +10 degree C and removed prior to application. If rolls cannot be stored in a heated environment, they may be pre-conditioned before installation, refer to manufacturers written recommendations on membrane application procedures.
- .3 Store adhesives and emulsion-based waterproofing mastics at a minimum +5 degree C. Store adhesives and solvent-based mastics at sufficiently high temperatures to ensure ease of application.
- .4 Materials delivered in rolls will be carefully stored upright; flashing will be stored to avoid creasing, buckling, scratches or any other possible damage.
- .5 Avoid material overloads which may affect the structural integrity of specific roof areas.
- .6 Place plywood runways over the Work to enable the movement of materials and other traffic during construction of roofing.
- .7 Protect surrounding surfaces against damage from roofing work. Where hoisting is necessary, hang tarpaulins to protect walls during delivery of materials from ground to roof.
- .8 Materials will be rejected and be replaced at no extra cost to the Owner where materials are damaged by the elements, improper handling or other causes; remove rejected materials promptly from the site.
- .9 Protect exposed surfaces of finished walls with tarp to prevent damage during roofing work, repair any damage caused to adjacent materials and finishes caused by roofing installation.

1.7 SITE CONDITIONS

- .1 Maintain roofing equipment in good working order.
- .2 Apply roofing within the range of ambient and substrate temperatures recommended by roofing system manufacturer:
 - .1 Do not apply roofing to a damp or wet substrate.
 - .2 Do not apply roofing in snow, rain, fog, or mist.

1.8 WARRANTY

- .1 Roofing Membrane Manufacturer: Provide manufacturer's warranty stating that they will repair or replace defective roofing (including labor) and base flashing materials that do not remain watertight, that splits, tears, or separates at the seams or from the substrate within the specified warranty period and as follows:

- .1 Warranty Period: Ten (10) years Standard Warranty, starting from Substantial Performance for the Project.

2 Products

2.1 MANUFACTURERS

- .1 Basis-of-Design products are named in this Section; additional manufacturers offering similar setting systems may be incorporated into the work provided they meet the performance requirements established by the named products.
- .2 Additional manufacturers offering similar Products may be incorporated into the work provided they meet the performance requirements established by the named products and provided they submit requests for substitution a minimum of ten (10) days in advance of Bid Closing.
- .3 Subject to compliance with requirements, manufacturers offering membrane products that may be incorporated into the Work include, but are not limited to, the following:
 - .1 Soprema Inc.
 - .2 Henry Company
 - .3 IKO
 - .4 Or approved equivalent.

2.2 PERFORMANCE REQUIREMENTS

- .1 Design and construct roof so that completed installation will not leak.
- .2 Structural Design Performance:
 - .1 Design Roof System to Resist:
 - .1 Maximum deflection not to exceed $l/180$ under system's own weight plus wind load (positive and negative) loads acting normal to the plane in accordance with the Building Code Climatic Data, wind load 1:50 years.
 - .2 Design the systems so that there is no air or water infiltration under the positive and negative forces imposed by wind and gravity loads.
 - .2 Thermal movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, overstressing of components, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime sky heat loss.
 - .1 Temperature change (range): 20 deg C; Ambient: 40 deg C, material surfaces.

2.3 MATERIALS

- .1 Primer: Manufacturers recommended primers specifically formulated for installation of materials outlined below, contributing to the wind uplift resistance rating indicated in this Section.
- .2 Vapour Retarder (VB-01):
 - .1 Self-adhesive membrane composed of SBS modified bitumen, with a surface screen made of high-density polyethylene laminated between two layers of polyethylene films.
 - .2 Resistance to water vapour transmission: 2.5 ng/Pa.s.m² (0.04 perm).
 - .3 Basis of Design Product: SOPRAVAP'R by Soprema Inc. (or approved equivalent).

- .3 Carpentry: Wood roof materials shall be as specified in Section 06 10 00. Do not use pressure treated materials where SBS membrane materials are to be adhered to wood fabrications.
- .4 Adhesive:
 - .1 Low-rise two-part urethane adhesive with no solvent content.
 - .2 Specified product: DUOTACK INSULATION ADHESIVE by Soprema or equivalent per Specification 01 25 00.
- .5 Insulation INS-01a (Bottom Flat Layer):
 - .1 CAN/ULC S704, ASTM C1289 Closed cell polyisocyanurate foam core between organic facers reinforced with glass fibres, suitable for use with adhesives.
 - .2 Thermal Resistance per 25mm (1"): R-5.7
 - .3 Compressive Strength – 138 kPa (20 psi).
 - .4 Linear Stability: < 5%
 - .5 Density: 32 kg/m³ (2.0 lb/ft³)
 - .6 Basis of Design Product: SOPRA-ISO by Soprema Inc. (or approved equivalent).
- .6 Insulation INS-01a – (Tapered Layer):
 - .1 CAN/ULC S704, ASTM C1289 Closed cell polyisocyanurate foam core between organic facers reinforced with glass fibres, suitable for use with adhesives.
 - .2 Compressive Strength – 138 kPa (20 psi).
 - .3 Linear Stability: < 5%
 - .4 Density: 32 kg/m³ (2.0 lb/ft³)
 - .5 Basis of Design Product: SOPRA-ISO TAPERED by Soprema Inc. (or equivalent per Specification 01 25 00).
- .7 Insulation INS-01b (Top Layer)
 - .1 ASTM C726, Type I, class 1 Dual-density mineral wool insulation board with a rigid upper layer, impregnated with bitumen layer, compatible with mechanical fastening and adhesive applied membranes.
 - .2 Mineral wool boards made from basalt rock and steel slag, resulting in a non-combustible insulation.
 - .3 Thermal Resistance per 25mm (1"): R-3.8
 - .4 Compressive Strength – Top Layer at 25%: 37psi.
 - .5 Density – Top Layer: 220 kg/m³
 - .6 Density – Bottom Layer: 160 kg/m³
 - .7 Basis of Design Product: SOPRAROCK DD PLUS by Soprema Inc. (or approved equivalent).
- .8 Insulation INS-02 (Parapet Wall)
 - .1 Fibrous mineral wool insulation, unfaced, in accordance with CAN/ULC S702, Type 1, thermal resistance not less than RSI 0.76/25 mm; rated non-combustible in accordance with CAN/ULC S114 and having a flame spread rating of 5 or less in accordance with CAN/ULC S102; density 72 kg/m³; square edges, board size 406 mm x 1220 mm x thickness indicated on the Drawings:
 - .2 Density: To ASTM C303:
 - .1 Outer layer: 100 kg/m³

- .2 Inner layer: 60 kg/m³
- .3 Water vapour permeance: 1555 ng/Pa.s.m².
- .4 Moisture sorption: 1 % maximum to ASTM C1104/C1104M.
- .5 Fungi resistance: Zero mould growth to ASTM C1338.
- .6 Basis of Design Material: CavityRock by ROCKWOOL Inc., or approved equivalent
- .9 Spray Applied Polyurethane Foam Insulation system in accordance with CAN/ULC S705.1-15 Standard for Thermal Insulation Spray Applied Rigid Polyurethane Foam, Medium Density, Material Specification and those specific objectives performances.
- .10 Asphaltic Overlay Board with Laminated Base Sheet Membrane
 - .1 CSA A123.23, SBS modified base sheet membrane and polyester reinforcement, factory-laminated on asphaltic board. Top surface sanded. Side laps 60% self-adhesive and 40% thermofusible. 7 mm total thickness.
 - .2 Specified product: 2-1 SOPRASMART BOARD SANDED by Soprema or equivalent per Specification 01 25 00.
- .11 Cover Strip
 - .1 CSA A123.23, Membrane strip of 330 mm (13 in) made of SBS modified bitumen with a composite reinforcement. Top surface sanded, underface self-adhesive. The strip ensures watertightness in the end laps.
 - .2 Specified product: SOPRALAP STICK by Soprema or equivalent per Specification 01 25 00.
- .12 Membranes
 - .1 Base Sheet Membrane Flashing:
 - .1 CGSB 37-GP-56M, Type 2, Class C, Grade 2 (CSA A123.23, Type C, Grade 3)
 - .2 Roofing membrane with glass and polyester reinforcement and SBS modified bitumen. Top face sanded, under side self-adhesive. Top face marked with three (3) distinctive blue chalk lines to ensure proper roll alignment.
 - .1 Thickness: 3mm
 - .2 Mass: 3.3 kg/m³
 - .3 Specified product: SOPRAPLY STICK DUO by Soprema or equivalent per Specification 01 25 00.
 - .2 Flexible Air Barrier Membrane Flashings (Transition Flashings):
 - .1 40 mils (1mm) thick x width to suit, strips of self-adhering, SBS rubberized asphalt laminated to a cross-laminated, high density polyethylene film with a silconized release liner.
 - .2 Basis of Design Product: Blueskin TWF by Henry Company, or approved equivalent.
 - .3 Water-resistive Barrier for Walls (WRB-01):
 - .1 Vapor permeable water-resistive barrier with tear-resistant thermo-bonded, non-woven polyester substrate and waterproof acrylic polymeric coating stabilized against oxidation and UV degradation and factory applied adhesive edge strips.
 - .2 Service Life Expectancy: Twenty-five (25) years.

- .3 Weight: 5.5 lb/100 ft², 270 g/m², 44 lb/roll nominal.
- .4 Colour: Black.
- .5 Basis of Design Materials: Dörken Systems Inc., DELTA®-FASSADE S (or approved equivalent).
- .13 Cap Sheet Field Membrane and Cap Flashing:
 - .1 Membrane composed of SBS modified bitumen and composite reinforcement.
 - .2 Surface: Covered and protected by coloured granules; Underside: Fine mineral aggregate for cold adhesive applications.
 - .1 Thickness: 3.5mm
 - .2 Mass: 4.3 kg/m³
 - .3 Colour of Granules: As selected by the Consultant from the manufacturer's standard product line.
 - .3 Basis of Design Product: COLPLY TRAFFIC CAP by Soprema Inc. (or equivalent per Specification 01 25 00).
- .14 Jointing Mastic / Caulking: SOPRAMASTIC by Soprema Inc. (or approved equivalent).
- .15 Metal Flashings: As indicated in Section 07 62 00.

3 Execution

3.1 EXAMINATION

- .1 Inspect completed roof deck and ensure that any defect of level or construction is corrected before proceeding with the work of this Section.
- .2 Do not apply any roofing to surfaces which are dusty, rusty or covered in loose material, snow, water, ice or any other substance which might impair the bond of roofing materials.
- .3 Verify that roof drains have been properly set and installed by the mechanical trade. Report any discrepancies to the Consultant so that they may be corrected.
- .4 Ensure items projecting through roof are solidly set and reglets and nailing strips are in place.
- .5 Inspect wood blockings, curbs and cants. Do not install roofing over such items if method of attachment is inadequate to withstand stresses imposed by thermal movement of roofing components.
- .6 Start of roofing work will be interpreted as meaning roofing conditions are in accordance with manufacturer's requirements.

3.2 PREPARATION

- .1 Protect finished work to avoid damage during roof installation and material transportation.
- .2 Install protective boardwalks to enable passage of personnel and materials without causing damage to installed roofing materials.
- .3 Mount mechanical application devices on pneumatic tired wheels; use devices designed and maintained to operate without damaging insulation, roofing membrane or structural components.
- .4 Flame heated equipment is prohibited.
- .5 Thoroughly clean all surfaces which are to receive the roofing and flashings by whatever means necessary to remove laitance, frost, snow, ice, water, debris, extraneous matter and other substances which could affect the proper performance of the work of this Section.

- .6 Prime vertical surfaces with asphalt primer commencing at the top of the cant strip to the reglet or highest point as detailed. Allow sufficient time for the asphalt primer to cure and ensure that primer does not run into the building or stain wall faces.

3.3 INSTALLATION

- .1 Prepare surfaces and complete roofing work specified in this Section in accordance with manufacturer's written instructions and guidelines.
- .2 Install roofing elements on clean and dry surfaces; in a continuous operation when substrates are ready and as weather conditions permit.
- .3 Seal seams in base sheets that are not covered by a cap sheet membrane in the same day; do not install cap sheet if any moisture is present at or within base sheet seams.
- .4 Protect work of other sections during installation of work of this Section; repair or compensate other sections for damage caused by this Section.
- .5 Vapour Retarder (VB-01):
 - .1 Install self-adhering vapour barrier membrane VB-01 by unrolling vapour barrier membrane onto deck sheathing board substrate, starting at bottom of slope without removing silicone release sheet, and as follows:
 - .1 Align roll parallel to sheathing board supporting membrane.
 - .2 Peel back one end of silicone release sheet and adhere membrane to substrate; peel remaining release sheet at a 45 deg angle to avoid wrinkles in membrane.
 - .3 Cut roll and start again where membrane is not properly aligned to deck sheathing board; re-align membrane and overlap end of misaligned piece by 150mm (6").
 - .4 Overlap adjacent membranes by 75mm (3"); overlap end laps by 150mm (6"); stagger end laps by 305mm (12"); place thin sheet of metal under end lap of membrane to provide structural support to lapped membranes.
 - .2 Overlap roof vapour barrier to wall air/vapour barrier using compatible continuity strip to provide continuity of building envelope.
 - .3 Install vapour barrier at insulation perimeters and around each element piercing insulation to provide sealed connections with base sheet at up-stands.
- .6 Insulation:
 - .1 Adhere insulation INS-04a to vapour barrier using manufacturer's recommended adhesive applied at rate recommended by manufacturer; adhere insulation at locations where roof deck will be visible in final installation.
 - .2 Insulation may be mechanically fastened into top flutes of steel deck in accordance with manufacturer's written recommendations only where fasteners will not be visible from underside of deck in final installation.
 - .3 Install tapered insulation panels INS-04a in conformance with manufacturers instructions and layout indicated on reviewed shop drawings
 - .4 Install secondary insulation INS-04b as the top layer, followed by installation of overlay board.
 - .5 Stagger vertical joints between primary insulation boards and secondary insulation modules and between two rows of insulation board.
 - .6 Install only as much insulation as can be covered by roof membranes in the same day.
- .7 Asphaltic Overlay Board with Laminated Base Sheet Membrane

- .1 Install composite board with adhesive in continuous strips spaced 30 cm (12 in) on the field. Decrease the spacing between ribbons to a minimum of 15 cm (6") at the perimeter and 10 cm (4") at the corners.
- .2 Adhere the first 60 mm (2.5 in) of the self-adhesive side and end laps by removing the silicone release paper and using a membrane roller, then heat-weld the last 40 mm (1.5 in) (self-adhesive, heat-welded side laps).
- .3 Seal end laps by installing a 330-mm (13-in) wide protection strip centered on the joint.
- .4 Ensure all boards are evenly and tightly butted together
- .5 Avoid forming wrinkles, swelling or fishmouths
- .8 Base Sheet Flashing Installation:
 - .1 Apply primer to the substrate at rate recommended by manufacturer. Allow primer to dry before installation of Base Sheet
 - .2 Install reinforcing gussets at all inside and outside corners.
 - .3 Install base sheet flashing in one- (1) metre widths to cover roofing substrate over 100 mm. Overlap side laps by 75 mm. Stagger side laps by at least 100 mm from base sheet overlaps on roof to avoid excessive layering.
 - .4 Apply base sheet flashing directly onto substrate by removing siliconed paper cover sheet. Proceed from top to bottom. Once in place, apply pressure manually in a uniform fashion to obtain homogenous adherence over entire surface. Preferably seal seams with rubber roller. Nail outside edge at 300 mm o/c.
 - .5 Avoid forming wrinkles, air pockets or fishmouths.
 - .6 Always seal overlaps at the end of the workday
- .9 Installation of Cap Sheet (Field):
 - .1 Starting at drain, unroll membrane on base sheet, taking care to align the edge of the first selvage with the edge of the roof.
 - .2 Cut off corners at end laps at areas to be covered by the next roll.
 - .3 Each selvage will overlap the previous one along lines provided for this purpose, and will overlap by 150mm (6") at ends. Space end laps a minimum of 305mm (12").
 - .4 Apply adhesive to base sheet membrane for first 125mm (5") of end laps using steel trowel with 5mm (3/16") notches.
 - .5 Use electric hot-air torch on all side laps and last 25mm (1") of end laps, rolling with membrane roller to adhere cap sheet membrane to base sheet, as recommended by the membrane manufacturer.
 - .6 During installation, be careful not to overheat the membrane or its reinforcements.
 - .7 Avoid the formation of wrinkles, swellings or fishmouths.
 - .8 Avoid walking over finished surfaces until adhesive has cured; use rigid protective walkways as needed.
- .10 Cold Applied Cap Sheet Flashings:
 - .1 Install cap sheet flashings in 1000mm (3.25') wide strips.
 - .2 Each selvage will overlap the previous one laterally along lines provided for this purpose, and will overlap by 150mm (6") the field surface.

- .3 Space flashing membranes a minimum 100mm (4") with respect to the cap sheet membranes on the field surface, to avoid areas of excessive membrane thickness.
- .4 Cut off corners at end laps on areas to be covered by the next roll.
- .5 Use a chalk line to draw a straight line on the field surface, 150mm (6") from flashings and parapets.
- .6 Starting from the chalk line on the field surface to the bottom edge of the flashing or parapet, as well as on the granulated vertical surfaces to be overlapped, apply adhesive for first 125mm (5") of end laps using steel trowel with 5mm (3/16") notches.
- .7 Use electric hot-air torch on all side laps and last 25mm (1") of end laps, rolling with membrane roller to apply pressure and complete the installation.
- .8 Avoid the formation of wrinkles, swellings or fishmouths.
- .9 During installation, be careful not to overheat the membrane and its reinforcements.

3.4 WATERPROOFING OF PENETRATIONS

- .1 Ensure substrate is clear of loose granules and all foreign substances that can impair adhesion.
- .2 Apply a base coat of liquid waterproofing.
- .3 Trim reinforcing material to conform to shape of penetrations and embed in base coat.
- .4 Apply a second coat fully saturating the reinforcement.
- .5 To add colour or match existing granules, apply a thin coat of liquid waterproofing and embed granules before it dries.

3.5 FIELD QUALITY CONTROL

- .1 An independent inspection and testing company appointed and paid for by the Owner may carry out inspection and testing.
- .2 Arrange site meeting with roofing inspector three weeks prior to commencement of work on site to review work and procedures specified in this Section.
- .3 Cooperate with the inspector and afford all facilities necessary to permit full inspection of the work and testing of materials prior to their use.

END OF SECTION

1 General

1.1 SUMMARY

- .1 Furnish labour, materials and other services to complete the fabrication and installation of the following:
 - .1 Cap and base flashing; curb flashings,
 - .2 Roof edge flashing,
 - .3 Flashing at intersection of roof with vertical surfaces,
 - .4 Break metal flashings where shown,
 - .5 Prefinished flashings where indicated,
 - .6 Any other flashing as indicated on the drawings or as required, including all materials and fitments required for the operation of any unit furnished, in the manner, direction and performance shown on the shop drawings and specified herein.

1.2 REFERENCE STANDARDS

- .1 American Society for Testing and Materials (ASTM):
 - .1 ASTM A653/A653M-11, Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc Iron Alloy Coated (Galvannealed) by the Hot Dip Process.
- .2 Canadian General Standards Board (CGSB):
 - .1 CAN/CGSB-1.108-M89, Bituminous Solvent Type Paint
 - .2 CAN/CGSB-1.181-99, Ready Organic Zinc-Rich Coating
 - .3 CAN/CGSB-19.24-M90, Multicomponent, Chemical-Curing Sealing Compound
- .3 Canadian Roofing Contractors Association
 - .1 CRCA Specifications Manual

1.3 SUBMITTALS

- .1 Provide submittals specified and as required to assess conformance with the Contract Documents, in accordance with Division 01.
- .2 Submit shop drawings indicating material, thickness and finish.
- .3 Submit duplicate 4 sq.in. samples of each type of sheet metal material, colour and finish for review by Consultant prior to fabrication.

1.4 QUALITY ASSURANCE

- .1 Fabricator and tradesmen executing the work of this Section shall have had a minimum five (5) years continuous experience in successful manufacture and installation of Work of type and quality shown and specified. Submit proof of experience upon Consultant's request.
- .2 Erection of metal flashing systems shall be by workmen especially trained and experienced in this type of work. Have a senior, qualified representative at the job site to direct the work of this Section at all times.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Store materials flat at site under protection to prevent staining from the work of other trades or from collection of water on material and secured against wind damage.
- .2 Carefully store preformed sheet metal work in such a manner as to prevent twisting, bending and rubbing.

- .3 Protect sheet metal work from corrosive materials and dissimilar metals.

1.6 WARRANTY

- .1 Warrant the work of this Section against defects in materials and workmanship in accordance with General Conditions, but for a period of two (2) years. Agree to promptly make good defects which become evident during warranty period without cost to the Owner.
- .2 Without restricting the generality of the Warranty, defects shall include deformation, buckling, leakage, weather tightness, failure of anchors and fastenings, failure of paint coating and sealants.
- .3 Promptly make good defects and/or failures in the work of this Section upon written notification by the Owner that such exist. Remedy shall include labour, materials, equipment and services required to make good defective work, and to replace components and finishes and Owner's property damaged or disturbed in the course of remedying defects.

2 Products

2.1 MATERIALS

- .1 Sheet Metal Materials (MF-01): Prefinished galvanized sheet steel to ASTM A653/A653M-11 Grade A with G90 designation zinc coating to ASTM A653/A653M-11, factory precoated with Series 8000 paint finish, minimum 26 gauge.
- .2 Hold-down, fastener clips - 20 ga. galv. steel sheet as above, unpainted.
- .3 Nails, bolts screws and rivets: Material - galvanized steel, stainless steel or same metal as material to be fastened. Type - to approved samples.
- .4 Bituminous Paint: Conforming to CAN/CGSB-1.108-M, Type 2.
- .5 Field Touch-Up Paint: Zinc rich anti-corrosion primer, conforming to CAN/CGSB-1.181-92, 'Galvafruid, Grade SB' by W.R. Meadows of Canada Limited and top coating of type and colour to match finish sheet.
- .6 Underlay for metal flashing: Asphalt laminated 3.6 to 4.5 kg kraft paper.
- .7 Sealant: Multi-component, chemical curing epoxidized polyurethane type sealant conforming to CAN/CGSB-19.24-M90, 'DYmeric 240' by Tremco (Canada) Ltd., or approved equal. Colour as selected later by Consultant. Provide primers, bond breakers and cleaning agents as recommended by the sealant manufacturer.
- .8 All other materials not specifically described but required for a complete and proper installation of the work of this Section shall be new first quality of their respective kinds and subject to the approval of the Consultant.

2.2 FABRICATION

- .1 Fabricate metal flashings and other sheet metal work to applicable CRCA 'FL' series specifications and as detailed.
- .2 Form flashings, counter flashings, scuppers and copings as required to suit each condition. Use prefinished sheet steel in all locations. Form pieces in 8'-0" maximum lengths. Make allowance for expansion at joints.
- .3 Fabricate sheet metal components with lines, arrises and angles sharp and true and plane surfaces free from objectionable wave, warp or buckle.
- .4 Mitre and seal corners with sealant. Form drip edging at 45 deg angle, secure with a continuous 20 ga. hold-down clip.

- .5 Exposed edges of sheet metal shall be folded back to form a 1/2" wide hem on the side concealed from view. Prefabricate corner pieces for flashings and copings. The workmanship and methods employed for forming, anchoring, cleating and the provision for expansion and contraction of sheet metal work shall be to the approval of the Consultant.
- .6 Form sections square, true and accurate to size, free from distortion and other defects detrimental to appearance or performance.
- .7 Fabricate scuppers and overflow scuppers to applicable CRCA 'FL' Series details and as detailed.
- .8 Apply two coats of bituminous paint to metal surfaces to be in contact with masonry, concrete, mortar or dissimilar metals.

2.3 FINISHING

- .1 Provide 8000 series finished sheet for all work.
- .2 Colour: As selected by the Consultant from the Manufacturers full colour range. Allow for three (3) colours in Base Bid.

3 Execution

3.1 EXAMINATION

- .1 Inspect substrate surfaces on which the work of this Section is erected for any irregularities detrimental to the application and performance of the Work. Confirm conditions satisfactory before proceeding. Report to Consultant in writing, defects of work prepared by other trades and unsatisfactory site conditions. Commencement of work implies acceptance of surfaces and conditions.

3.2 INSTALLATION

- .1 Metal flashing shall be in compliance with best sheet metal trade practice and shall in no way be contrary to sheet metal practice that will qualify for the Guarantee Certificate specified. Install with "S" lock expansion joints or standing seams incorporated on end of flashing length and all joints sealed with mastic.
- .2 Provide continuous starter strips to present true, non-waving leading edge. Provide clips and anchor to backup in an approved manner to provide rigid, secure installation. Conceal fastenings in completed flashing. Lap, lock and seal all seams.
- .3 Provide underlay under sheet metal. Secure in place and lap joints 100mm (4").
- .4 Install sheet metal flashings, cap flashings and copings as indicated on drawings using flat lock seams. Make joints to permit thermal movement. Make surfaces free from buckling, warp, wave, dents, oil canning or other defects. Make corners square and surfaces straight and in true planes. Equally space joints in cap flashings to suit wall panel module. Space seams not farther apart than 2439mm (8').
- .5 All sheet and strip flashing to be held in place by 14 gauge galvanized iron clips of a size and type to be determined by the construction requirements, except where specifically detailed on the drawings.
- .6 Caulk flashing at cap flashing with sealant.
- .7 Lock end joints and caulk with sealant.
- .8 Use rubber-asphalt sealing compound for joints between sheet metal and bitumen.
- .9 Supply rigid flashing, copings and sheet metal back-up to other trades where required to be built into other work at doors, windows, block openings, curbs and where shown on drawings.

- .10 Take careful note of fans, vents, etc., on mechanical drawings to determine whether flashing and counter flashing is required or whether units are self-counter flashing.
- .11 Caulking shall be installed as per written manufacturer's recommendations.
- .12 Exposed fastenings will be permitted where indicated or where concealed fastening is not possible. Obtain Consultant's approval of exposed fastenings and methods of making same.
- .13 If exposed screws or bolts are used, use cupped neoprene washers.
- .14 Install scupper drains and overflow scupper drains as indicated on drawings, in strict accordance with CRCA manual.

3.3 CLEANING

- .1 Remove, as the work progresses, all excess or foreign material which would set up or become difficult to remove from finished surfaces.
- .2 Do all final cleaning upon completion of the Work of this Section. Leave building and Work in condition to meet the approval of the Consultant.
- .3 Remove excess sealant by the moderate use of mineral spirits or other solvent acceptable by the sealant manufacturer.

END OF SECTION

1 General

1.1 SUMMARY

- .1 Read other Sections of the Specification for extent of sealant specified in those Sections. Do all other sealing indicated, specified or required.
- .2 Provide all items, articles, materials, operations or methods listed, mentioned or scheduled on drawings and/or herein, including all labour, materials, equipment and incidentals necessary and required for the completion of the sealant.

1.2 REFERENCE STANDARDS

- .1 American Society for Testing and Materials (ASTM):
 - .1 ASTM C509-06(2011), Standard Specifications for Elastomeric Cellular Performed Gasket and Sealing Material
 - .2 ASTM C920-11, Standard Specification for Elastomeric Joint Sealants
 - .3 ASTM C-1382-11, Standard Test Method for Determining Tensile Adhesion Properties of Sealants when Used in Exterior Insulation and Finish Systems (EIFS) Joints
 - .4 ASTM D2240-05(2010), Standard Test Method for Rubber Property - Durometer Hardness
- .2 Canadian General Standards Board (CGSB):
 - .1 CAN/CGSB-19.13-M87, Sealing Compound, One-Component, Elastomeric, Chemical Curing
 - .2 CAN/CGSB-19.24-M90, Sealing Compound, Multi-Component, Chemical Curing

1.3 SUBMITTALS

- .1 Provide submittals in accordance with Division 01.
- .2 Action Submittals: Provide the following submittals before starting any work of this Section:
 - .1 Manufacturer's Data: Submit manufacturer's literature describing each material to be used in the work of this Section. Literature shall contain a statement that the material complies with the specified standard.
 - .2 Samples: Submit for approval and colour selection sample of each type of compound, recommended primers and joint filler or fillers proposed to be used.
 - .3 Mock-Up:
 - .1 If requested by the Consultant, construct mock-ups where directed to show location, size, shape, colour and depth of joints complete with back-up material, primer and sealant. Mock-up may be part of finished work.
 - .2 Allow 24-hours for inspection of work before proceeding with work.
 - .3 Obtain the Consultant's written acceptance of each mock-up prior to proceeding with the balance of related work.
 - .4 Safety Data Sheets: Submit WHMIS safety data sheets for inclusion with project record documents. Keep one copy of WHMIS safety data sheets on Site for reference by workers.

1.4 QUALITY ASSURANCE

- .1 Adhere to Manufacturer's recommendations for mixing or preparation of materials listed in this Section.

- .2 Pot life or installation times shall not be exceeded.
- .3 Integral materials which compose a joint detail shall be compatible.
- .4 Component parts, where possible, shall have the same manufacturer.
- .5 A representative of sealant material manufacturer shall visit the site during application to ensure that all Work is carried out according to the manufacturer's printed instructions.

1.5 SITE CONDITIONS

- .1 Apply sealants only to completely dry surfaces, and at air, substrate and material temperatures above minimum established by manufacturer's written specifications.
- .2 Take proper precautions to prevent adjacent surfaces from becoming stained, marked or soiled during installation.

1.6 DELIVERY, STORAGE HANDLING AND PROTECTION

- .1 Deliver all materials to the jobsite in their original, unopened containers, with all labels intact.
- .2 Receive and store materials as recommended by materials manufacturer.
- .3 Maintain containers and labels in undamaged condition.

1.7 WARRANTY

- .1 Provide a written warranty endorsed and issued in the name of the Owner stating that all sealant work of this Section is warranted against leakage, cracking, crumbling, melting, running, deterioration, shrinkage, loss of cohesion, loss of adhesion, staining of adjoining or adjacent work or surfaces, or failure to provide intended seal for a period of five (5) years from the Date of Substantial Performance of the Work, and that any defects will be made good including, related materials and installation at no additional cost to the Owner.

2 Products

2.1 MATERIALS

- .1 Joint Cleaner:
 - .1 Non-corrosive solvents as recommended by sealant manufacturer for applicable substrate material(s).
- .2 Primer:
 - .1 Non-staining type as recommended by sealant manufacturer, for use on substrate conditions outlined, and compatible with specified sealant being applied.
- .3 Joint Back-Up – Backer Rod:
 - .1 Round, closed cell, reticulated foam, 50% compression, compatible with sealant and primer, non-adhering to sealant.
- .4 Bond Breaker:
 - .1 Pressure sensitive plastic tape, not bondable to sealant as recommended by sealant manufacturer.
- .5 Sealant Type "A" – Joints around Interior Door Frames, Windows and Under Exterior Thresholds:
 - .1 One-part, low or medium modulus, neutral curing 100% silicone joint sealant, conforming to ASTM C920-11, Type S, Grade NS, Class 35.
 - .1 DC CWS by Dow Corning.
 - .2 SWS by GE

- .3 SikaSil WS-305CN by Sika
- .4 Or approved equivalent.
- OR
- .2 One component, low modulus, moisture curing, polyurethane joint sealant, conforming to ASTM C920-11, Type S, Grade NS, Class 25.
 - .1 Dymonic FC by Tremco Ltd., division of RPM Company.
 - .2 Sikaflex 1A by Sika Canada Inc.
 - .3 Sonolastic NP1 by BASF.
 - .4 Pourthane NS by W.R MEADOWS
 - .5 Or approved equivalent.
- .6 Sealant Type "B" – Exterior Wall Joints; Control Joints; Expansion Joints:
 - .1 Multi-component polyurethane non-sag type sealant, conforming to CAN/CGSB-19.24-M90, Type M, Grade NS, Class 25
 - .1 Sikaflex 2c NS EZ Mix by Sika Canada Inc.
 - .2 Or approved equivalent.
- .7 Sealant Type "C" – Floor Control Joints:
 - .1 Multi-component, chemical curing, self-levelling, polyurethane joint sealant, conforming to ASTM C920-11, Type M, Grade P, Class 25.
 - .1 THC-900 by Tremco (Canada) Ltd., division of RPM Company.
 - .2 Sonolastic SL2 by Sonneborn Building Products, division of BASF Building Systems.
 - .3 Sikaflex 2c SL by Sika Canada Inc.
 - .4 Or approved equivalent.
- .8 Sealant Type "E" – Mould and Mildew Resistant:
 - .1 Mould and mildew resistant, Shore A Hardness 15-25, conforming to ASTM C920-11, Type S, Grade NS, Class 25, use NT, G, and A:
 - .1 SCS1700 by GE
 - .2 DC 786 by Dow Corning
 - .3 Tremsil 200 by Tremco
 - .4 Omni Plus by Sonneborn
 - .5 SikaSil –GP by Sika
 - .6 Or approved equivalent.
- .9 Sealant Type "F" – Glazing Joints:
 - .1 Silicone Sealant: Butt glazing, one part, moisture curing, shore A hardness 15-25, conforming to CAN/CGSB-19.13-M, Classification C-1-40-B-N and C-1-25-B-N and ASTM C920-11, Type S, Grade NS, Class 25, use NT, G, A, O; Colour: clear (translucent):
 - .1 Spectrum 2 by Tremco
 - .2 Tremsil 400 by Tremco
 - .3 Or approved equivalent.
- .10 Sealant Type "F" – Glazing Joints:

- .1 Silicone Sealant: Butt glazing, one part, moisture curing, shore A hardness 15-25, conforming to CAN/CGSB-19.13-M, Classification C-1-40-B-N and C-1-25-B-N and ASTM C920-11, Type S, Grade NS, Class 25, use NT, G, A, O; Colour: clear (translucent):
 - .1 Spectrum 2 by Tremco
 - .2 Tremsil 400 by Tremco
 - .3 Or approved equivalent.
- .11 Sealant Type "H" – Saw Cut Sealant:
 - .1 Multi-component, self-levelling, conforming to ASTM D2240-05(2010):
 - .1 Tremco Control Joint Sealant
 - .2 BASF Masterfill 300
 - .3 Sika Loadflex
 - .4 Rezi-Weld Flex by W.R MEADOWS
 - .5 Or approved equivalent.
- .12 Sealant Type "I" – HVAC Sealant:
 - .1 One-part, RTV, acetoxycure silicone sealant for heating, ventilation, air conditioning and refrigeration applications:
 - .1 Dow Corning HVAC Silicone Sealant
 - .2 Or approved equivalent.
- .13 Sealant Type "J" – Electrical Sealant:
 - .1 One-part, white, non-flowing moisture cure adhesive for electrical applications:
 - .1 Dow Corning 738 Electrical Sealant
 - .2 Or approved equivalent.
- .14 Sealant Type "K" - Interior Acoustical Sealant:
 - .1 Non-skinning, non-hardening, single component synthetic rubber sealant, conforming to CAN/CGSB-19.21-M:
 - .1 Tremco Acoustic Sealant
 - .2 Chemtron Metaseal
 - .3 Or approved equivalent.
- .15 Preformed Compression Seal:
 - .1 Compartmental open cell neoprene extrusion type conforming to ASTM C509-06(2011), complete with liquid lubricant adhesive recommended by manufacturer.

3 Execution

3.1 INSPECTION

- .1 Verify at site that joints and surfaces conditions provided will not adversely affect execution, performance or quality of completed work.
- .2 Ensure masonry and concrete have cured 28 days minimum.
- .3 Ascertain that sealers and coatings applied to substrates are compatible with sealant used and that full bond of the sealant and substrate is attained. Request samples of the

sealed or coated substrate from their fabricators for testing of compatibility and adhesion, if necessary.

- .4 Verify that specified recommended environmental conditions are present before commencing work.
- .5 Defective work resulting from application to unsatisfactory joint conditions will be considered the responsibility of those performing the work of this section.
- .6 Do not start work of this Section until conditions are satisfactory.

3.2 PREPARATION

- .1 Clean joint surfaces using joint cleaner as necessary, to remove dust, paint, loose mortar, and other foreign matter and dry joint surfaces.
- .2 Remove dust, silt, scale and coatings from ferrous metals by wire brush, grinding or sandblasting.
- .3 Remove oil, grease and other coatings from non-ferrous metals with approved cleaning solvent.
- .4 Ensure surfaces are free of frost, rust, lacquers, laitance, release agents, moisture or other matter which might adversely affect adhesion of sealant.
- .5 Examine joint sizes and correct as required to allow for anticipated movement and to achieve proper width/depth ratio per manufacturer's written recommendations for specified sealant.
- .6 Support joint filler on horizontal traffic surfaces against vertical movement which might result from traffic loads or foot traffic.
- .7 Prepare surfaces as recommended by sealant manufacturer.
- .8 Fully remove existing sealant scheduled to be removed and replaced with new sealant, in areas indicated on the Drawings.
 - .1 Follow manufacturers procedures for removal of existing sealant and test areas for adhesion of new sealant. Provide the Consultant with field report identifying results of adhesion testing.
- .9 Install joint backing material or apply bond breaker tape to achieve correct joint depth and prevent three-sided adhesion.
- .10 To protect adjacent surfaces, mask adjacent surfaces with tape prior to priming and/or sealing.
- .11 Prime sides of joints using two cloth method in accordance with manufacturer's directions immediately prior to sealing.
- .12 Before any sealing is commenced, a test of the material shall be made for indications of staining, poor adhesion or other undesirable effects.
- .13 Seal joints in surfaces to be painted before painting. Where surfaces to be sealed are prime painted in shop before sealing, check to make sure prime paint is compatible with primer and sealant. If incompatible inform Consultant, consult the manufacturer, and change primer and sealant to approved compatible types.
- .14 Check form release agent used on concrete for compatibility with primer and sealant. If incompatible inform Consultant and change primer and sealant to approved compatible types or clean concrete to Consultant's approval.

3.3 APPLICATION

- .1 Apply sealant in accordance with manufacturer's directions, using a gun with proper nozzle size, ensuring to fill voids and joints completely, to leave a weathertight, airtight installation. Superficial pointing with skin bead is not acceptable.

- .2 Neatly tool surface to a slight concave profile. Surface of sealant shall be smooth, free from ridges, wrinkles, sags, air pockets and embedded impurities.
- .3 Clean adjacent surfaces immediately and leave Work neat and clean. Remove excess sealant and droppings, using recommended cleaners as Work progresses. Remove masking tape after tooling of joints.

3.4 CLEANING AND PROTECTION

- .1 Remove all waste materials from site. Sealant shall be cleaned of all foreign material as recommended by the sealant manufacturer. Leave work in a condition satisfactory to the Consultant.

END OF SECTION

1 General

1.1 SUMMARY

- .1 This section covers the provision of all labour, materials, equipment, plant, products and equipment required for the refurbishment of heritage steel windows as shown on the Drawings, including but not limited to:
- .2 This Section includes requirements for supply and installation of double glazed, historic steel framed windows as indicated on the Drawings to match existing steel windows, including but not limited to:
 - .1 Glazing replacement.
 - .2 Window painting.
 - .3 Silicone sealant glazing stop.
 - .4 Operating hardware.

1.2 REFERENCE STANDARDS

- .1 Canadian Standards Association (CSA):
 - .1 CSA W47.1-09, Certification of Companies for Fusion Welding of Steel Structures
 - .2 CSA W59-03(2008), Welded Steel Construction (Metal Arc Welding), Metric.

1.3 ADMINISTRATIVE REQUIREMENTS

- .1 Pre-construction conference: Arrange a site meeting, to coincide with regular bi-weekly site meetings, attended by the Contractor, the Subcontractor's representative and foreman for this project, the Consultant, materials supplier(s), and other relevant personnel before commencement of work for this Section.
 - .1 Review and finalize construction schedule and verify availability of materials, installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - .2 Review, discuss, and coordinate the interrelationship of steel windows with other exterior wall components. Include provisions for structural anchorage, glazing, flashing, weeping, air barriers, sealants, and protection of finishes.
 - .3 Review and coordinate the sequence of work required to provide the minimum interference with the use of the premises by the occupants, and the maximum safety of the occupants during the Work.

1.4 SUBMITTALS

- .1 Provide submittals in accordance with Division 01. Provide the following submittals before starting any work of this Section.
- .2 Samples:
 - .1 Submit sample sections of new frame and glazing bead sections to Consultant for review. Do not proceed with work without written approval.
- .3 Mock-up:
 - .1 Provide mock-up on site of refurbished window frame, connections, fasteners and accessories, including application of sealant and heritage painting as per related sections 07 92 00, 08 80 00 and 09 97 13.
 - .2 Submit for Consultant's review and written approval before commencing work.
 - .3 Provide colour sample of finish for approval, as per Section 09 90 00.

- .4 Prepare a detailed schedule of repairs made to the heritage windows. Submit the schedule to the Construction Manager at the completion of the work.
- .5 Arrange with Consultant to review window repairs.

1.5 PROJECT CLOSEOUT SUBMISSIONS

- .1 Provide operations and maintenance information in accordance with Division 01.
- .2 Submit data for materials and methods for cleaning and maintenance that will not harm or stain glass, aluminum, rubber, sealant and other components of the assembly.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Protect window components during delivery and store in a dry, well ventilated place indoors and protect from injury.
- .2 Protect primed components from damage to coating.

1.7 QUALITY ASSURANCE

- .1 Qualifications: Provide proof of qualifications when requested by the Consultant:
 - .1 Repair and installation: Work to be undertaken by a contractor with not less than five (5) years experience in restoration of heritage steel windows.

1.8 SITE CONDITIONS

- .1 Site Measurements:
 - .1 Check all dimensions of existing metal window frames on site before submitting shop drawings for preparation of any new components as required.

1.9 PROTECTION

- .1 Provide temporary protection as required to prevent elemental and animal infiltration between removal of existing windows and glazing units, and installation of new units.

1.10 HAZARDOUS WASTE DISPOSAL

- .1 Dispose of contaminated material generated by the work in accordance with OHSA Leda Abatement Type 2 Guidelines.

1.11 APPROACH TO REPAIR WORK

- .1 The intent of the repairs to existing windows is to make them structurally sound, and stable, whilst conserving the maximum amount of existing fabric and its existing character.
- .2 Fabricate replacement parts to match existing in size, section and mould profile, and only when absolutely required as directed by Consultant. Use as far as possible the original methods of fastening.
- .3 Existing operable sash window to be fixed closed prior to repainting and installation of new glazing.

1.12 WARRANTY

- .1 Provide manufacturers written guarantee, signed and issued in the name of Owner, to replace the following items for defective material and workmanship for ten (10) years from date of Substantial Performance.

2 Products

2.1 MATERIALS

- .1 Steel sections for new window frames: In accordance with CAN/CSA-G40.21M-W44.
- .2 Welding materials: In accordance with CSA W59; type required for materials being welded.

- .3 Shop and touch-up primer alkyd metal primer to suit the select finishing coats.
- .4 Counter-sunk bolts: In accordance with ASTM A325 or A307.
- .5 Metal filler for steel windows only: epoxy type with high proportion of metal particles.
- .6 Mineral spirits: Varsol or similar.
- .7 Mechanical Scrapers.
- .8 Chemical paint stripper: Use 'Smart Strip' and associated neutralizer as required, available from Dumond Chemicals: (dumondchemicals.com)
- .9 Rust converter: 'Conquest' converter, available from Liner Rolpanit Inc.
- .10 Glazing, including glazing tape: refer to section 08 80 00.
- .11 Sealants: refer to Section 07 92 00.
- .12 Primer and paints: refer to Section 09 97 13.
- .13 Replacement sections if required:
 - .1 Industrial Series steel sections by Bliss Nor-Am Doors and Windows Ltd., from solid, hot-rolled carbon steel, minimum thickness 3mm (1/8"), shop primed for site painting.

2.2 FABRICATION

- .1 Fabricate replacement parts to match existing in size, section and mould profile, as required. Use as far as possible the original methods of fastening.
- .2 Finish metal surfaces to be smooth, even and free of nicks and scratches. Weld spatters and burrs must all be removed.
- .3 Grind exposed joints flush and smooth with adjacent finish surfaces. Make exposed joints butt tight, flush and hairline.'
- .4 Wire brush areas of rusted metal down to sound metal. For non-structural surface damage, up to 2.5mm (3/32") deep, make good with specified filler, restoring original profile and surfaces flush.
- .5 Ease all exposed edges to small uniform radius.
- .6 Form corners as full mitres, rightly fitting and fully welded.

2.3 FABRICATION TOLERANCES

- .1 Maximum variation in overall dimension of all new frames: 1.5mm (1/16") in length or breadth.
- .2 Maximum variation in sectional dimensions of frames: 0.8mm (1/32").
- .3 Maximum offset from true alignment of component: 1.5mm (1/16").

2.4 PRIME PAINTING

- .1 Apply one coat of primer immediately after cleaning (refer to Section 09 97 13)

2.5 SOURCE QUALITY CONTROL

- .1 Arrange schedule of site visits by and with Consultant.
- .2 Perform work in accordance with CSA W47.1 and W55.3.

3 Execution

3.1 INSPECTION

- .1 Inspect Work and conditions affecting the Work of this Section. Proceed only after deficiencies, if any, have been corrected.

- .2 Take site measurements of existing construction to which work of this Section must conform.

3.2 PREPARATION

- .1 Before installing replacement components, ensure that existing frames are securely fastened to the window jambs.
- .2 Report any areas of significant deterioration of the frames to the Consultant prior to commencing work.
- .3 Preparation of existing metal windows for painting:
 - .1 Refer to Part 3.3 of Section 09 97 13.

3.3 MODIFICATION OF EXISTING STEEL WINDOW FRAMES

- .1 Repair all existing window frames in-situ, as shown on the Drawings.
- .2 The intent of the modifications to the existing windows is to create an overall uniform façade appearance whilst making them structurally sound and stable and conserving the maximum amount of existing fabric.
- .3 Remove loose paint and rust manually with scrapers from exposed surfaces of the frame on the exterior and interior.
- .4 Remove all existing putty and sealants, including existing sealant at the junction between the masonry and window frame for full perimeter.
- .5 Remove existing glazing units.
- .6 Remove all loose, cracked, worn or otherwise deteriorated putty from existing windows once glazing units are removed.
- .7 Remove glass and putty from casement sash to be repaired.
- .8 Use steam to loosen existing putty.
- .9 Use salvaged components from frames of windows to be replaced as required.
- .10 Strip off existing paint and wire brush areas of rusted metal down to sound material without the use of power tools. For non-structural surface damage, up to 3/32" deep, and 3 square inches, make good with specified filler, restoring original curved profile and flush surfaces. As far as possible remove all spalled, delaminated or heavily rusted components (more than 25% of original section thickness lost) from frames to be repaired.
- .11 Where frame is corroded more than 3 square inches review proposed repairs with Consultant to be paid for under contingency.
- .12 Replace missing, bent or otherwise defective components of frames, matching the existing configuration and assembly of elements using salvaged components from frames of windows to be replaced.
- .13 Make rebuilt parts of window frames square, true and free of distortions in relation to the surviving part of the frame.
- .14 Join components with plug welds at 6" centres or as otherwise agreed with Consultant.
- .15 Form corners as full mitres, tightly fitting and fully welded.
- .16 Release seized existing horizontal pivot sash to allow them to be closed tightly against frame. Tack weld sash permanently closed and seal full perimeter on interior only.
- .17 Free rabbets, stops and glass edges of dust, dirt, moisture, oil and other foreign matter detrimental to glazing material adhesion.
- .18 Replace glazing units with new as directed, as per Section 08 80 00.
- .19 Review repairs with Consultant.

3.4 SITE REGLAZING

- .1 Ensure than rebate is primed and received 1 coat of paint before glazing.
- .2 Make good primer and first finish coat damaged by welding before starting reglazing.
- .3 Reglaze with glass as specified in Specification 08 80 00.
- .4 Ensure all stops, gaskets, splines, seals etc., are perfectly aligned and ready to receive glazing and insulated panels as specified herein.
- .5 Set the glass in the existing sash on Tremco 400 glazing tape and finish interior with beveled Tremco Spectrem 2.
- .6 All preformed tapes or gaskets shall be of a continuous length corner to corner and shall be cut over length to prevent stretching. Joints, splices and corners shall be mitred and sealed.
- .7 Clean all contact surfaces of glazing with solvent and wipe dry. Ensure all glazing channels are clean, true to line, and free of dirt or debris and that weep and drainage vents are open.
- .8 Reglaze all sash and frames on site.

3.5 REPAINTING

- .1 Let structural silicone cure for 1 week before applying final coat of paint.

3.6 SEALANT

- .1 Clean away residual sealant from masonry to ensure bond for new sealant.
- .2 Apply sealant to exterior junction between masonry and window frame, as specified in Section 07 92 10.

3.7 ADJUSTING AND CLEANING

- .1 At completion and continuously as Work proceeds, remove all surplus materials, debris and scrap.
- .2 At completion of Work, remove all protective surface covering film and wrappings. Clean all glass, panels and frames using mild soap or other cleaning agent approved by manufacturer.
- .3 Remove all excess glazing or joint sealing materials from exposed surfaces. Clean and polish glass.
- .4 Adjust operating hardware to function properly, without binding and to provide tight fit at contact points and weather-stripping.
- .5 Remove all debris resulting from work of this Section from site.

END OF SECTION

1 General

1.1 SUMMARY

- .1 Furnish glazing materials and accessories to complete the fabrication and installation of:
 - .1 Tempered Glass and Interior Glazed Screens
 - .2 Exterior Insulated Glass Units
 - .3 Fire Rated, Ceramic Fire-Rated Glass

1.2 REFERENCE STANDARDS

- .1 Insulating Glass Manufacturers Alliance (IGMA) Manual.
- .2 American Society for Testing and Materials (ASTM):
 - .1 ASTM C542-05(2011), Standard Specification for Lock-Strip Gaskets
 - .2 ASTM C920-11, Standard Specification for Elastomeric Joint Sealants
 - .3 ASTM C1172-09e1, Standard Specification for Laminated Architectural Flat Glass
- .3 Canadian General Standards Board (CGSB):
 - .1 CAN/CGSB-12.1-M90, Tempered or Laminated Safety Glass
 - .2 CAN/CGSB-12.3-M91, Flat, Clear Float Glass
 - .3 CAN/CGSB-12.8-97, Insulating Glass Units
 - .4 CGSB-12.20-M89, Structural Design of Glass for Buildings
- .4 National Fire Protection Association (NFPA):
 - .1 NFPA 80-2013, Standard For Fire Doors and Other Opening Protectives

1.3 SUBMITTALS

- .1 Provide submittals in accordance with Division 01.
- .2 Action Submittals: Provide the following submittals before starting any work of this Section:
 - .1 Product Data: Submit manufacturer's product data for each type of product specified. Data shall indicate compliance with specification and installation recommendations of manufacturer of products being used.
 - .2 Samples: Submit samples of materials if required by Consultant before commencing work of this section. Samples shall be clearly labeled with manufacturer's name and type.
 - .3 Shop Drawings: Submit shop drawings, to the Consultant for review prior to fabrication.
 - .1 Clearly indicate each type of glass and identify relationships with adjacent materials or system where glazing is being installed or supported.
 - .4 Samples for Verification: Submit samples for verification including sample sets showing the full range of variations expected where products involve normal colour variations.
 - .5 Maintenance Data: Upon completion of installation, supply instructions covering re-glazing, adjustments and other relevant maintenance data.

1.4 QUALITY ASSURANCE

- .1 Conform to the requirements of the Flat Glass Marketing Association Glazing Manual, latest Edition.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Delivery and Acceptance Requirements: Deliver packaged materials in their original containers with manufacturer's labels and seals intact.
- .2 Storage and Handling Requirements: Store vertically, blocked off the floor in a weatherproof enclosure in original containers with manufacturers labels and seals intact until read for installation, and as follows:
 - .1 Install glass as soon as possible after delivery to site.
 - .2 Handle glass carefully to its place of installation.
 - .3 Prevent damage to glass, adjacent materials and surfaces.

1.6 SITE CONDITIONS

- .1 Ambient Conditions: Maintain temperature, humidity and solar exposure conditions of Glass Glazing materials during shipping, storage and site installation as required by manufacturer to maintain warranty and performance of installed products.

1.7 WARRANTY

- .1 Provide manufacturer's warranty for the following types of glass listed, against defects in materials and workmanship for the period indicated, commencing from the date of Substantial Performance of Work:
 - .1 Seal Failure: Failure of hermetic seal under normal use that is attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning insulating glass contrary to manufacturer's written instructions.
 - .2 Evidence of Failure: Obstruction of vision by dust, moisture, or film on interior surfaces of glass.
 - .3 Allowable Specific Exclusions: Breakage resulting from thermal stress will be accepted as a limitation to the warranty in accordance with CAN/CGSB 12.20.
 - .4 Warranty Period: Ten (10) Years.

2 Products

2.1 MATERIALS

- .1 Float Glass: In accordance with CAN/CGSB-12.3, glazing quality and as follows:
 - .1 Clear Glass: No tint
- .2 Tempered Glass (TGL):
 - .1 Clear, conforming to CAN/CGSB-12.1, Type 2, Class 'B'. Tempering shall be performed using horizontal tong free method.
- .3 Fire Rated, Ceramic Fire-Rated Glass (FRG): Material used in door and screen applications with fire rating requirements of 60 minutes with hose stream test.
 - .1 Fire Rated Glass: Two-ply of glass ceramic, laminated with Teflon or PVB interlayer and as follows:
 - .1 Thickness: 8mm
 - .2 Fire Rating: 60 minutes or as scheduled.

- .3 Labelled: Permanent logo listing name of product, manufacturer, testing laboratory, fire rating period and safety requirements
- .4 Basis-of-Design Materials:
 - .1 Technical Glass Products, FireLite Plus
 - .2 VetroTech, Keralite Select L
 - .3 SAFTI: Pyran Platinum L
 - .4 Or approved equivalent.
- .4 Gaskets:
 - .1 Neoprene/EPDM thermoplastic rubber type gaskets of sufficient thickness to be compressed 25% when installed, having 2,000 psi tensile strength, with 50 durometer shore A hardness plus/minus 5, maximum 30% resistance to permanent set, resistance to ozone without cracking, minimum elongation at break of 300% and conforming to ASTM C542.
 - .2 Colour - "Black".
- .5 Sealant:
 - .1 One component, silicone base, solvent curing sealant conforming to ASTM C920. Colour as selected Later by Consultant.
- .6 Glazing Compound:
 - .1 Non-hardening modified oil type glazing compound.
- .7 Setting Blocks:
 - .1 Neoprene/EPDM rubber type, 4" long, with 40 to 50 durometer shore A hardness plus/minus 5; resistant to sunlight, weathering, oxidation and permanent deformation under load and wide enough to extend from fixed stop to opposite face of glass of thickness suitable to glazing condition to provide adequate glazing "bite".
- .8 Spacer Shims:
 - .1 Neoprene/EPDM rubber type, with 40 to 50 durometer shore A hardness plus/minus 5; resistant to sunlight, weathering, oxidation and permanent deformation under load and of adequate thickness to provide correct glass to face clearance at least 1/8".
- .9 Glazing Tape:
 - .1 Macro-polyisobutylene preformed glazing tape, 'Polyshim' or 'Vision Strip' by Tremco Ltd., division of RPM Company, or approved equal.

2.2 INSULATING GLASS

- .1 Insulating Glass Units: Provide sealed insulating glass units in accordance with CAN/CGSB-12.8 in configurations indicated, IGMA certified, and as specified herein.
- .2 Manufacture sealed insulating glass units without edge channels or tape, that is, with bare glass edges.
- .3 Use two stage seal method of manufacture, as follows:
 - .1 Primary Seal: Polyisobutylene sealing compound between glass and metal spacer/separator. Colour: Black.
 - .2 Secondary Seal: Structural silicone based, filling gap between the lites of glass at the edge up to the spacer/separator and primary seal. Colour: Black.

- .4 Install stainless steel capillary breather tubes to equalize pressure differentials between insulating glass fabricating location and insulating glass installation location; crimp tube immediately prior to installation in accordance with glass fabricators written instructions.
- .5 Insulating Glass Units (IGU):
 - .1 Insulated Glass Unit (IGU-01) Standard Double-Glazed:
 - .1 Unit Composition:
 - .1 Outer Lite: 3mm thick, frosted glass complete with Low-E coating on Surface #2.
 - .1 Low-E Coating (Surface #2) Basis of Design Materials: SunGuard SuperNeutral 68 by Guardian Glass, or approved equivalent.
 - .2 Gas Infill: 6.4mm (1/4"); 90% Argon, 10% air filled.
 - .3 Inner Lite: 3mm thick, clear glass
 - .1 Refer to Window Schedule for glazing units with security film (F1) on Surface #4.
 - .2 Unit Characteristics:
 - .1 Unit Thickness: 13mm
 - .2 Visible Light Transmittance: 70%
 - .3 Visible Light Reflectance: 11%
 - .4 Solar Heat Gain Coefficient (SHGC): 0.39
 - .5 Glass U-Value Winter: 1.88 (w/m2*K)
 - .3 Basis of Design Manufacturer: Guardian Glass, or approved equivalent.
 - .2 Insulated Glass Unit (IGU-02) Standard Double-Glazed:
 - .1 Unit Composition:
 - .1 Outer Lite: 3mm thick, clear glass complete with Low-E coating on Surface #2.
 - .1 Low-E Coating (Surface #2) Basis of Design Materials: SunGuard SuperNeutral 68 by Guardian Glass, or approved equivalent.
 - .2 Gas Infill: 6.4mm (1/4"); 90% Argon, 10% air filled.
 - .3 Inner Lite: 3mm thick, clear glass
 - .1 Refer to Window Schedule for glazing units with security film (F2) on Surface #4.
 - .2 Unit Characteristics:
 - .1 Unit Thickness: 13mm
 - .2 Visible Light Transmittance: 70%
 - .3 Visible Light Reflectance: 11%
 - .4 Solar Heat Gain Coefficient (SHGC): 0.39
 - .5 Glass U-Value Winter: 1.88 (w/m2*K)
 - .3 Basis of Design Manufacturer: Guardian Glass, or approved equivalent.

2.3 GLAZING FILMS

- .1 Clear Security Film (F1): Micro-layered film designed for tear resistance and glass fragment retention.
 - .1 Film Thickness: 8 mil
 - .2 Film Type: Polyester
 - .3 Opacity: Clear
 - .4 Basis-of-Design Materials: 3M ScotchShield Ultra S800 Series, or approved equivalent
- .2 Translucent Security Film (F2): Micro-layered film designed for tear resistance and glass fragment retention.
 - .1 Film Thickness: 8 mil
 - .2 Film Type: Polyester
 - .3 Opacity: Translucent
 - .4 Basis-of-Design Materials: 3M ScotchShield 30PL Series, or approved equivalent

2.4 FABRICATION AND MANUFACTURE

- .1 Label each light of glass with the registered name of the product and the weight and quality of the glass.
- .2 Check dimensions on site before cutting materials.
- .3 Minimum bite or lap of glass on stops and rabbets as recommended by glass manufacturer. Finish surfaces shall be free of tong marks.
- .4 Cut glass true to dimensions, square, plumb and level. Verify all dimensions prior to fabrication.
- .5 Distortion, pock marking or defects detrimental to appearance and/or performance, as determined by the Consultant, will be rejected.

2.5 GLAZING COMPOUND FOR FIRE RATED GLAZING MATERIALS

- .1 Glazing Tape: Closed cell polyvinyl chloride foam, coiled on release paper over adhesive on two sides, maximum water absorption by volume of 2%, designed for compression of 25% to effect an air and vapour seal.
- .2 Silicone Sealant: One-part neutral curing silicone, medium modulus sealant, Type S; Grade NS; Class 25 with additional movement capability of 50% in both extension and compression (total 100%); Use (Exposure) NT; Uses (Substrates) G, A, and O as applicable.
- .3 Acceptable materials:
 - .1 Dow Corning Corp., Dow Corning 795
 - .2 General Electric Co., Silglaze-II 2800
 - .3 Tremco Inc., Spectrum 2
 - .4 Or approved equivalent.
- .4 Setting Blocks: Hardwood, glass width by 4"x 1/4" thick.
- .5 Spacers: Neoprene or other resilient blocks of 40 to 50 Shore A durometer hardness, adhesive-backed on one face only, tested for compatibility with specified glazing compound.
- .6 Cleaners, Primers, and Sealers: Type recommended by manufacturer of glass and gaskets.

2.6 FABRICATION: FIRE RATED GLASS

- .1 Fabricate glass and other glazing products in sizes required to glaze openings indicated for project, with edge and face clearances, edge and surface conditions, and bite complying with recommendations of product manufacturer and referenced glazing standards as required to comply with system performance requirements.

3 Execution

3.1 EXAMINATION

- .1 Examine areas of work affecting the work of this section. Report in writing all defects, errors and discrepancies immediately to the Consultant.
- .2 Commencement of work implies acceptance of surfaces and conditions.

3.2 PREPARATION

- .1 Openings shall be free from moisture, frost, rust, dirt and foreign matter.
- .2 Clean surface to receive sealant with a clean cloth dampened with xylol or a 50-50 mixture of acetone and xylol. Wipe dry with a clean, dry cloth.

3.3 INSTALLATION

- .1 Conform to the recommendation of the glazing manual, Flat Glass Marketing Association, latest edition and as specified herein.
- .2 Unless otherwise indicated on drawings otherwise, provide tempered glass at all doors, transoms, sidelights and vision lites within 2'-6" of grade and/or finished floor.
- .3 Glaze doors scheduled to be glazed.
- .4 Set sheet glass with draw lines horizontal.
- .5 Glaze interior openings using compound or glazing tapes or gaskets.
- .6 Install removable stops. Insert spacer shims between glass and stops at 24" O.C. and not less than 1/4" below "sight lines". Fill remaining voids with sealant or glazing compound to "sight lines" and trim sealant/glazing compound to produce clean, sharp, straight lines without voids or depressions.
- .7 Replace loose stops in their original positions, tighten all screws.
- .8 Refer to drawings and door and frame schedule for locations of each type of glass.

3.4 INSTALLATION – FIRE RATED GLASS

- .1 Comply with GANA standards and instructions of manufacturers of glass, glazing sealants, and glazing compounds.
- .2 Protect glass from edge damage during handling and installation. Inspect glass during installation and discard pieces with edge damage that could affect glass performance.
- .3 Place hardwood setting blocks located at quarter points of glass with edge block no more than 150mm (6") from corners.
- .4 Glaze vertically into labelled fire rated metal frames or partition walls with same fire rating as glass and push against tape for full contact at perimeter of pane or unit.
- .5 Place glazing tape on free perimeter of glazing in same manner described above.
- .6 Do not remove protective edge tape.
- .7 Install removable stop and secure without displacement of tape.
- .8 Do not pressure glaze. Knife trim protruding tape.
- .9 Provide minimum 1/4" edge clearance.

- .10 Install vision panels in fire rated doors to requirements of NFPA 80.
- .11 Install so that appropriate fire rating labels and markings remain permanently visible.

3.5 INSTALLATION – GLAZING FILMS

- .1 Install in accordance with the manufacturer's written instructions and the contract documents, plumb, true, and level over clean glazing.
- .2 Install film continuously, but not necessarily in one continuous length, with no gaps or overlaps and as follows:
- .3 Install seams vertical and plumb where necessary; horizontal seams will not be allowed.
- .4 Do not remove release liner from film until just before each piece of film is cut and ready for installation.
- .5 Install film with mounting solution and custom cut to the glass with neat, square corners and edges to within 3 mm of window frame.
- .6 Remove air bubbles, wrinkles, blisters, and other defects.
- .7 Installation Tolerances: Consultant will view film installation from a distance of 3 metres against a bright uniform sky or background and will accept installation where it appears uniform in appearance with no visible streaks, banding, thin spots or pinholes; remove and replace with new film when directed by the Consultant for materials not meeting requirements.

3.6 CLEANING

- .1 Repair all defects caused by the work of this section. Remove as work progresses, all excess or foreign materials or droppings which would set or become difficult to remove from surfaces at time of final cleaning.
- .2 Immediately prior to acceptance of work of this section by Consultant, remove temporary protection, clean and polish exposed surfaces of all work of this section. Use proper cleaning materials and methods to prevent damage to surfaces, finishes, sealer or work of other trades. Make good such damage to Consultant's satisfaction.
- .3 Do not use steel wool, wire brushes or steel scrapers on any finished surfaces.
- .4 Replace or make good to Consultant's satisfaction, upon completion of work of this section, all defective, scratched or damaged work, at no extra cost to the Owner.

END OF SECTION

1 General

1.1 SUMMARY

- .1 This Section includes requirement for supply and installation of components required for a complete gypsum board assembly with proprietary components as follows:
 - .1 Gypsum Board Panels:
 - .1 Standard Gypsum Board
 - .2 Fire-Rated Gypsum Board 'Type X'
 - .3 Gypsum Ceiling Board
 - .4 Tile Backer Board
 - .5 Abuse Resistance Gypsum Board
 - .2 Gypsum Wallboard Accessories:
 - .1 Screws, tape, joint compound and all other accessories required for gypsum board ceiling and wall partitions.

1.2 REFERENCE STANDARDS

- .1 American Society for Testing and Materials International (ASTM):
 - .1 ASTM A641/A641M-09a, Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire.
 - .2 ASTM A653/A653M-11 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - .3 ASTM A792/A792M-10, Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.
 - .4 ASTM A875/A875M-10, Specification for Steel Sheet, Zinc-5% Aluminum Alloy-coated by the Hot Dip Process.
 - .5 ASTM A1003/A1003M-12, Specification for Steel Sheet, Carbon, Metallic and Non-Metallic Coated for Cold Formed Framing Members.
 - .6 ASTM C11-10a, Standard Terminology Relating to Gypsum and Related Building Materials.
 - .7 ASTM C473-12, Standard Test Methods for Physical Testing of Gypsum Panel Products.
 - .8 ASTM C475/C475M-12, Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board.
 - .9 ASTM C514-04(2009)e1, Standard Specifications for Nails for the Application of Gypsum Board.
 - .10 ASTM C645-11a, Standard Specification for Nonstructural Steel Framing Members.
 - .11 ASTM C665-12, Standard Specification for Mineral-Fibre Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.
 - .12 ASTM C754-11, Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products.
 - .13 ASTM C834-10, Standard Specification for Latex Sealants.
 - .14 ASTM C840-11, Standard Specification for Application and Finishing of Gypsum Board.

- .15 ASTM C841-03(2008)e1, Standard Specification for Installation of Interior Lathing and Furring.
- .16 ASTM C954-11, Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs From 0.033" to 0.112" in Thickness.
- .17 ASTM C955-11c, Standard Specification for Load-Bearing (Transverse and Axial) Steel Studs, Runners (Tracks), and Bracing or Bridging for Screw Application of Gypsum Panel Products and Metal Plaster Bases
- .18 ASTM C1002-07, Standard Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs.
- .19 ASTM C1047-10a, Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base.
- .20 ASTM C1177/C1177M-08, Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing.
- .21 ASTM C1178/C1178M-11, Standard Specification for Coated Glass Mat Water-Resistant Gypsum Backing Panel.
- .22 ASTM C1186-08, Standard Specification for Flat Fiber-Cement Sheets.
- .23 ASTM C1278/C1278M-07a(2011), Standard Specification for Fiber-Reinforced Gypsum Panel.
- .24 ASTM C1396/C1396M-11, Standard Specification for Gypsum Board.
- .25 ASTM C1629/C1629M-06(2011), Standard Classification for Abuse-Resistant Nondecorated Interior Gypsum Panel Products and Fiber-Reinforced Cement Panels.
- .26 ASTM C1658/C1658M-12, Standard Specification for Glass Mat Gypsum Panels.
- .27 ASTM D3273-12, Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber.
- .28 ASTM D3274-09, Standard Test Method for Evaluating Degree of Surface Disfigurement of Paint Films by Fungal or Algal Growth, or Soil and Dirt Accumulation.
- .29 ASTM D3678-97(2008)e1, Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Interior-Profile Extrusions.
- .2 Gypsum Association (GA):
 - .1 GA-214-10, Recommended Levels of Gypsum Board Finish.
 - .2 GA-216-10, Application and Finishing of Gypsum Board.
 - .3 GA-231-06, Assessing Water Damage to Gypsum Board.
 - .4 GA-238-03, Guidelines for the Prevention of Mold Growth on Gypsum Board.
- .3 Underwriters Laboratories of Canada (ULC):
 - .1 CAN/ULC S101-07, Standard Methods of Fire Endurance Tests of Building Construction and Materials
 - .2 CAN/ULC S102-10, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies
 - .3 ULC List of Equipment and Materials
 - .4 Underwriters' Laboratories (UL), Standards for Safety acceptable to the Standards Council of Canada (SCC)

1.3 QUALITY ASSURANCE

- .1 Contractor executing work of this Section shall have a minimum of five (5) years continuous experience in successful installation of work of type and quality shown and specified.
- .2 Submit proof of experience upon Consultant's request.

1.4 SUBMITTALS

- .1 Provide submittals in accordance with the requirements of Division 01.
- .2 Shop Drawings: Submit shop drawings showing the design, construction and relevant details of furring, enclosures and partitions which require a fire rating.
- .3 Product Data: Submit manufacturer's current technical literature for each component.
- .4 Samples: Supply for Consultant's review, if requested, samples of the following:
 - .1 Board: Submit sample of each panel product specified, 150mm (6") square.
 - .2 Trim: Submit sample of each type of trim specified, 305mm (12") long.
- .5 Quality Assurance Submittals:
 - .1 Design Data, Test Reports: Provide manufacturer's test reports indicating product compliance with indicated requirements.
 - .2 Manufacturer's Instructions: Provide manufacturer's written installation instructions.

1.5 DELIVERY, STORAGE, HANDLING AND PROTECTION

- .1 Coordinate deliveries to comply with construction schedule and arrange ahead for off the ground, enclosed, under cover storage location. Do not load any area beyond the design limits.
- .2 Materials shall be carefully checked, unloaded, stored and handled to prevent damage. Protect materials with suitable non-staining waterproof coverings.
- .3 Store material in original, undamaged containers or wrappings with manufacturer's seals and labels intact, in accordance with GA-238 and manufacturer's recommendations.
- .4 Protect bagged products from excessive moisture or wetting. Store metal component sections in crates to prevent damage to material. Do not use bent or deformed material.

1.6 PROJECT CONDITIONS

- .1 Establish and maintain environmental conditions for application and finishing gypsum wallboard to comply with ASTM C 840 and in accordance with manufacturer's written instructions.
- .2 In cold weather (outdoor temperatures less than 13 deg. C, controlled heat in the range of 13 deg. C to 21 deg. C must be provided. Recommended temperature must be maintained twenty-four (24) hours before, during, and after entire gypsum board joint finishing and until the permanent heating system is in operation or the building is occupied.
 - .1 Minimum temperature of 10 deg. C shall be maintained during gypsum board application.
- .3 Ventilate building spaces to remove excess moisture and humidity during the drying process. Avoid drafts during dry, hot weather to prevent materials from drying too rapidly.

2 Products

2.1 MATERIALS – WALLBOARD (GWB)

- .1 Standard Gypsum Board:
 - .1 Conforming to ASTM C1396, ivory paper faced, tapered edges, 1220mm (48") wide sheets of maximum practical lengths to minimize end joints, 1/2" thick unless indicated otherwise on drawings.
 - .1 Sheetrock Brand Gypsum Panels by CGC Inc.
 - .2 ProRoc Regular by CertainTeed.
 - .3 ToughRock Gypsum Wallboard by Georgia-Pacific Canada.
 - .4 Or approved equivalent.
- .2 Fire-Rated Gypsum Board 'Type X':
 - .1 Conforming to ASTM C1396, 1220mm (48") wide sheets of maximum practical lengths to minimize end joints, tapered edges, 16mm (5/8") thick, as indicated on drawing.
 - .1 Sheetrock Brand Gypsum Panels, Firecode Core by CGC Inc.
 - .2 ProRoc Type X by CertainTeed.
 - .3 ToughRock Fireguard Gypsum Board by Georgia-Pacific Canada.
 - .4 Or approved equivalent.
- .3 Gypsum Ceiling Board:
 - .1 Sag Resistant Gypsum Board: Meeting requirements of ASTM C1396M, ceiling board manufactured to have more sag resistance than regular type gypsum board with long edges tapered, and as follows:
 - .1 Location: Ceiling surfaces.
 - .2 Acceptable Materials:
 - .1 Sheetrock Interior Ceiling Board by CGC Inc.
 - .2 Tough Rock CD Ceiling Board by Georgia Pacific Canada.
 - .3 ProRoc Interior Ceiling Board by CertainTeed.
 - .4 Or approved equivalent.
- .4 Tile Backer Board:
 - .1 Glass Mat Water Resistant Gypsum Backer Board: Manufactured in accordance with ASTM C1178 and C1658 to produce greater resistance to water penetration and to provide improved surface bonding characteristics for ceramic tile than standard gypsum board:
 - .1 Location: Substrate for any ceramic tile or hygienic panel installation.
 - .2 Acceptable Materials:
 - .1 Fiberock Aqua Tough Tile Backerboard by CGC Inc.
 - .2 Diamondback Tile Backer by CertainTeed.
 - .3 GlasRoc Tile Backer by Georgia-Pacific Canada.
 - .4 Or approved equivalent.
- .5 Abuse Resistant Gypsum Board:

- .1 Manufactured to produce greater resistance to surface indentation and impact penetration resistance than standard gypsum panels:
 - .1 Gypsum panels with glass fibre reinforced core, tapered edges, minimum 5/8" thickness, Type X ULC fire rating, conforming to ASTM C1396M and tested to the following performance ratings.
 - .2 Acceptable Materials:
 - .1 Sheetrock Abuse Resistant Firecode by CGC Inc.
 - .2 Abuse Resistant Type X by CertainTeed.
 - .3 ToughRock Abuse Resistant Fireguard by Georgia Pacific Canada.
 - .4 Or approved equivalent.
- .6 Exterior Sheathing Board:
 - .1 Glass mat faced, water-resistant treated core gypsum board, 1220mm (48") wide sheets of maximum practical lengths to minimize end joints, 13mm (1/2") thick, silicone treated gypsum core, front and back faces penetrated with inorganic glass fibre mats, square edge, conforming to ASTM C1177. Mould resistant panel score of 10 when tested in accordance with ASTM D3273 and evaluated to ASTM D3274.
 - .1 Securock Glass-Mat Sheathing by CGC Inc.
 - .2 Dens-Glass Gold by Georgia-Pacific Canada.
 - .3 GlasRoc Sheathing by CertainTeed.
 - .4 Or approved equivalent.
- .7 Exterior Soffit Board:
 - .1 Mould and moisture resistant cement board, non-combustible, 1220mm (48") wide sheets of maximum practical lengths to minimize end joints, 13mm (1/2") thick, aggregated portland cement core wrapped in polymer-coated, glass-fiber mesh. panel score of 10 when tested in accordance with ASTM D3273:
 - .1 Acceptable Materials:
 - .1 Durock by CGC Inc.
 - .2 PermaBase Cement Board by CertainTeed
 - .3 ToughRock Fireguard Soffit Board by Georgia-Pacific Canada.
 - .4 Or approved equivalent.

2.2 ACCESSORIES

- .1 Concrete Anchors:
 - .1 Self-drilling tie wire anchors, "Red-Head No. T-32" by Phillips Drill Company, Division of ITT Industries of Canada Ltd., (or approved alternate).
- .2 Concrete Inserts:
 - .1 Hot-dip galvanized "turtle back" type concrete inserts to suit conditions as approved by Consultant, by Acrow-Richmond National Concrete Accessories, Division of Premetalco Inc., (or approved alternate).
- .3 Mineral Fibre Acoustical Insulation: As indicated in Section 07 21 16.

- .4 Gypsum Wallboard Accessories:
 - .1 In general, gypsum wallboard accessories shall conform to ASTM C1047.
 - .2 Corner Beads:
 - .1 Made from galvanized steel sheet conforming to ASTM A653, minimum 0.0179" (25 gauge). Minimum width of flanges 28mm for 13mm (1-1/8" for 1/2") thick wallboard and 32mm for 16mm (1-1/4" for 5/8") thick wallboard.
 - .3 Casing Beads:
 - .1 Made from galvanized steel sheet conforming to ASTM A653, minimum 30 gauge, U-shaped designed for finishing with joint compound.
 - .4 Control Joints:
 - .1 Made from galvanized sheet steel conforming to ASTM A653, minimum 0.0179" (25 gauge), or roll-formed zinc-alloy to resist corrosion, with expansion joint material perforated flanges.
 - .1 'Zinc Control Joint No. 093' by CGC Inc.
 - .2 (or approved alternate).
 - .5 Reveals:
 - .1 Galvanized sheet steel conforming to ASTM A653, minimum 0.0179" (25 gauge), in profiles as indicated on drawings.
- .5 Wallboard Screws:
 - .1 Corrosion resistant, self-drilling, self-tapping gypsum wallboard screws conforming to ASTM C1002 (Type S) and ASTM C954 (Type S-12), 25mm (1") long No. 6 for single layer application, 41mm (1-5/8") long No. 7 for double layer application.
 - .2 At fire rated construction, type and size of wallboard screw shall be same as used in fire-rating test.
- .6 Joint Compound for Interior Gypsum Board:
 - .1 Conforming to ASTM C475 and as recommended by gypsum wallboard, fire-rated gypsum wallboard and exterior wallboard manufacturers to suit conditions.
- .7 Joint Compound for Tile Backing Panels:
 - .1 Gypsum based tile backing board: Use setting type taping and setting type, sandable topping compounds.
- .8 Joint Compound for Exterior Sheathing Boards and Soffit Panels:
 - .1 Fibreglass mesh tape.
- .9 Joint Compound for Abuse-Resistant Panels:
 - .1 ToughRock™ Sandable Joint Compound, by Georgia-Pacific.
 - .2 Durabond/Sheetrock Setting-Type Joint Compound, by CGC Canada Inc.
 - .3 Or approved equivalent.
- .10 Resilient Sponge Tape:
 - .1 Closed cell neoprene sponge type tape with self-sticking adhesive on one side. 'Permastik 122X' by Jacobs and Thompson Ltd., or foamed vinyl type tape, 'Arnofoam' by Arno Adhesive Tape Incorporated, (or approved alternate).
- .11 Adhesive:

- .1 Conforming to CGSB 71-GP-25M, and as recommended by manufacturer and compatible with contacted surfaces.

3 Execution

3.1 EXAMINATION

- .1 Examine gypsum wallboard panels for damage and existence of mould. Install only undamaged panels.
- .2 Examine gypsum wallboard in accordance with GA-231 for water damage.
- .3 Examine areas and substrates, with installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance.
- .4 Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- .1 Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.
- .2 Coordinate installation of gypsum board suspension systems with installation of acoustical ceiling tiles (ACT) suspension systems. Where gypsum board suspension systems abut ACT systems, ensure that ceiling tiles grid fit into gypsum grid without affecting overall design and appearance.
- .3 Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.

3.3 INSTALLATION - GENERAL

- .1 Conform to ASTM C840, except as otherwise specified herein. Co-operate with mechanical, electrical and other trades to accommodate fixtures, fittings and other items in wallboard areas.
- .2 Review extent of temporary heat provided. Carry out the work of this Section only when temperature is maintained and controlled in the range of 13 deg. C to 21 deg. C for at least twenty-four (24) hours before installing gypsum board and shall be maintained until joint compound and adhesives are dried or cured.
- .3 Bring gypsum board into contact, but do not force into place.

3.4 GYPSUM WALLBOARD - SINGLE LAYER APPLICATION

- .1 Metal Studs:
 - .1 Apply gypsum wallboard with screws. Erect wallboard with long dimension at right angles to supports. For fire rated partitions, erect board vertically or horizontally according to the ULC listing. Locate end joints over supporting members.
 - .2 Locate vertical joints at least 305mm (12") from the jamb/head/sill lines of openings.
 - .3 For parallel application space screws at 200mm (8") O.C. at board edges at 305mm (12") O.C. on board fields.
- .2 Fasteners:
 - .1 Perimeter screws shall be not less than 10mm (3/8") from edges and ends and shall be opposite the screws on adjacent boards.

- .2 Screws shall be driven with a power screw gun and set with countersunk head slightly below the surface of the board.

.3 Joints:

- .1 Finish all joints.

3.5 GYPSUM WALLBOARD - DOUBLE LAYER APPLICATION

.1 General:

- .1 Lay out work to minimize end joints on the face layer and to offset parallel joints between face and base layers by at least 254mm (10"). Apply the face layer at right angles to the base layer.

.2 Base Layer:

- .1 The base layer shall be same as face layer or wallboard backing board applied at right angles to framing members. Secure base layers with screws spaced 305mm (12") O.C. to each member. Perimeter screws shall be opposite the screws on adjacent boards.
- .2 The surface of the erected base layer shall be straight, plumb or level, and without protrusions before the face layer is applied.

.3 Face Layer:

- .1 Apply face layer at right angles to base layer with adhesive. Apply adhesive with a notched spreader to leave 10mm x 13mm (3/8" x 1/2") ribbons, 38mm (1-1/2") apart over entire back side of face layer. Erect wallboard immediately after spreading adhesive.
- .2 Supplement adhesive with screw fasteners. Provide temporary support for wallboard until adhesive bond has fully developed.
- .3 As an alternative to adhesive specified, joint compound mixed with water in accordance with manufacturer's directions may be used. Allow joint compound and water mixture to stand thirty (30) minutes before using.

.4 Joints:

- .1 Finish joints in face layers only, unless otherwise required to achieve fire resistant ratings indicated, as hereinafter specified.

3.6 TILE BACKING PANELS

- .1 Install standard gypsum board panels in areas not subject to wetting to produce a flat surface.
- .2 Install water resistant gypsum board in locations requiring tile or hygienic panel applications in washrooms, and as indicated on the Drawings.
- .3 Shim surfaces to produce a uniform plane across panel surfaces where tile backing panels abut other types of panels in the same plane.

3.7 EXTERIOR SHEATHING BOARD

- .1 Install exterior sheathing board to exterior walls in accordance with manufacturer's written instructions. Seal all cut edges, ends, utility holes and fastener heads, as recommended by manufacturer.
- .2 Sufficient anchors must be provided on each structural stud prior to erection of stud. Sequentially lift anchors as exterior sheathing board is being installed such that each anchor rests on edge of the exterior sheathing board.
- .3 Tape and fill all joints and fastener heads using materials recommended by exterior sheathing board manufacturer.

3.8 FIRE RESISTANT ASSEMBLIES

- .1 Fire resistance rating of gypsum board assemblies and framing shall be as called for on drawings or schedules, and as required to conform with applicable codes and requirements of authorities having jurisdiction.
- .2 Appropriate ULC designs as listed in current ULC list of equipment and materials, Volume II, Building Construction, shall be placed when applicable. Extend partitions full height through ceiling space unless otherwise noted on drawings.
- .3 Vertical bulkheads in ceiling spaces over fire rated glazed partitions, doors and the like shall have same fire rating as the door or partition over which they occur. All such bulkheads shall be of drywall construction unless otherwise noted.
- .4 Use fire rated gypsum board as specified.
- .5 Where lighting fixtures, diffusers, and the like are recessed into fire rated ceilings or bulkheads, provide enclosure to maintain required fire rating. Form removable panel to give access to fixture outlet box.
- .6 Where fire hose cabinets or other fixtures or equipment are recessed in fire rated walls or partitions, provide drywall enclosure or backing to maintain required fire rating, unless otherwise detailed.

3.9 CONTROL JOINTS

- .1 Install control joints using metal control joint strip as specified where:
 - .1 A partition, furring or column fireproofing abuts a structural element, dissimilar wall or partition assembly, or other vertical penetration, or ceiling.
 - .2 A ceiling or soffit abuts a structural element, dissimilar wall or partition assembly or other vertical penetrations.
 - .3 Wings of "L", "U" and "T"-shaped ceiling/soffit areas are joined;
 - .4 Construction changes within the plane of the partition or ceiling or soffit.
 - .5 Partition, restrained ceiling or furring run exceeds 9144mm (30').
 - .6 Unrestrained ceiling dimensions exceed 15240mm (50') in either direction.
 - .7 Expansion or control joints occur in the base exterior wall.
 - .8 Wallboard is installed over masonry control joints.
 - .9 And elsewhere as indicated on the drawings.
- .2 Install in accordance with manufacturer's instructions. Where application is on furring members and double furring members at control joints, place one furring member on each side of the control joint.

3.10 BULKHEADS

- .1 Fur out bulkheads in areas indicated and as required to conceal mechanical, electrical or other services in rooms where drywall finishes are scheduled, and elsewhere if called for on drawings.
- .2 Ensure hangers are installed as to prevent splaying.

3.11 PRESSED STEEL (HOLLOW METAL) FRAMES

- .1 Install pressed steel (hollow metal) frames where they occur in gypsum wallboard partitions.
- .2 Anchor frames securely to studs using a minimum of three (3) anchors per jamb for jambs up to 2134mm (7') high and minimum of four (4) anchors per jamb for jambs over 2134mm (7') high.

3.12 THERMAL BREAK

- .1 Install self-sticking resilient sponge tape at edges of wallboard in contact with metal windows and exterior door frames to provide a thermal break.
- .2 Adhere tape to casing bead and compress during installation.

3.13 FINISHING

- .1 Before proceeding with installation of finishing materials ensure the following:
 - .1 Wallboard is fastened and held close to framing and furring.
 - .2 Fastening heads in wallboard are slightly below surface in dimple formed by driving tool.
- .2 Levels of Gypsum Wallboard Finish:
 - .1 Level 0: Temporary construction only.
 - .2 Level 1: Plenum areas and above ceilings. Where a fire-resistance rating is required finishing should be in accordance with reports of fire tests of assemblies that have met the requirements of the fire rating imposed.
 - .3 Level 2: Areas of water resistant gypsum backing board under tile, exposed areas where appearance is not critical.
 - .4 Level 3: Service corridors and areas to receive heavy or medium textured coatings or heavy-duty wall coverings.
 - .5 Level 4: Areas to receive light textured coatings or lightweight wall coverings.
 - .6 Level 5: Areas to receive gloss, semi-gloss or flat sheen paints and critical lighting conditions. Embed tape and apply separate first, fill, and finish coats of joint compound to tape, fasteners, and trim flanges, and apply skim coat over entire surface for corridors, long hallways, walls and ceilings longer than 7500 mm or walls higher than 3600 mm, and for all curved or angled wall surfaces.
- .3 Finish gypsum wallboard in strict accordance with ASTM C840, GA-214 and GA-216 and as follows:
 - .1 Fill and tape joints and internal corners and fill screw depressions in board face and smooth out along corner beads and metal strip with joint compound.
 - .2 Mix joint compound (powder) in accordance with manufacturer's written instructions.
 - .3 Prefill "V" grooves of rounded edges with special setting type joint compound using a 127mm to 150mm (5" to 6") joint finishing knife. Finish flush with tapered surface ready for tape reinforcing application. Allow prefill material to dry thoroughly before application of embedding compound and tape.
 - .4 Apply joint compound in thin uniform layer. Embed reinforcing tape accurately centred on joint and securely pressed in, leaving sufficient compound under tape to provide proper bond. Immediately apply skim coat over tape application. Allow to dry thoroughly before application of next coat.
 - .5 Apply fill coat finishing the tapered depression flush with board surfaces. Allow to dry thoroughly before application of finish coat.
 - .6 Apply finish coat extending slightly beyond the filler coat and feathered out onto the board surface. Do not apply finish coat to gypsum board scheduled to be sprayed with acoustic surfacing finish.
 - .7 Sand between coats and following the finishing coat, where necessary, and leave surface smooth and ready for painting.

- .8 Finish screw depressions with filler material and finish coat as specified above.
- .9 Joint and depression finish shall in no case protrude beyond the plane of the board surface.
- .10 Furnish corner beads and metal trim flush with board surface using filler and finishing coats feathered out approximately 50mm (2") and 100mm (4") respectively onto the board surface.
- .11 Provide metal casing beads at exposed edges, at junctions of gypsum board with dissimilar material, at control joints and at junction with columns. Casing beads are required at perimeter of gypsum wallboard ceilings and soffits. Fasten with screws at 305mm (12") O.C. along entire length.
- .12 Finish gypsum board to receive a Level 4 finish, unless indicated on the Drawings as a Level 5 finish.

3.14 REPAIRS

- .1 After taping and finishing has completed, and before decoration, repair all damaged and defective work, including non-decorated surfaces.
- .2 Patch holes or openings 13mm (1/2") or less in diameter, or equivalent size, with a setting type finishing compound or patching plaster.
- .3 Repair holes or openings over 13mm (1/2"), or equivalent size, with 16mm (5/8") thick gypsum wallboard secured in such a manner as to provide solid substrate equivalent to undamaged surface.
- .4 Tape and refinish scratched, abraded or damaged finished surfaces including cracks and joints in non-decorated surface to provide smoke tight construction, fire protection equivalent to the fire rated construction and STC equivalent to the sound rated construction.

3.15 PROTECTION

- .1 Protect installed products from damage during remainder of construction period.
- .2 Remove and replace panels that are damaged.

END OF SECTION

1 General

1.1 SUMMARY

- .1 This Section includes requirements for supply and installation of ceilings consisting of the following, complete with exposed suspension system and trim:
 - .1 Acoustical tiles for interior ceilings.
 - .2 Suspension grid systems.

1.2 REFERENCE STANDARDS

- .1 American Society for Testing and Materials (ASTM):
 - .1 ASTM C635/C635M-13a, Standard Specification for the Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings
 - .2 ASTM C636/C636M-13, Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels
 - .3 ASTM E1264-14 Standard Classification for Acoustical Ceiling Products
- .2 Underwriters Laboratories of Canada (ULC):
 - .1 CAN/ULC S102-10, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies

1.3 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination: Coordinate layout and installation of acoustic tile ceiling and suspension system with other construction that penetrates ceilings or is supported by them including; but not limited to, light fixtures, HVAC equipment, fire suppression system, and partition assemblies, and as follows:
 - .1 Schedule and coordinate installation of ceiling to occur after completion of overhead mechanical and electrical work.
 - .2 Schedule and coordinate ceiling installation with mechanical and electrical trades building in components into ceiling finish panels.
- .2 Pre-Installation Conference: Conduct conference at Project site in accordance with requirements of Division 01 to discuss coordination issues with Contractor, Subcontractor and Consultant present.

1.4 SUBMITTALS

- .1 Provide submittals in accordance with Division 01.
- .2 Action Submittals: Provide the following submittals before starting any work of this Section:
 - .1 Product Data: Submit product data for each type of product specified.
 - .2 Coordination Drawings: Reflected ceiling plans drawn to scale and coordinating penetrations and ceiling mounted items indicating the following:
 - .1 Ceiling suspension system members.
 - .2 Method of attaching suspension system hangers to building structure.
 - .3 Ceiling mounted items including light fixtures; air outlets and inlets; speakers; sprinklers; and special mouldings at walls, column penetrations, and other junctures of acoustic ceilings with adjoining construction.

- .3 Samples for Initial Selection: Manufacturer's colour charts consisting of sections of acoustic panels, suspension systems, and trim showing the full range of colours, textures, and patterns available for each type of ceiling assembly indicated.
- .4 Samples for Verification: Full size units of each type of ceiling assembly indicated; in sets for each colour, texture, and pattern specified, showing the full range of variations expected in these characteristics:
 - .1 150mm (6") square samples of each acoustic panel type, pattern, and colour
 - .2 Set of 305mm (12") long samples of exposed suspension system members, including trim, for each colour and system type required.
- .5 Maintenance and Materials:
 - .1 Provide five percent (5%) of each type of acoustic ceiling panels and two percent (2%) of each suspension system and trim for future repairs. Identify cartons and place where directed by the Owner.
 - .2 Maintenance materials shall be of same production run as installed materials.

1.5 INFORMATIONAL SUBMITTALS

- .1 Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - .1 Ceiling suspension-system members.
 - .2 Structural members to which suspension systems will be attached.
 - .3 Method of attaching hangers to building structure.
 - .4 Carrying channels or other supplemental support for hanger-wire attachment where conditions do not permit installation of hanger wires at required spacing.
 - .5 Size and location of initial access modules for acoustical tile.
 - .6 Items penetrating finished ceiling and ceiling-mounted items including the following:
 - .1 Lighting fixtures.
 - .2 Diffusers.
 - .3 Grilles.
 - .4 Speakers.
 - .5 Sprinklers.
 - .6 Access panels.
 - .7 Perimeter moldings.
 - .7 Show operation of hinged and sliding components adjacent to acoustical tiles.
 - .8 Minimum Drawing Scale: $\frac{1}{4}" = 1'$ (1:48).

1.6 QUALITY ASSURANCE

- .1 The Contractor executing work of this Section shall have a minimum of five (5) years continuous experience in successful installation of work of type and quality shown and specified. Submit proof of experience upon Consultant's request.
- .2 Single-Source Responsibility: Provide acoustic ceilings and grid components by a single manufacturer to ensure compatibility.

- .3 Letter of Certification:
 - .1 Contractor together with manufacturer, shall submit a written confirmation, signed by manufacturer's registered professional Engineer, stating that the suspended ceiling system will provide adequate support for electrical fixtures.

1.7 DELIVERY, STORAGE, HANDLING AND PROTECTION

- .1 Coordinate deliveries to comply with construction schedule and arrange ahead for off-the-ground, under cover storage location. Do not load any area beyond the design limits.
- .2 Materials shall be carefully checked, unloaded, stored and handled to prevent damage. Protect materials with suitable non-staining waterproof coverings.
- .3 Store material in original, undamaged containers or wrappings with manufacturer's seals and labels intact.

1.8 SITE CONDITIONS

- .1 Ambient Conditions: Install acoustic unit ceilings only when building is enclosed, has sufficient heat, when overhead mechanical and electrical work is complete, and dust and moisture producing activities are complete; maintain uniform temperatures and relative humidity within range recommended by material manufacturer from the time of installation until Substantial Performance for the project; make adjustments to temperature and humidity gradually within tolerances indicated by manufacturer.

1.9 WARRANTY

- .1 Acoustical Panel: Submit manufacturers standard ten (10) year written warranty executed by the manufacturer, agreeing to repair or replace panels that fail within the warranty period. Failures include, but are not limited to the following:
 - .1 Panels: Sagging and warping.
 - .2 Grid System: Rusting and manufacturer's defects.

2 Products

2.1 MANUFACTURERS

- .1 Acceptable Materials Manufacturers: Subject to compliance with requirements specified in this Section, manufacturers offering products that may be incorporated into the Work include the following:
 - .1 Armstrong World Industries, Inc.
 - .2 CertainTeed
 - .3 CGC Interiors, a USG Company
 - .4 Or approved equivalent.

2.2 DESIGN CRITERIA

- .1 Superimposed Loads: Determine superimposed loads applied to suspension systems by components of the building and verify that adequate hangers are installed to support additional loads in conjunction with normal loads of the ceiling system, and as follows:
 - .1 Maximum Deflection: Limit deflection to L/360 in accordance with ASTM C635 deflection test.

2.3 MATERIALS

- .1 Acoustic Ceilings (ACT-01): Provide manufacturer's fibreglass acoustical ceiling system, tested in accordance with ASTM E84 and as follows:
 - .1 Surface Texture: Smooth
 - .2 Composition: Fiberglass

- .3 Color: White
- .4 Size: 610mm x 610mm x 25mm (24in x 24in x 1in)
- .5 Edge Profile: Square
- .6 Noise Reduction Coefficient (NRC): ASTM C 423; Classified with UL label on product carton .90
- .7 Articulation Class (AC): ASTM E 1111; Classified with UL label on product carton 190
- .8 Flame Spread: ASTM E 1264; Class A (UL)
- .9 Light Reflectance (LR) White Panel: ASTM E 1477; 0.88
- .10 Dimensional Stability: HumiGuard Plus
- .11 Material Ingredient Transparency: Health Product Declaration (HPD); Declare Label
- .12 Life Cycle Assessment: Third Party Certified Environment Product Declaration (EPD)
- .13 Acceptable Product: Optima, 3159 as manufactured by Armstrong World Industries, or equivalent

2.4 METAL SUSPENSION SYSTEM

- .1 Metal Suspension-System Standard: Provide manufacturer's standard, direct-hung, metal suspension system and accessories according to ASTM C 635/C 635M and designated by type, structural classification, and finish indicated.
 - .1 Installation shall be by use of torsion springs, field engaged into factory supplied spring retainers, and field installed on the back of the panel on the coated extruded aluminum panel edge.
 - .2 Panel assembly is then lifted into place, and the torsion springs are engaged into the factory supplied "butterflies" which have been field installed during the assembly of the suspended factory supplied extruded aluminum grid.
 - .3 The grid system shall consist of main tees and cross tees, which shall incorporate a continuous "panel location" fin to ensure correct panel alignment during installation and future access.
 - .1 The suspension system shall be completely engineered and fabricated in the factory, to avoid any field cutting of the suspension components.

2.5 ACCESSORIES

- .1 Attachment Devices: Size for five times the design load indicated in ASTM C 635/C 635M, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.
- .2 Wire Hangers, Braces, and Ties: Provide wires as follows:
 - .1 Zinc-Coated, Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
 - .2 Size: Wire diameter sufficient for its stress at three times hanger design load (ASTM C 635/C 635M, Table 1, "Direct Hung") will be less than yield stress of wire, but not less than 0.106" (2.69mm).
- .3 Hanger Rods: Mild steel, zinc coated or protected with rust-inhibitive paint.
- .4 Flat Hangers: Mild steel, zinc coated or protected with rust-inhibitive paint.

3 Execution

3.1 INSPECTION

- .1 Examine the work upon which the work of this Section depends and report any defects to the Consultant. Do not commence installation until such time as all wet trades have been completed. Commencement of work implies acceptance of surface and conditions.
- .2 Ensure that a uniform minimum temperature of 15 deg. C and humidity of 20 - 40% before, during and after installation is maintained.

3.2 INSTALLATION

- .1 Cooperate with mechanical, electrical, drywall and other trades to accommodate fixtures, and the like. Examine mechanical and electrical drawings to establish hanger layout and ensure that ceiling hanger layout and furring are designed to span ducts, and the like, where required. Supply all hangers, including inserts for hangers and supplementary framing members as required for complete installation.
- .2 Prior to installation of acoustic panels notify the Consultant for inspection and approval of suspension system.
- .3 All installations shall be by skilled mechanics and in strict accordance with system manufacturer's printed directions to produce first-class, flush finished surface in true plane, free from drooping, warped, soil or damaged board or grid.
- .4 Provide all additional supports, hangers and steel trapeze channel framing required to support fixtures located under mechanical ducts.
- .5 Hangers, where required:
 - .1 Space hangers to support grid on 1220mm (48") centres each way securely fastened to structure. Hangers shall not, under any circumstances, be secure to pipes, ducts or any electrical or mechanical items.
 - .2 Frame around recessed fixtures, grilles and openings with an allowance for movement. Hangers shall be plumb and not pressed against ducts, pipes or conduits.
- .6 Anchors, where required:
 - .1 Self-drilling type, installed by means of an electrically powered drill specifically designed for this purpose.
 - .2 The anchor manufacturer shall evaluate the specific job conditions and advise in writing regarding anchor sizes necessary. The safe working load shall not exceed 25% of the manufacturer's stated average test loads for the anchor.
 - .3 Receive instruction from the anchor manufacturer regarding correct usage and comply with these requirements.
- .7 Assemble ceiling system in accordance with drawings. Install ceilings centered on room axis unless noted otherwise. Lay patterned ceiling panels in one direction with pattern parallel to the shortest room dimension.
- .8 Cooperate with the mechanical contractor and cut ceiling panels as required to accommodate air handling diffuser throughout the work.
- .9 Install acoustic ceiling panel types as indicated on drawings and schedules.

3.3 CLEANING

- .1 Thoroughly clean all acoustic ceiling surfaces upon completion of the installation.
- .2 Promptly as the work proceeds and on completion, remove all surplus materials and debris resulting from the work of this Section.

END OF SECTION

1 General

1.1 SUMMARY

- .1 Section includes surface preparation and the application of paint systems on the following interior and exterior substrates:
 - .1 Concrete;
 - .2 Concrete masonry units (CMU)
 - .3 Steel and iron;
 - .4 Galvanized metal;
 - .5 Hollow metal doors and frames;
 - .6 Gypsum board;
 - .7 Cotton or canvas insulation covering;
 - .8 Dimensioned lumber;
 - .9 Asphalt
- .2 Refer also to Intumescent Paint requirements as outlined in Specification 07 81 23.

1.2 REFERENCE STANDARDS

- .1 Environmental Choice Paints and Surface Coatings, Low VOC Product Listings Program (ECP):
 - .1 Paints and Surface Coatings, Low VOC Product Listings
- .2 The Master Painters Institute (MPI):
 - .1 New Surfaces: Architectural Painting Specification Manual.
- .3 The Society for Protective Coatings (SSPC):
 - .1 Coating Materials Guidelines
 - .2 Surface Preparation Guidelines
 - .3 Application, Inspection and Quality Control Guidelines

1.3 DEFINITIONS

- .1 Gloss Levels: Standard coating terms defined by MPI Manual apply to products of this Section as follows:
 - .1 MPI Gloss Level 1: Not more than five units at 60 degrees and 10 units at 85 degrees, according to ASTM D523.
 - .2 MPI Gloss Level 2: Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D523.
 - .3 MPI Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D523.
 - .4 MPI Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D523.
 - .5 MPI Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D523.
 - .6 MPI Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D523.
 - .7 MPI Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D523.

- .2 Gloss Values: Generally, provide paints and coatings having the following sheens when installed on the following substrates:
 - .1 Walls: Eggshell (G3) or Satin (G4) as selected by Consultant at a later date.
 - .2 Trim and Doors: Semi-gloss (G5).
 - .3 Ceilings: Flat (G1).

1.4 SUBMITTALS

- .1 Provide required information in accordance with Division 01.
- .2 Action Submittals: Provide the following submittals before starting any work of this Section:
 - .1 Product Data: Submit list of all painting materials used for the Work to the Consultant for review prior to ordering materials for each paint system indicated, including block fillers and primers.
 - .1 Material List: An inclusive list of required coating materials indicating each material and cross reference specific coating, finish system, and application; identify each material by manufacturer's catalogue number and general classification.
 - .2 Manufacturer's Information: Manufacturer's technical information, including label analysis and instructions for handling, storing, and applying each coating material.
 - .2 Samples: Provide stepped samples, defining each separate coat, including block fillers and primers using representative colours required for the project; label each sample for location and application, and as follows:
 - .1 Drawdown Samples: Provide three (3) drawdown sample charts (cards) for each type, texture and colour of finish specified for verification purposes before ordering paint materials.
 - .3 Informational Submittals: Provide the following submittals when requested by the Consultant:
 - .1 Certification: Submit certification reports for paint products indicating that they meet or exceed low VOC and coloured base requirements listed in this Section.

1.5 PROJECT CLOSEOUT SUBMISSIONS

- .1 Operation and Maintenance Data: Submit copies of paint manufacturer's written maintenance information for inclusion in the operations manual in accordance with Division 01, including specific warning of any maintenance practice or materials that may damage or disfigure the finished Work.
- .2 Maintenance Materials: Deliver maintenance materials to Owner in quantities indicated and in accordance with Division 01, that match products installed; packaged with protective covering for storage, and identified with labels describing contents and building location and as follows:
 - .1 Paints and Coatings: Minimum of 4-4L containers of field colours and 4-1 L containers of each accent colour, and all remnants.

1.6 QUALITY ASSURANCE

- .1 Conform to the standards contained in the MPI Manual.
- .2 Applicator Qualifications: A firm or individual experienced in applying paints and coatings similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in service performance, and as follows:
 - .1 Have a minimum of five (5) years proven satisfactory experience and shall show proof before commencement of work that he will maintain a qualified crew of painters throughout the duration of the work.
 - .2 When requested provide a list of the last three comparable jobs including, name and location, specifying authority, start and completion dates and cost amount of the painting work.
 - .3 Apprentices may be employed provided they work under the direct supervision of a qualified journeyman in accordance with trade regulations.
- .3 Source Limitations: Obtain block fillers and primers for each coating system from the same manufacturer as the finish coats and as follows:
 - .1 Use only paint manufacturers and products as listed under the Approved Products section of the MPI Manual Architectural Painting Specification Manual.

1.7 MOCKUPS

- .1 Mockups: Apply mockups of each paint system indicated and each colour and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - .1 Consultant will select one surface to represent surfaces and conditions for application of each paint system.
 - .1 Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft. (9 sq. m).
 - .2 Other Items: Consultant will designate items or areas required.
 - .2 Final approval of colour selections will be based on mockups.
 - .1 If preliminary colour selections are not approved, apply additional mockups of additional colours selected by Consultant at no added cost to Owner.
 - .3 Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Consultant specifically approves such deviations in writing.
 - .4 Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

- .1 Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 7 deg C (45 deg F).
 - .1 Maintain containers in clean condition, free of foreign materials and residue.
 - .2 Remove rags and waste from storage areas daily.

1.9 FIELD CONDITIONS

- .1 Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 10 and 35 deg C (50 and 95 deg F).
- .2 Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 3 deg C (5 deg F) above the dew point; or to damp or wet surfaces.

1.10 WARRANTY

- .1 Provide upon completion of the work, a Warranty Certificate, in the name of the Owner, stating that the work of this section was performed in accordance with these specifications and the MPI manual (latest edition), and is warranted against defects in material or installation, for a period of two (2) years from Date of Substantial Performance.

2 Products

2.1 MANUFACTURERS

- .1 Subject to compliance with requirements, manufacturers that have attained the prerequisites for ecologically sustainable labelling mark on their products and may be incorporated into the Work include; but are not limited to, the following:
 - .1 Dulux Paints
 - .2 Sherwin-Williams LLC
 - .3 Benjamin Moore and Co. Limited
 - .4 ICI Paints (Canada) Inc.

2.2 PAINT, GENERAL

- .1 MPI Standards: Products shall comply with MPI standards indicated and shall be listed in its "MPI Approved Products Lists".
- .2 Material Compatibility:
 - .1 Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
 - .2 For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.
- .3 VOC Content: For field applications, paints and coatings shall comply with VOC content limits of authorities having jurisdiction and the following VOC content limits:
 - .1 Flat Paints and Coatings: 50 g/L.
 - .2 Nonflat Paints and Coatings: 50 g/L.
 - .3 Dry-Fog Coatings: 150 g/L.
 - .4 Primers, Sealers, and Undercoaters: 100 g/L.
 - .5 Rust-Preventive Coatings: 100 g/L.
 - .6 Zinc-Rich Industrial Maintenance Primers: 100 g/L.
 - .7 Pretreatment Wash Primers: 420 g/L.
 - .8 Shellacs, Clear: 730 g/L.
 - .9 Shellacs, Pigmented: 550 g/L.
- .4 Paint Colour and Manufacturer (PT): As selected by the Consultant from the manufacturer's standard product line. Carry five (5) colours and three (3) accent colours in Bid Price.

2.3 PREPARATORY COATS

- .1 CMU Block Filler:
 - .1 Benjamin Moore; Coronado Super Kote 5000 Latex Block Filler (958-11).
 - .2 PPG; Speedhide Interior/Exterior Masonry Latex Block Filler (6-7).
 - .3 SW; PrepRite Block Filler Interior/Exterior Latex (B25W25).

3 Execution

3.1 EXAMINATION

- .1 Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- .2 Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
 - .1 Concrete: 12 percent.
 - .2 Fiber-Cement Board: 12 percent.
 - .3 Masonry (Clay and Concrete Masonry Units): 12 percent.
 - .4 Wood: 15 percent.
 - .5 Portland Cement Plaster: 12 percent.
 - .6 Gypsum Board: 12 percent.
- .3 Gypsum Board Substrates: Verify that finishing compound is sanded smooth.
- .4 Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.
- .5 Proceed with coating application only after unsatisfactory conditions have been corrected.
 - .1 Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- .1 Comply with manufacturer's written instructions and recommendations in "MPI Painting Specification Manual" applicable to substrates and paint systems indicated.
- .2 Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
 - .1 After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
- .3 Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
 - .1 Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.
- .4 Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.
 - .1 Use abrasive blast-cleaning methods if recommended by paint manufacturer.

- .5 CMU / Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceeds that permitted in manufacturer's written instructions.
- .6 Steel Substrates: Remove rust, loose mill scale, and shop primer, if any. Clean using methods recommended in writing by paint manufacturer, but not less than the following:
 - .1 SSPC-SP 3.
- .7 Shop-Primed Steel Substrates: Clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.
- .8 Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.
- .9 Gypsum Wallboard: Repair all surfaces in gypsum wallboard with wallboard joint finishing compound or spackling compound, filled out flush and sanded smooth. Clean all surfaces and taped joints of dust, dirt and other contaminants and be sure they are thoroughly dry before applying paint.
- .10 Cotton or Canvas Insulation Covering Substrates: Remove dust, dirt, and other foreign material that might impair bond of paints to substrates.
- .11 Mix and prepare paint materials according to manufacturer's written instructions.
 - .1 Maintain containers used in mixing and applying paint in a clean condition, free of foreign materials and residue.
 - .2 Stir material before application to produce a mixture of uniform density. Stir as required during application. Do not stir surface film into material. If necessary, remove surface film and strain material before using.
 - .3 Use only thinners approved by paint manufacturer and only within recommended limits.

3.3 APPLICATION

- .1 Apply paints according to manufacturer's written instructions and to recommendations in "MPI Manual."
 - .1 Use applicators and techniques suited for paint and substrate indicated.
 - .2 Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
 - .3 Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
 - .4 Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
 - .5 Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.
- .2 Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match colour of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.
- .3 Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.

- .1 The number of coats and film thickness required are the same regardless of application method. Do not apply succeeding coats until previous coat has cured as recommended by manufacturer. If sanding is required to produce a smooth, even surface according to manufacturer's written instructions, sand between applications.
 - .1 Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to ensure a finish coat with no burn-through or other defects due to insufficient sealing.
 - .2 Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.
 - .3 If undercoats, stains, or other conditions show through final coat of paint, apply additional coats until paint film is of uniform finish, color, and appearance. Give special attention to ensure that edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.
- .2 Allow sufficient time between successive coats to permit proper drying. Do not recoat surfaces until paint has dried to where it feels firm, and does not deform or feel sticky under moderate thumb pressure, and until application of another coat of paint does not cause undercoat to lift or lose adhesion.
- .4 Apply paints and coatings by brush, roller, spray, or other applicators according to manufacturer's written instructions.
 - .1 Brushes: Use brushes best suited for type of material applied. Use brush of appropriate size for surface or item being painted.
 - .2 Rollers: Use rollers of carpet, velvet-back, or high-pile sheep's wool as recommended by manufacturer for material and texture required.
 - .3 Spray Equipment: Use airless spray equipment with orifice size as recommended by manufacturer for material and texture required.
- .5 Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and colour breaks.
- .6 Apply block fillers to CMU at a rate to ensure complete coverage with pores filled.
- .7 Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:
 - .1 Paint the following work where exposed in equipment rooms and where exposed in occupied spaces:
 - .1 Equipment, including panelboards.
 - .2 Uninsulated metal piping.
 - .3 Uninsulated plastic piping.
 - .4 Pipe hangers and supports.
 - .5 Metal conduit.
 - .6 Plastic conduit.
 - .7 Tanks that do not have factory-applied final finishes.
 - .8 Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
- .8 Paint portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets that are visible from occupied spaces.
 - .1 Colour: Flat (gloss level 1), nonspecular, black.

3.4 FIELD QUALITY CONTROL

- .1 Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.
 - .1 Contractor shall touch up and restore painted surfaces damaged by testing.
 - .2 If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

3.5 CLEANING AND PROTECTION

- .1 At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- .2 After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- .3 Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Consultant, and leave in an undamaged condition.
- .4 At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 EXTERIOR PAINTING SCHEDULE

- .1 Galvanized Metal (doors, frames, railings, misc. steel, pipes, overhead decking, ducts, gutters, flashing, etcetera):
 - .1 Latex System - MPI EXT 5.3A.
 - .1 Semi-gloss (MPI Gloss Level 5).
 - .2 Wash Primer/2-Component Aliphatic Polyurethane Finish (High Contact Areas) - MPI EXT 5.3D:
 - .1 Semi-gloss (MPI Gloss Level 5).
- .2 Traffic markings on asphalt surfaces:
 - .1 Latex System – MPI EXT 2.1A
- .3 Dimensioned Lumber (trellis, columns, etc)
 - .1 Semi-transparent stain finish – MPI EXT 6.2L.

3.7 INTERIOR PAINTING SCHEDULE

- .1 Concrete Substrates:
 - .1 Latex System - MPI INT 3.1A:
 - .1 Primer: Alkali resistant, water based.
 - .2 Intermediate Coat: Latex, interior, matching topcoat.
 - .3 Topcoat: Latex, interior (gloss as selected by the Consultant).
- .2 CMU Substrates:
 - .1 Latex System - MPI INT 4.2A:
 - .1 Primer: CMU block filler.
 - .2 Intermediate Coat: Latex, interior, matching topcoat.
 - .3 Topcoat: Latex, interior (gloss as selected by the Consultant).
- .3 Structural Steel Substrates:

- .1 Water-Based Dry Fall Finish - MPI INT 5.1C
- .2 High-Performance Architectural Latex System - MPI INT 5.1R:
 - .1 Primer: Acrylic.
 - .2 Intermediate Coat: Latex, interior, high performance architectural; matching topcoat.
 - .3 Topcoat: Latex, interior, high performance architectural (gloss as selected by the Consultant).
- .3 Coordinate with existing structural steel elements scheduled to receive applied fireproofing and/or intumescent fireproofing.
- .4 Steel (Factory-Primed) Substrates:
 - .1 High-Performance Architectural Latex System:
 - .1 Primer: Acrylic (applied over factory primer).
 - .2 Intermediate Coat: Latex, interior, high performance architectural; matching topcoat.
 - .3 Topcoat: Latex, interior, high performance architectural (gloss as selected by the Consultant).
- .5 Galvanized-Metal Substrates:
 - .1 High-Performance Architectural Latex System - MPI INT 5.3M:
 - .1 Prime Coat: Primer, galvanized, water based.
 - .2 Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.
 - .3 Topcoat: Latex, interior, high performance architectural, semi-gloss (MPI Gloss Level 5).
- .6 Hollow Metal Doors and Frames.
 - .1 High-Performance Architectural Latex System - MPI INT 5.3M:
 - .1 Prime Coat: Primer, galvanized, water based.
 - .2 Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.
 - .3 Topcoat: Latex, interior, high performance architectural, semi-gloss (MPI Gloss Level 5).
- .7 Gypsum Board Substrates:
 - .1 Latex System - MPI INT 9.2A:
 - .1 Primer: Sealer, latex, interior.
 - .2 Intermediate Coat: Latex, interior, matching topcoat.
 - .3 Topcoat: Latex, interior (gloss as selected by the Consultant).
- .8 Cotton or Canvas Insulation-Covering Substrates: Including pipe and duct coverings.
 - .1 Latex System - MPI INT 10.1A:
 - .1 Prime Coat: Primer sealer, latex, interior.
 - .2 Topcoat: Latex, interior, flat (MPI Gloss Level 1).

END OF SECTION

1 General

1.1 SUMMARY

- .1 Section includes surface preparation and repainting of Heritage Steel Windows, prepared as per Section 08 51 23.

1.2 REFERENCE STANDARDS

- .1 Environmental Choice Paints and Surface Coatings, Low VOC Product Listings Program (ECP):
 - .1 Paints and Surface Coatings, Low VOC Product Listings
- .2 The Master Painters Institute (MPI):
 - .1 New Surfaces: Architectural Painting Specification Manual.
- .3 The Society for Protective Coatings (SSPC):
 - .1 Coating Materials Guidelines
 - .2 Surface Preparation Guidelines
 - .3 Application, Inspection and Quality Control Guidelines

1.3 SUBMITTALS

- .1 Provide required information in accordance with Division 01.
- .2 Action Submittals: Provide the following submittals before starting any work of this Section:
 - .1 Product Data: Submit list of all painting materials used for the Work to the Consultant for review prior to ordering materials for each paint system indicated, including block fillers and primers.
 - .1 Material List: An inclusive list of required coating materials indicating each material and cross reference specific coating, finish system, and application; identify each material by manufacturer's catalogue number and general classification.
 - .2 Manufacturer's Information: Manufacturer's technical information, including label analysis and instructions for handling, storing, and applying each coating material.
 - .2 Samples: Provide stepped samples, defining each separate coat, including block fillers and primers using representative colours required for the project; label each sample for location and application, and as follows:
 - .1 Drawdown Samples: Provide three (3) drawdown samples, 4" x 9" (100mm x 250mm) in size, of each paint formula type and colour specified on applicable materials, for Consultant review prior to commencement of the work.
 - .2 Once drawdown samples are approved, paint one frame and one window in approved colours for Owner and Consultant's review. Do not proceed with painting until written approval is given.
 - .3 Informational Submittals: Provide the following submittals when requested by the Consultant:
 - .1 Certification: Submit certification reports for paint products indicating that they meet or exceed low VOC and coloured base requirements listed in this Section.

1.4 PROJECT CLOSEOUT SUBMISSIONS

- .1 Operation and Maintenance Data: Submit copies of paint manufacturer's written maintenance information for inclusion in the operations manual in accordance with Division 01, including specific warning of any maintenance practice or materials that may damage or disfigure the finished Work.
- .2 Maintenance Materials: Deliver maintenance materials to Owner in quantities indicated and in accordance with Division 01, that match products installed; packaged with protective covering for storage, and identified with labels describing contents and building location and as follows:
 - .1 Paints and Coatings: Minimum of 4-4L containers of field colours and 4-1 L containers of each accent colour, and all remnants.

1.5 QUALITY ASSURANCE

- .1 Comply with the recommended specifications and practices as described in Architectural Painting Specification manual as endorsed by the Ontario Painting Contractors Association.
- .2 Applicator Qualifications: A firm or individual experienced in applying paints and coatings similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in service performance, and as follows:
 - .1 Have a minimum of five (5) years of documented continuous experience in preparing and painting at heritage buildings.
 - .2 When requested provide a list of the last three comparable jobs including, name and location, specifying authority, start and completion dates and cost amount of the painting work.
 - .3 Although the companies above have been prequalified by the Consultants, this does not exclude any other company from bidding, provided that a CCA Document 11 Prequalification Statement is submitted with their bid.

1.6 MOCKUPS

- .1 Mockups: Apply mockups of each paint system indicated and each colour and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - .1 Consultant will select one surface to represent surfaces and conditions for application of each paint system.
 - .2 Final approval of colour selections will be based on mockups.
 - .1 If preliminary colour selections are not approved, apply additional mockups of additional colours selected by Consultant at no added cost to Owner.
 - .3 Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Consultant specifically approves such deviations in writing.
 - .4 Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver materials to site in their original containers with labels intact and store in a dry safe place.
- .2 Keep materials covered at all times and take all necessary precautions against fire.
- .3 Store materials in ventilated and heated space.

- .4 Protect adjacent masonry and other non-painted surfaces from paint splatters and damage during paint removal and repainting.
- .5 Ensure minimum fire and health hazards and provide fire extinguishers at all paint work areas and storage areas.

1.8 FIELD CONDITIONS

- .1 Do not paint when the temperature is 10 deg C or lower (and not after 3:00 pm at these temperatures), in misty, excessively humid or windy weather, in direct sunlight above 27 deg C or on damp surfaces.
- .2 For winter working, maintain 10 deg C in enclosure for minimum of three (3) days after painting to allow paint to set up.

1.9 WORKERS PROTECTION

- .1 Provide workers with personally issued and marked respiratory equipment acceptable to Labour Canada or Provincial Labour Department as suitable for the lead exposure in the work area. If organic vapour cartridges are used, provide sufficient filters and cartridges so that workers can install new filters and cartridges following disposal of used filters and cartridges before re-entering contaminated areas. No worker or authorized visitor may have facial hair which prevents proper contact between respirator face piece and skin.
- .2 Protective clothing and goggles: Workers shall wear personal protective equipment described in paint removal product data and authorities having jurisdiction.
- .3 Eating, drinking, chewing and smoking are not permitted in the work area.
- .4 Workers shall wash hands and face when leaving the work area.

1.10 INSTRUCTION AND TRAINING

- .1 Before commencing work, provide the Consultant satisfactory proof that every work has had instruction and training in the hazards of lead paint exposure, in personal hygiene and work practices, and in the use, cleaning and disposal, of respirators and protective clothing.
- .2 Instruction and training related to respirators shall include instruction and training related to:
 - .1 The limitations of the equipment
 - .2 The inspection and maintenance of the equipment
 - .3 The fitting of the equipment
 - .4 The disinfecting of the equipment

1.11 WARRANTY

- .1 Provide upon completion of the work, a Warranty Certificate, in the name of the Owner, stating that the work of this section was performed in accordance with these specifications and the MPI manual (latest edition), and is warranted against defects in material or installation, for a period of two (2) years from Date of Substantial Performance.

2 Products

2.1 MANUFACTURERS

- .1 Top of the line products from:
 - .1 ICI Devco Coatings
 - .2 Pratt and Lambert Ltd.
 - .3 Benjamin Moore and Co. Limited

- .4 Pittsburgh Industries Ltd.
- .5 Dumond Chemicals
- .6 Approved equivalent

2.2 MATERIALS

- .1 General: Apply materials in strict accordance with manufacturer's printed instructions. All paint, stains, thinners, cleaners and pigments shall conform to CGSB 1-GP-1, to 1-GP-189 where applicable and to CGSB 1-GP-72 specification selection on use basis.
- .2 Metal primer: Devguard 4360 Low VOC Universal Primer type: supplied by ICI Devoe Coatings, or approved equal.
- .3 Metal Alkyd paint: Devguard 4336 DTM Urethane Alkyd Semi-gloss Enamel type: supplied by ICI Devoe Coatings, or approved equal.
- .4 Paints, enamels, fillers, primers and varnishes shall be ready-mixed products of listed manufacturers. Use thinners and cleaners as recommended by the paint manufacturer.
 - .1 Colour for all final painted surfaces to be specified at a later date by Consultant.
- .5 Detergent: Anionic Detergent/Sodium Dodecyl Sulphate (SDS).
- .6 Mineral Spirits: Varsol or similar.
- .7 Mechanical Scrapers.
- .8 Maskin for Glass: Strippable type for window protection.

2.3 PAINT FORMULA

- .1 Existing exterior ferrous metal: 1 coat exterior grade metal alkyd primer where bare metal exposed; 2 coats exterior grade alkyd semi-gloss enamel.
- .2 Painting coats are intended to cover surfaces thoroughly; if in the Painter's opinion, the formula specified is inadequate to provide a first-class finished surface, review with Consultant before commencing work.

3 Execution

3.1 PREPARATION, GENERAL

- .1 Comply with manufacturer's written instructions and recommendations in "MPI Painting Specification Manual" applicable to substrates and paint systems indicated.
- .2 All surface preparation must be done using only hand tools such as scraper/brushes. Hand tools must have rounded edges to prevent unnecessary damage such as gouging and scratching to the adjacent surface or the surface being prepared.
- .3 Surfaces may be hand sanded as required.

3.2 PREPARATION, EXISTING STEEL WINDOWS

- .1 Remove all loose, flaking or blistered paint down to firm substrate using hand preparation only. The Consultant must approve the use of power tools or any abrasive preparation of the metal finishes.
- .2 Remove glazing and putty/sealants and clean rebate to provide clean surface for painting. Remove existing sealant at the junction between the masonry and window.
- .3 The Consultant must approve the use of power tools or any abrasive preparation of the metal finishes.
- .4 Review with Consultant the cleaned surface to determine requirements for 'Smart Strip', as required.
- .5 Clean all rusted areas with steel wool before priming and apply rust converter where full rust removal is not possible and on return faces of frames at hoppers.

- .6 Wash the steel window frame and sash with TSP to remove grease and dirt, and provide a lightly scoured surface for priming.
- .7 Apply primer immediately after stripping and wiping down, including glazing rebate.

3.3 FINISH APPLICATION

- .1 Mix paints thoroughly to a uniform consistency.
- .2 Mask, cover, protect, ventilate as required.
- .3 Do not finish prefinished materials.
- .4 Cut straight, neat and true junction lines.
- .5 Finish concealed edges with 2 coats of paint.
- .6 Post "wet paint" signs throughout freshly finished areas and remove when finishes are dry.
- .7 Sand lightly between coats of paint.
- .8 Apply coats in even uniform sheen, colour and texture, free of runs, brush marks, sags, crawls and other defects.
- .9 Any areas exhibiting incomplete or unsatisfactory coverage shall have the entire surface painted. Patching will not be acceptable.
- .10 Do not paint when the temperature is 10 deg C or lower on damp surfaces.
- .11 Let structural silicone cure for 1 week before applying final coat of paint.

3.4 CLEANING AND PROTECTION

- .1 At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- .2 After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- .3 Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Consultant, and leave in an undamaged condition.
- .4 At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

END OF SECTION

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END OF SECTION

PART 1 – GENERAL

1.1 WORK INCLUDED 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 Owner.
- .3 Prior to removing any piping, ensure the system is completely isolated and is not live.
- .4 Complete all work impacting existing Building Operations after hours only.

1.2 QUALIFICATIONS

- .1 Work of this section shall be executed by trades personnel having a minimum of five years' 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 Owner 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 Owner. 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 Owner. Remove, handle and transport such items to storage area designated by the Owner 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 Owner.

1.5 MAINTAINING TRAFFIC

- .1 Maintain and preserve Owner'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 Owner'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 OWNER'S OPERATIONS

- .1 There will be absolutely no interruptions to the Owner's 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 Owner's operations in and around the Building, 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 Owner's 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 Owner. Owner is responsible for removal of designated substances.

1.9 PROTECTION

- .1 Prevent movement, settlement or damage of adjacent structures, services, walks, paving, 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 Owner.
- .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 Owner at no cost to the Owner.

PART2 - PRODUCTS

Not applicable

PART3 – 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 Owner.

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:
 - 1 Appointment of official representatives in the project.
 - 2 Schedule of work.
 - 3 Delivery schedule for specified equipment.
 - 4 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:

- 1 Review of outstanding deficiencies.
- 2 Submission of maintenance manuals, warranties and as-built drawings.
- 3 Results of performance tests and described further in this section.
- 4 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, Specification and/or Contract Documents.
- .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.
- .3 Supplementary to definitions established are:
 1. "Concealed" means hidden from normal sight in furred spaces, shafts, ceiling spaces, walls, or partitions.
 2. "Exposed" means work normally visible, including work in equipment rooms, tunnels, and similar spaces.
 3. "Provide" (and all tenses) means supply and install for a complete, operational, and code-compliant system, including all devices, equipment, materials, accessories and/or components as specified or as otherwise required for a complete, operational, and code-compliant installation.
 4. "Install" (and all tenses) means secure in position, connect as specified, test, and verify.
 5. "Supply" means to supply all devices, equipment, materials, accessories and/or components to the responsible trade.
 6. "Remove" means to isolate, disconnect, disassemble, remove, and dispose of all devices, equipment, materials, accessories and/or components. Patch and make good all surfaces affected by the removal. Remove and dispose of all redundant material off site.
- .4 Where used, wordings such as "approved, to approval, as directed, permitted, permission, accepted, acceptance", shall mean: approved, directed, permitted, accepted, by authorized representative of the Owner.

1.4 INTERFERENCES

- .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. Install as high as possible, unless otherwise directed by the Consultant. 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.
 - .10 Prepare and submit complete interference drawings (in PDF format) to avoid and/or resolve conflict of trades and to coordinate the work of the Mechanical Division with that of all other Trades. Submission of interference drawings shall be done no later than 10 business days after the Project has officially begun. The cost of producing the interference drawings shall be included for in the Base Tender Price.
 - .11 Include costs (in the Base Tender Price) for the services of a third-party to 3D scan the entire area of construction upon completion of demolition. System shall be Matterport or similar. The

intent to is capture and submit to the Consultant a full 3D perspective of the space. This model shall be used to identify any potential conflicts ahead of installation and ordering of equipment to allow for quick resolution of site conflicts. 3D Model shall capture all architectural, structural, mechanical and electrical conditions on site and all such conditions shall be part of the model. The model, along with site verifications, shall be used as the basis for interference drawings.

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.
- .8 All new ductwork and piping shall be supported from a secondary structure site supplied and installed by the Contractor consisting of unistruct (or alternate as necessary) structure fastened to the building OWSJ structure. No supporting of piping, conduits ductwork or equipment from the roof deck will be permitted.

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 with 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 base the submitted Tender Price based on the base specified equipment; any approved alternate will only be entertained after Notification of Award.

1.12 BASE BID SPECIFIED EQUIPMENT & SUBSTITUTIONS WITH APPROVED ALTERNATES

- .1 Requests for substitutions will not be accepted prior to the Notification of Award. Substitutions will be considered:
 - 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.

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.
- .4 **The Mechanical Contractor is responsible for consolidating all Mechanical Shop Drawings and submitted them in no more than three (3) packages as per the following:**
 1. HVAC Equipment and Material.
 2. Plumbing Equipment, Fixtures and Material.
 3. Fire Protection Equipment, Fixtures and Material.

Individual shop drawings not consolidated will not be accepted.

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. Completion of the As-Built Drawings in AutoCAD will be the responsibility of the Mechanical Contractor at no extra cost to the project. The

Mechanical Contractor is responsible for updating all Architectural Plans based on the Architectural As-Builts while producing the Mechanical As-Builts

- .3 Put a digital copy of the as-built files (in AutoCAD 2017 format) 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 TRIAL 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 ENERGY CONSUMPTION

- .1 The Consultant may reject equipment submitted for approval on basis of performance or energy consumed or demanded.
- .2 All equipment installed on the project shall conform to the requirements outlined in ASHRAE 90.1 latest edition.

1.22 ELECTRIC MOTORS

- .1 Provide motors for mechanical equipment as specified.
- .2 If delivery of specified motor will delay delivery or installation of any equipment, install an acceptable motor for temporary use. Final acceptance of equipment will not occur until specified motor is installed.
- .3 All motors shall be manufactured and installed in accordance with CSA requirements.
- .4 Motor speed shall be 1750 rpm unless otherwise specified.
- .5 All motors shall be "T" frame CEMA Standard Design "B" with Class "B" insulation, 40°C ambient, standard drip-proof with a 1.15 service factor, or as otherwise specified. Motors in air stream or exposed shall be TEFC type.
- .6 Motors shall be of adequate size to operate associated equipment and drive mechanisms under all conditions of load and service and to bring equipment up to operating speed within 13 seconds without overloading, and be not less than the nameplate HP specified or indicated on the Drawings.
- .7 Integral HP motor sizes ½ HP and above shall be squirrel cage induction motors rated 575 volt or 230volt, 3 phase, 60 hertz, unless noted otherwise.
- .8 Fractional HP motors up to but not including ½ HP shall be rated 120 volt, single phase, 60 hertz and will be capacitor start, induction motors, with adequate thrust capacity when used with direct mounted equipment, and shall be provided with integral overload and overheating protection. Shaded pole starting devices will not be accepted.
- .9 Multi-speed motors and associated switching devices shall be circuited to protect the motor at each speed.
- .10 All motors, 1 HP and up shall comply with the Ontario Hydro EnerMark Motor Efficiency Level as tested either CSA 390 M 1985, or IEEE 112B, and be approved under the Canadian Electrical Safety Code.
- .11 All starter panels shall be lockable and supplied with locks.

.12 Special Requirements:

- .1 Where motor power requirements of equipment furnished deviate from power shown on plans, provide electrical service designed under the requirements of NFPA 70 without additional time or cost to the Owner.
 - .2 Assemblies of motors, starters, controls and interlocks on factory assembled and wired devices shall be in accordance with the requirements of this specification.
- .13 Wire and cable materials specified in the electrical division of the specifications shall be modified as follows:**
- .1 Wiring material located where temperatures can exceed 71 degrees C (160 degrees F) shall be stranded copper with Teflon FEP insulation with jacket. This includes wiring on the boilers.
 - .2 Other wiring at boilers and to control panels shall be NFPA 70 designation THWN.
 - .3 Provide shielded conductors or wiring in separate conduits for all instrumentation and control systems where recommended by manufacturer of equipment.
- .14 Select motor sizes so that the motors do not operate into the service factor at maximum required loads on the driven equipment. Motors on pumps shall be sized for non-overloading at all points on the pump performance curves.**
- .15 Motors utilized with variable frequency drives shall be rated "inverter-ready" per NEMA Standard, MG1, Part 31.4.4.2. Provide motor shaft grounding apparatus that will protect bearings from damage from stray currents.**
- .16 Insulation Resistance: Not less than one half meg-ohm between stator conductors and frame, to be determined at the time of final inspection.**

1.23 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.

1.24 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.

1.25 THERMOMETERS AND PRESSURE GAUGES

- .1 General:

- .1 Locate direct reading thermometers and gauges for reading from floor or platform.
- .2 Provide remote reading thermometers and gauges where direct reading instruments cannot be satisfactorily located.
- .3 Locate engraved lamacoid nameplate as specified in Section Identification, identifying medium adjacent to thermometers and gauges.

- .2 Thermometers:

- .1 Industrial, 9" adjustable angle cast aluminum case, CGSB standard CAN/CGSB-14.4-M88 red reading mercury, lens front tube, white scale black embossed figures, clear glass or acrylic window, tapered aluminum stem.
- .2 Scale shall be suitable for 2 times the temperature range of service. Scale shall be combined Celsius and Fahrenheit.
- .3 Standard of Acceptance: Weiss, Ashcroft, Terrice.

- .3 Pressure Gauges:

- .1 5" dial, solid front blow out back, fibreglass reinforced polypropylene case, phosphor bronze bourdon tube and brass 1/4" N.P.T. socket, bottom connection, stainless steel rotary type movement, gauge to be registered with the Provincial Boiler and Pressure Vessel Safety Branch with a registration number and conform to ANSI B40.1. Accuracy to be grade "A".
- .2 On pumps liquid filled gauges shall be utilized.
- .3 Standard of Acceptance: Weiss, Ashcroft, Terrice.
- .4 Provide bronze stop cock, bronze bar stock 1/4" N.P.T. bronze porous core pressure snubber for pulsating operation and diaphragm for corrosive service.

- .5 Use materials compatible with system requirements.
- .6 Gauges shall have combined kilopascal and psi scales.

1.26 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:
 - 1 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.
 - 2 For vertical runs use epoxy painted or plastic coated riser clamps.
 - 3 For supporting tube to strut: Provide epoxy painted pipe straps for copper tube or plastic inserted vibration isolation clamps.
- .9 Insulated Lines:
 - 1 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.

1.27 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.

1.28 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.

1.29 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.

1.30 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.

1.31 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.

1.32 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.

1.33 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.

1.34 DIELECTRIC COUPLINGS

- .1 Provide wherever pipes of dissimilar metals are joined.
- .2 Provide insulating unions for pipe sizes larger than 2" diam. and under; same for flanges of pipe sizes over 2" diam.
- .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.

1.35 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 min. 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

1.39 MAINTENANCE MANUALS

- .1 Provide minimum of one (1) hard (hard cover binder) and three (3) soft (USB's) 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.

1.40 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.

1.41 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.

1.42 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.

1.43 INTERFERENCE DRAWINGS

- .1 The Mechanical Contractor is responsible for preparing detailed interference drawings once demolition work has proceeded to the point where all existing conditions are visible. Provide 2D plan view and 3D isometric view layouts for all project areas depicting site measurements of all floor areas, height, width and depth of all existing structural elements, new architectural walls, ceilings and floor assemblies, new structural elements and new mechanical ductwork and piping plans. Prior to proceeding with new work, ensure that any concerns of interference are alleviated; consult with the Engineer as necessary. Provide written notice to the Engineer of any potential interferences of concerns with existing conditions based on the site findings after demolition.

1.44 MECHANICAL PROJECT COMPLETION

- .1 10 (ten) 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.

1.45 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.

1.46 PROJECT SPECIFIC NOTES

1. Obtain all approvals from public authorities having jurisdiction prior to commencing any work. Include, in the tender price, for all permit and inspection fees required by Authorities having Jurisdiction. Arrange for and attend all inspections required as per requirements of the Building Department or an Authority having Jurisdiction.
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 Mechanical 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, All Applicable Codes 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 Mechanical 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 Owner in detail prior to commencing any work.
7. The Mechanical Contractor must review and submit shop drawings for all materials to be supplied as a part of the Contract in conjunction with the General Contractor to the Architect and Mechanical Consultant prior to ordering. Order only upon receipt of approval. Order, supply and install as per all comments. The Shop Drawings must be reviewed and ensured for compliance with the Contract Documents by the Mechanical Contractor and General Contractor prior to submission; confirmation of review and confirmation that the submittal is in compliance with the Contract Documents is the responsibility of the Mechanical Contractor and General Contractor to include in writing with each Shop Drawing Submittal. Any non-conformance of the Submittal with the Contract Documents identified by the Mechanical Consultant will require a resubmission of the Shop Drawing Submittal by the Mechanical Contractor prior to review. The Mechanical Contractor shall bear all costs of any review by the Mechanical Consultant

beyond the Original Shop Drawing Submission at a cost of \$250.00 CAD + HST per resubmission.

8. All access panel ratings shall match that of the surface in which it is being installed. All access panels requiring supply/install as a part of the project work shall be included for in the Base Tender Price.
9. 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.
10. 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.
11. All work shall be done with minimum possible interruption to the existing building systems and in the time schedule permitted by the Owner. Consult with the project supervisor prior to pricing. Complete the project within the allocated schedule.
12. Unless otherwise explicitly stated in writing in the Contract Documents, all materials, labour, scope and descriptions of work described in the Contract Documents is the responsibility of the Mechanical Contractor to supply and install as a part of the Base Tender Price. No materials and/or labour is to be completed under the Project Allowances unless explicitly noted as such in the Contract Documents.
13. All demolition and new work shall be completed in strict accordance with the Contract Documents with no deviations unless instructed by the Mechanical Consultant in writing prior to execution of the work. The Mechanical Consultant is not responsible, nor required, to accept any work (regardless of its compliance with code) not completed in accordance with the Contract Documents. The Mechanical Contractor will be responsible, at his/her cost, of furnishing a Sealed Letter from a Professional Engineer licensed in the Province of Ontario to accept and assume responsibility for all work not completed in accordance with the Contract Documents. The cost of obtaining this letter and the retaining of the Engineer, including all associated inspection charges, is the sole responsibility of the Contractor.
14. Unless otherwise noted, all devices, equipment, material, supplies, etc. shown on the drawings or otherwise required for a fully operational system as described/illustrated on the Drawings shall be supplied and installed under this Project. It shall not be assumed that any of the devices, equipment, material, supplies, etc. shown on the Drawings are to be provided (in part or in whole) by any other Party.
15. The Mechanical Contractor is responsible for taking pictures of work completed at the end of each week for record purposes. Pictures shall be taken throughout the work space and shall demonstrate all work completed that past week. When requested, share the pictures with the Mechanical Consultant. Pictures may be used for review of the monthly draws, conflicts identified on site, etc.

1.47 CLOSEOUT DOCUMENTS

- .1 Coordinate with the General Contractor to submit a comprehensive Closeout Document Package incorporating documents from all trades in one consolidated package. Closeout Documents shall consist of one (1) 3-ring binder hard copy and 3 USBs/CDs. The Mechanical Section of the Closeout Documents shall consist of the following:
 - (a) Mechanical Contractor Warranty Letter, signed and dated. Warranty shall be for a period of twelve (12) months starting on the Date of Substantial Completion.
 - (b) Project Shop Drawings, in consecutive order of the Consultant's number scheme.
 - (c) O&M Manuals for all equipment supplied on the project.
 - (d) AHJ Inspection Certificates & All Test Certificates.
 - (e) Fire Damper installation letter from the Sheet Metal Contractor stating 'All fire dampers and fire flaps have been installed in strict accordance with the Manufacturer's recommendations and requirements as well as Code Requirements.'
 - (f) Start-Up Reports for all Equipment.
 - (g) Red-Line As-Builts and CAD As-Builts (both completed by the Mechanical Contractor).

1.48 PROJECT PROGRESS THROUGHOUT CONSTRUCTION

- .1 The Mechanical Contractor is responsible for taking photos of all existing conditions and mechanical systems on site being affected by the Project at the onset of construction. All photos shall be date stamped.
- .2 The Mechanical Contractor is responsible for taking photos of the project's progress throughout the construction site every two weeks. All progress photos shall be shared and sent electronically to the Mechanical Consultant on the 15th and 30th of every month. Photos are meant to illustrate the progress of the project and correction of any deficiencies identified in routine site reviews and review of progress photos.
- .3 The Mechanical Consultant will, from time-to-time, visit the Project Site and issue a Field Review Report. The Mechanical Contractor is obligated to rectify any deficiency identified within 7 working days of receipt of the Report. The Mechanical Contractor is responsible for signing the Field Review Report upon 72 hours of the report being sent to the General Contractor, acknowledging receipt of the report. The Mechanical Contractor must take photos of all remedial work within 7 working days of receipt of the Report and distribute to the Consultant.

END OF SECTION

1 GENERAL

1.1 Conform to Sections of Division 1 as applicable.

1.1.1 Conform to Section 20 05 11 Mechanical General Requirements as applicable.

1.2 RELATED SECTIONS

1.2.1 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

1.4.1 **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.

2 PRODUCTS

2.1 MATERIALS

2.1.1 Welding Studs

-Graham

-Omark

-Nelson

2.1.2 Concrete Inserts and Anchors

-Readhead by ITW

-SSS by Star

-Parabolt by USM

- Kwik-Bolt by Hilti

2.1.3 Beam Clamps

- Grinnell
- Myatt
- Hilti

2.1.4 Concrete Grout:

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

2.1.5 Pipe Hangers:

- Grinnell
- Myatt
- Hilti

2.1.6 Zinc-Rich Paint: Galvafroid by W.R. Meadows.

2.1.7 Primer: CAN/CGSB-1.40-M.

3 EXECUTION

3.1 GENERAL CONSTRUCTION REQUIREMENTS

3.1.1 Attachment to Building Construction

- 3.1.1.1 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") dia, use steel clips or brackets, secured to building steel by welding or bolting method of attachment as approved by Consultant.
- 3.1.1.2 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.
- 3.1.1.3 Support rods for any suspended item must not be attached to or extended through steel pan type roofs or through concrete slab roofs.
- 3.1.1.4 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.
- 3.1.1.5 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.

- 3.1.1.6 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 members 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

3.2.1 General

- 3.2.1.1 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.
- 3.2.1.2 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

3.3.1 General

- 3.3.1.1 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.
- 3.3.1.2 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.
- 3.3.1.3 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.

3.3.1.4 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.

3.3.1.5 Do not hang any pipe from another pipe unless specifically indicated on Drawings.

3.3.2 Saddles and Roller Supports

3.3.2.1 Provide saddles at roller supports for piping carrying liquids at 10.5 deg C (51 deg F) or higher. Weld saddles to black or galvanized steel piping. Refinish galvanized surfaces destroyed by welding with zinc rich paint.

3.3.3 Hangers

3.3.3.1 For insulated piping up to NPS 4 carrying liquids at temperatures 10.5 deg C (51 deg F) and higher, use standard weight clevis hangers with level adjustment and locknut.

3.3.3.2 For insulated lines of NPS 4 dia and larger carrying liquids at temperatures 10.5 deg C (51 deg 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.

3.3.3.3 For insulated piping carrying liquids at temperature of 10 deg C (50 deg F) or less, use elongated clevis type hangers, with clevis of sufficient width to fit over insulation bearing plate.

3.3.3.4 Provide insulation protection bearing plates at hangers and supports for piping carrying liquids at temperature of 10 deg C (50 deg F) or less. Install temporary spacers between plate and pipe equal to thickness of insulation specified. (Refer to Section 15081, Piping Insulation).

3.3.3.5 Bearing plates may be either shop fabricated, or manufactured plates of size required to properly fit outside diameter of pipe insulation.

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

Pipe Size (NPS)	P	Length of plate mm (in)	Thickness of Plate mm (ga)
1/2 thr. 1-1/2		130 (5)	1.2 (18)
2		150 (6)	.52 (16)
2-1/2		200 (8)	1.52 (16)
3		230 (9)	1.52 (16)
4 and up		250 (10)	1.52 (16)

3.3.3.7 Form bearing plates to outside diameter of adjoining pipe insulation and extend plate up to horizontal centre line of pipe.

- 3.3.3.8 For non-insulated piping use clevis type of wrought steel construction with adjustable rod, level locking feature and backnuts.
- 3.3.3.9 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.
- 3.3.3.10 Attach hanger rods to building structure by means of malleable iron beam clamps, concrete inserts, and/or approved anchors as hereinbefore specified.

3.3.4 **Hanger Spacing**

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

<u>Pipe Size (NPS)</u>	<u>Distance m (ft)</u>	<u>Dia. of Rod mm (in)</u>
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)

- 3.3.4.3 Provide additional hangers in locations where there are concentrated loads such as valves, specialties and other such items.
- 3.3.4.4 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.
- 3.3.4.5 For horizontal runs of piping fabricated of PVC, use hanger spacing as recommended by manufacturer.

3.3.5 **Vertical Piping Supports**

- 3.3.5.1 Support vertical plumbing and drainage piping as required by OBC, unless more stringent requirements are specified herein.
- 3.3.5.2 Support cast iron soil pipe at every floor and other piping at every other floor unless otherwise

required by expansion conditions or otherwise specified.

- 3.3.5.3 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.
- 3.3.5.4 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.
- 3.3.5.5 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.

3.3.6 **Anchors and Guides**

- 3.3.6.1 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.
- 3.3.6.2 Acceptable Materials: Grinnell #256 or Myatt.

3.4 **MISCELLANEOUS STEEL**

3.4.1 **General**

- 3.4.1.1 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.
- 3.4.1.2 Submit detailed shop drawings to structural engineer for review before commencing fabrication.

3.4.2 **Materials and Fabrication**

- 3.4.2.1 Conform to CAN/CSA-S16 for materials, design of details and execution of work.
- 3.4.2.2 Conform to CAN/CSA-G40.20/G40.21, grade 300W for structural shapes, plates, and other similar items.
- 3.4.2.3 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.
- 3.4.2.4 Conform to latest issue of following CSA Specifications.
 - CSA W47.1, for qualification of welders
 - CSA W48.1-M, for electrodes (only coated rods allowed)
 - CSA W59-M, for design of connections and workmanship

CSA W117.2, for safety

3.4.3 Painting and Cleaning

3.4.3.1 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.

3.4.3.2 Clean steel by scraping, wire brushing or other effective means to remove base scale, rust, oil, dirt or other foreign matter.

3.4.3.3 Apply 1 coat of zinc chromate iron oxide primer, conforming to CAN/CGSB-1.40-M to miscellaneous steel.

3.4.3.4 In field, touch up bolt heads and nuts, previously unpainted connections and surfaces damaged during erection with primer as herein before specified.

3.4.3.5 Give 2 coats of primer to surfaces which will be inaccessible after erection.

3.4.3.6 Remove foreign matter from steelwork on completion of installation.

3.4.4 With exception of prime painting of miscellaneous steel or any other specific requirements as specified above or under respective Sections of the Mechanical Contractor, or equipment otherwise factory painted, painting will be provided under Division 9, Finishes.

3.5 CONCRETE INSERTS

3.5.1 Install inserts required for attachment of hangers, either for suspension of piping or equipment.

3.5.2 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.

3.6 SEALED (STAMPED) SHOP DRAWINGS FOR PIPE SUPPORT SYSTEM

3.6.1 The Mechanical Contractor, as part of the Base Tender Price, is responsible for retaining the services of a Professional Engineer licensed in the Province of Ontario to prepared detailed support drawings (sealed by the Professional Engineer), with the drawings outlining the following information:

- .1 Floor Plans depicting support types being proposed in each area of work for each type of piping system (plumbing, drainage, heating, etc.). The support types are to be reviewed and approved by the Engineer for use in this application.
- .2 Floor Plans depicting attachment method of attaching the supports to the Building Structures.
- .3 Floor Plans depicting the maximum span of the supports in each area of work.

The Professional Engineer is responsible for overseeing the construction and supply/installation of the supports and provide a Letter of Completion at the end of the work confirming that all work has been completed in accordance with the Engineered

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ROOF REPLACEMENT

PIPE HANGERS AND SUPPORTS

20 05 31-8

Plans.

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 of Section 20 05 11 Mechanical General Requirements.

1.2 SHOP DRAWINGS

- 1.2.1 Submit shop drawings in accordance with 20 05 11 Mechanical General Requirements.
- 1.2.2 Submit for approval, manufacturer's catalogue literature related to installation and fabrication.

PART 2 - PRODUCTS

2.1 GENERAL

- 2.1.1 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.
- 2.1.2 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" (300mm x 300mm)
- 2.1.3 All doors shall open 180 degrees and have rounded safety corners
- 2.1.4 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 Mechanical Contractor shall be responsible for reviewing the drawings and providing fire rated access doors where they are required.
- 2.1.5 Where body access is possible the access doors shall be provided with a releasing mechanism on both sides of the door.

2.1.6 Provide access panels in all ductwork where fire dampers or combination fire/smoke dampers are shown on the Drawings to allow for inspection of the dampers.

2.1.7 Provide access panels at all balancing damper locations to allow access to the damper in the future.

2.2 RECESSED ACCESS DOOR FOR DRYWALL APPLICATIONS

2.2.1 Door shall be 16 gauge steel. Mounting frame shall be 14 gauge galvanized steel.

2.2.2 Door shall be provided with a 25 mm (1") recess or 14mm (5/8") to suit the thickness of the drywall ceiling.

2.2.3 The frame shall be provided with a galvanized steel drywall taping bead on all sides.

2.2.4 The hinge shall be a concealed pivoting rod.

2.2.5 The latch shall be a flush to the surface, screwdriver operated cam latch.

2.2.6 The steel finish shall be 5 stage iron phosphate preparation with prime coat of grey baked enamel.

2.2.7 Standard of Acceptance: Acudor DW-5015, Mifab, Zurn, Watrous, Williams Brothers

2.3 RECESSED ACCESS DOOR FOR PLASTER APPLICATIONS

2.3.1 Door shall be 16 gauge steel. Mounting frame shall be 14 gauge galvanized steel.

2.3.2 Door shall be provided with a 14mm (5/8") recess and shall be lined with self furring galvanized lath.

2.3.3 The frame shall be provided an expansion casing bead with 75 mm (3") wide galvanized lath, recessed 20mm (3/4") to receive plaster.

2.3.4 The hinge shall be a concealed pivoting rod.

2.3.5 The latch shall be a flush to the surface, screwdriver operated cam latch.

2.3.6 The steel finish shall be 5 stage iron phosphate preparation with prime coat of grey baked enamel.

2.3.7 Standard of Acceptance: Acudor AP-5010, Mifab, Zurn, Watrous, Williams Brothers

2.4 FLUSH ACCESS DOORS FOR TILED WALL APPLICATIONS

2.4.1 For doors 400mm x 400mm (16" x 16") and smaller the door shall be 16 gauge with 18 gauge mounting frame.

2.4.2 For doors over 400mm x 400mm (16" x 16") the door shall be 14 gauge with 16 gauge mounting frame.

- 2.4.3 Door shall be flush to frame with rounded safety corners.
- 2.4.4 The frame shall be one piece welded to the mounting frame.
- 2.4.5 The hinge shall be a continuous concealed hinge.
- 2.4.6 The latch shall be a stainless steel screwdriver cam latch.
- 2.4.7 The finish shall be type 304 #4 satin polish stainless steel.
- 2.4.8 Standard of Acceptance: Acudor UF-5000, Mifab, Zurn, Watrous, Williams Brothers

2.5 FIRE RATED ACCESS DOOR

- 2.5.1 Door shall be constructed of 20 gauge steel with a 16 gauge mounting frame.
- 2.5.2 Door shall be filled with 50mm (2”) thick fire rated insulation.
- 2.5.3 The door frame shall be provided with a 25mm (1”) wide flange and mounting frame to have anchor straps.
- 2.5.4 The hinge shall be concealed and shall be provided with a spring closer.
- 2.5.5 Door shall be UL/ULC rated for 1 ½ hour “B” label with 250 degree F temp rise in 30 minutes.
- 2.5.6 The latch shall be a universal self latching bolt, operated by either a knurled knob.
- 2.5.7 The steel finish shall be 5 stage iron phosphate prepared with a prime coat of grey baked enamel.
- 2.5.8 For drywall applications provide a galvanized steel drywall taping bead flange.
- 2.5.9 Standard of Acceptance: Acudor FB-5050, Mifab, Zurn, Watrous, Williams Brothers

2.6 FIRE RATED ACCESS DOOR WITH INSIDE LATCH RELEASE

- 2.6.1 Door shall be constructed of 16 gauge steel with a 16 gauge mounting frame.
- 2.6.2 Door shall be flush to frame with reinforced edges.
- 2.6.3 The door frame shall be provided with a 25 mm (1”) wide flange and shall be provided with anchor straps.
- 2.6.4 The hinge shall be concealed and shall be provided with a spring closer.
- 2.6.5 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.
- 2.6.6 The latch shall be a universal self latching bolt, operated by either a knurled knob.

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

2.7 VALVE BOX – SURFACE MOUNT

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

2.8 VALVE BOX – RECESSED

- 2.8.1 Door shall be stainless steel in public areas and steel in mechanical rooms and service areas.
- 2.8.2 Door and box shall be 16 gauge steel.
- 2.8.3 The door shall be flush to the frame with rounded safety corners.
- 2.8.4 The box shall be fully enclosed, completely attached to the frame.
- 2.8.5 The hinge shall be a continuous concealed hinge.
- 2.8.6 The door shall be provided with a cylinder lock and key.
- 2.8.7 For steel doors the finish shall be 5 stage iron phosphate preparation with prime coat of grey baked enamel.
- 2.8.8 Stainless steel doors shall be #4 satin finish.
- 2.8.9 Standard of Acceptance: Acudor ARVB, Mifab, Zurn, Watrous, Williams Brothers

PART 3 - EXECUTION

3.1 INSTALLATION

- 3.1.1 On some drawings, access door locations have been indicated for coordination. The drawings do not show all access doors required.
- 3.1.2 The Mechanical 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.
- 3.1.3 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.
- 3.1.4 The Mechanical Contractor shall be responsible for providing the access doors required to be installed in ductwork. Refer to other sections for requirements.

END OF SECTION

1 GENERAL

1.1 GENERAL

- .1 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.

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 inches (round, square, or rectangle) with smooth edges. Thickness 19 gauge (.040 inches) minimum.
- .2 Beaded Chain: Size 6, brass or aluminium, 4 1/2 inches 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 25 20 11.

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 colored top and bottom layers of the material are thermoset with a contrasting color core. Minimum thickness 0.062 inch.
- .5 Size: min. 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 inch from top, 1/8 inch from bottom, 1/16 inch 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 Colors associated with specific words such as "Danger," "Warning," "Caution," or "Notice" shall conform to ANSI Z35.1.

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-inch 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 color 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" diam. 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

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 20 05 11 Mechanical General Requirements.

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 in accordance with Section 20 05 11 shop drawings and product data
- .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

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 degrees F, suitable for temperatures from minus 20 degrees F to 450 degrees 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 domestic hot water and recirculation piping.
- .3 All hot water heating piping.
- .4 All condensate piping.
- .5 All horizontal and vertical sections of storm drainage.
- .6 All horizontal and vertical sections of sanitary drainage.

2.3 INSULATION THICKNESS

- .1 Hot water heating, all piping sizes: 1"
- .2 Domestic hot water less than 2" 1"
- .3 Domestic hot water larger than 2" 1½"
- .4 Domestic cold water, all piping sizes: 1"
- .5 Condensate, all piping sizes: 1"
- .6 Storm & Sanitary Piping, all piping sizes: 1"

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 inches 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: 1/2 inch 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 pounds/cubic foot.

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 degrees C (60 degrees 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 inches).
- .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 inch 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 degrees 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 ft 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 Testing, adjusting, and balancing (TAB) of heating, ventilating and air conditioning (HVAC) 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 CAABC: Canadian Associated Air Balance Council.
- .3 Hydronic Systems: Includes heating hot water, domestic hot water recirculation, and glycol water systems, as applicable to the project.
- .4 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.
- .5 Air distribution systems: Includes all grilles, diffusers, terminal units (by pass/VAV).
- .6 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:
 - .1 Air Filter resistance during tests, artificially imposed if necessary, shall be at least 90 percent of final values for pre-filters and after-filters.
 - .2 Flow rate tolerance:
 - .1 Air handling unit and all other fans, cubic meters/min (cubic feet per minute): Minus 5% to plus 10%.
 - .2 Grilles, diffusers and air terminal units (maximum values): -5% to +10%.
 - .3 Exhaust hoods/cabinets: 0 % to + 10 %.
 - .4 Minimum outside air: 0 % to +10 %.
 - .5 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 %.
 - .6 Heating hot water pumps and hot water coils: -5 % to +5 %.
 - .7 Heating hot water convectors, forced flow heaters, unit heaters: -5 % to +5 %.
 - .8 Chilled water and condenser water pumps: -5%t to +5 %.
 - .9 Chilled water coils: -5 % to +5 %.

1.4 SUBMITTALS

- .1 Submit Following for Review to the Consultant:
 - .1 Systems inspection report on equipment and installation for conformance with design.
 - .2 Duct Air Leakage Test Report, demonstrating compliance with all ASHRAE 90.1 ductwork sealing requirements.
 - .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

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.

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 are installed. Provide a report to the Consultant.

- .4 Reports: Follow check list format developed by CAABC 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.

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:

- .1 Wet bulb.
- .2 Dry bulb.

.6 Cross sectional area.

.7 Fans RPM

.8 Electrical power:

- .1 Voltage
- .2 Current draw.

.7 Locations of Measurements

.1 Inlet and outlet of each

- .1 Fan.
- .2 Coil.
- .3 Filter.
- .4 Balancing damper.
- .5 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 Pump.
- .2 Coil.
- .3 Boiler.
- .4 Balancing valve.
- .5 Automatic control valves
- .6 Chiller.

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 CONDUCTING THE TESTING AND BALANCING PROCEDURE

- .1 Part 1 - The Mechanical Contractor is responsible for conducting testing and balancing of all new mechanical systems and equipment as specified on the Drawings, Specifications and/or other Contract Documents and providing the comprehensive report to the Engineer.
- .2 Part 2 - The Contractor shall include for a repeat of all testing procedures to be conducted in witness of the Consultant on site after the completion of Part 1 (see .1). This is intended to demonstrate the operating characteristics of all mechanical systems once balancing has been complete and once the Engineer has had a chance to review the comprehensive report. The TAB Agency shall include for additional balancing during this Part as advise by the Engineer on site.

3.10 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

- 1.1.1 This section of the specification shall be read in conjunction with and shall be governed by the requirements outlined in Section 20 05 11 Mechanical General Requirements.
- 1.1.2 All valves must have a valid CRN Number. Statutory declaration must be provided on request.

1.2 REFERENCE STANDARDS

- 1.2.1 Do the work in accordance with the Ontario Building Code Plumbing Code and local authority having jurisdiction.
- 1.2.2 ASTM B62-09 Specifications for Composition Bronze or Ounce Metal Castings.
- 1.2.3 ANSI/ASME B16.5-2005 Pipe Flanges and Flanged Fittings.
- 1.2.4 ANSI/ASME B16.11-2009 Forged Fittings, Socket Welding.
- 1.2.5 ASTM B88-03 Specifications for Seamless Copper Water Tube.
- 1.2.6 CSA B242-M80 Groove and Shoulder Type Mechanical Pipe Couplings.
- 1.2.7 MSS SP 67-2002 Butterfly Valves
- 1.2.8 MSS SP 70-2006 Cast Iron Gate, Globe, Angle and Check Valves
- 1.2.9 MSS SP 71-2005 Cast Iron Swing Check Valves Flanged and Threaded Ends.
- 1.2.10 MSS SP 80-2003 Bronze Gate, Globe, Angle and Check Valves

1.3 SHOP DRAWINGS

- 1.3.1 Submit product data in accordance with Section 20 05 11.
- 1.3.2 Indicate following: valves.
- 1.3.3 Provide shop drawings for all grooved end components.
- 1.3.4 All grooved end components shall be provided by one manufacturer.

PART 2 - PRODUCTS

2.1 PIPING

- 2.1.1 Domestic hot, cold and recirc tubing, within building.
- .1 Above ground: copper tube, hard drawn, type L: to ASTM B88M.

.2 Buried: copper tube, soft annealed, type K: to ASTM B88M.

2.1.2 All piping shall have certification markings for compliance with ASTM B88.

2.2 FITTINGS

2.2.1 Brass or bronze flanges and flanged fittings: to ANSI B16.24.

2.2.2 Brass or bronze threaded fittings: to ANSI B16.15.

2.2.3 Cast bronze to ANSI B16.18- 1984 or wrought copper and bronze to ANSI B16.22.

2.3 JOINTS

2.3.1 Rubber gaskets, 0.063" (1.6 mm) thick: to AWWA C111 -95.

2.3.2 Bolts, nuts, hex head and washers: to ASTM A307-92a-07b, heavy series.

2.3.3 For installation of the potable water system only lead free solder shall be used in accordance with Ontario Building Code Standards.

2.3.4 Solder, tin antimony, 95:5: to ASTM B32.

2.4 GROOVED COPPER METHOD

2.4.1 Application

.1 Grooved piping system may be used in lieu of flanged or sweated copper in size 2" (50 mm) and larger. Couplings shall be designed with angle bolt pads to provide a rigid joint, complete with EPDM flush seal gasket suitable for temperatures from -30°F to 230°F (-34°C to 110°C).

2.4.2 Fittings

.1 Housing: ductile iron conforming to ASTM-A536, Grade 65-45-12

.2 Coating: rust inhibiting lead free paint

.3 Bolts and nuts: heat treated, zinc electroplated carbon steel oval-neck track bolts conforming to ASTM A-183 and zinc electroplated carbon steel heavy hex nuts conforming to ASTM A-563,

.4 Hinge Pin: carbon steel

.5 Gaskets: in accordance with ASTM D-2000. Grade E: EPDM rated for service between -30°F to 230°F (-34°C to 110°C).

.6 Copper Fittings: Copper per ASTM B-75 and ASTM B-584.

- .7 When connecting dissimilar metals in liquid systems from grooved end steel (IPS) to Copper (CTS) provide a dielectric waterway between the two materials.

2.4.3 Standard of Acceptance: Victaulic, Anvil

2.5 GROOVED END BUTTERFLY VALVES

- .1 NPS 2 1/2 and over, grooved ends:
 - .1 Class 300, bubble tight shut off to 300 psi (2065 KPa) bronze body.
 - .2 Operators:
 - .1 NPS 4 and under, lever handle
 - .2 NPS 6 and over, gear operated.
 - .3 Standard of Acceptance: Victaulic Series 608, Grinnell. Mueller

2.6 GATE VALVES

2.6.1 Gate valves shall only be utilized where specifically noted on the drawings. For all other shut off valve applications utilize ball valves for 2" (50 mm) or smaller and butterfly valves for 2.6" (65 mm) and larger.

2.6.2 NPS 2 and under, soldered:

- .1 Non-rising stem to MSS SP-80, Class 125, 860 kPa, bronze body, screw-in or bolted bonnet.
- .2 Standard of Acceptance: Jenkins, Crane, Toyo 281, Kitz 41, Grinnell

2.6.3 NPS 2 and under, screwed:

- .1 Rising stem: to MSS SP-80, class 125, 860 kPa, bronze body, solid wedge disc.
- .2 Standard of Acceptance: Jenkins, Crane, Toyo 293, Kitz 24, Grinnell

2.6.4 NPS 2-1/2 and over, in mechanical rooms, flanged:

- .1 Rising stem: to MSS SP-70, class 125, 860 kPa, FF flange, cast-iron body, OS&Y bronze trim.
- .2 Standard of Acceptance: Jenkins, Crane, Toyo 421, Kitz 72, Grinnell

2.6.5 NPS 2-1/2 and over, other than mechanical rooms, flanged:

- .1 Non-rising stem: to MSS SP-70, class 125, 860 kPa, FF flange, cast-iron body, bronze trim, bolted bonnet.
- .2 Standard of Acceptance: Jenkins, Crane, Toyo 415, Kitz 75, Grinnell

2.7 GLOBE VALVES

2.7.1 NPS 2 and under, balancing, soldered:

- .1 To MSS SP-80, Class 125, 860 kPa, bronze body, renewable composition disc, screwed over bonnet.
- .2 Lockshield handles: as indicated.
- .3 Standard of Acceptance: Jenkins, Crane, Toyo 222, Kitz 10, Grinnell

2.7.2 NPS 2 and under, balancing, screwed:

- .1 To MSS SP-80, class 125, 860 kPa, bronze body, screwed over bonnet, renewable composition disc.
- .2 Lockshield handles: as indicated.
- .3 Standard of Acceptance: Jenkins, Crane, Toyo 220, Kitz 09, Grinnell

2.8 SWING CHECK VALVES

2.8.1 NPS 2 and under, soldered:

- .1 To MSS SP-80, class 125, 860 kPa, bronze body, bronze swing disc, screw in cap, regrindable seat.
- .2 Standard of Acceptance: Jenkins, Crane, Toyo 237, Kitz 23, Grinnell

2.8.2 NPS 2 and under, screwed:

- .1 To MSS SP-80, class 125, 860 kPa, bronze body, bronze swing disc, screw in cap, regrindable seat.
- .2 Standard of Acceptance: Jenkins, Crane, Toyo 236, Kitz 22, Grinnell

2.8.3 NPS 2-1/2 and over, flanged:

- .1 To MSS SP-70, class 125, 860 kPa, cast iron body, FF flange, regrind renewable seat, bronze disc, bolted cap.
- .2 Standard of Acceptance: Jenkins, Crane, Toyo 435, Kitz 78, Grinnell

2.9 BALL VALVES

2.9.1 NPS 2 and under, branch isolators, screwed:

- .1 600 WOG, bronze body, solid chrome plated bronze ball, with Teflon seal.
- .2 Ball valves shall have full port opening.

- .3 Standard of Acceptance: Jenkins, Crane, Toyo 5044A, Kitz 58, Grinnell, Apollo.

2.10 AUTOMATIC CIRCUIT BALANCING VALVES

- 2.10.1 Circuit balancing valves shall be of the automatic variety. Manual circuit balancing valves will not be accepted.

- 2.10.2 Circuit Balancing Valves are required on the domestic hot water recirculation system.

- 2.10.3 Provide the following sizes:

- .1 Provide 0.032 l/s (0.5 gpm) for 12 mm pipe size.
- .2 Provide 0.063 l/s (1.0 gpm) for 20 mm pipe size.

- 2.10.4 Product Warranty and Performance Guarantee

- .1 Valves shall be warranted by the manufacturer to be free of defects in material and workmanship for a period of five years.
- .2 Valves shall control flow to within plus/minus 5 percent of design over an operating differential range of at least 14 times the minimum required for control. Four operating pressure ranges shall be available with the minimum range requiring less than 3 psid to actuate the mechanism.
- .3 The valve flow curve shall be smooth over its entire nominal control range. Gaps, bumps and dips in flow curves shall not be acceptable.

- 2.10.5 Shop Drawing Submission

- .1 The Balancing Valve Manufacturer shall submit a complete list of balancing valves, their location and their performance.
- .2 The Balancing Valve Manufacturer shall mark up a set of full size plans showing the location of each balancing valve and assign an appropriate identification tag for the balancing valve.
- .3 The Balancing Valve Manufacturer shall submit these drawings for the Consultant to review, incorporate any comments from the Consultant and then submit copies of this drawing to the Mechanical Contractor, Mechanical Consultant, Architect and Construction Manager.
- .4 All balancing valves shall be shipped to site with this tag number firmly attached to the valve and the full size drawings shall be utilized to identify the location where they are to be installed.

- 2.10.6 Valve Flow Control Cartridge (Typical for all valves)

- .1 The non adjustable flow control cartridge shall be 100% stainless steel. Parts made of

soft metals such as brass with only a coating of hard metal such as nickel shall not be allowed. Rubber based materials whose properties change with temperature and pressure shall not be allowed.

- .2 The cartridges shall have segmented ports through which water can pass, rather than a continuous large port, to eliminate noise and full travel linear coil spring.
- .3 The cartridge movement shall result in a shearing action that will dislodge or shear any particle that may tend to get stuck in a port.
- .4 Cartridge shall be removable from the housing and shall be held in place in the housing without adhesive.
- .5 All flow control cartridges shall be warranted by the manufacturer for five years from the date of sale.

2.10.7 Sizes 40mm and smaller

- .1 Valves shall have forged brass bodies and stainless steel cartridge assembly rated for a minimum of 230 psi/250F.

2.10.8 Valve end connections shall be either female sweat or FPT.

2.10.9 Valves shall be provided with two pressure/temperature taps.

2.10.10 Valves shall be provided with a union tailpiece and built in isolation valve.

2.10.11 The body design shall allow for inspection or removal of the cartridge without disturbing piping connections.

2.10.12 The valve shall come fully assembled and shall be permanently marked to show direction of flow and shall have a body tag to indicated flow rate and model number.

2.10.13 Provide a shut off valve upstream of the valve to allow the system to be shut off and the balancing valve to be removed without shutting down the entire heating system.

2.10.14 Standard of Acceptance: Griswold Isolator R valve.

PART 3 - EXECUTION

3.1 INCOMING WATER MAIN

3.1.1 The products utilized to build the meter assembly shall be in accordance with the Local Authorities requirements.

3.1.2 Where the Local Authority requires that this assembly use gate valves with all soldered connections the Mechanical Contractor shall solder all of the joints and use gate valves as specified above.

- 3.1.3 When the local authority does not allow the use of grooved fittings the use of grooved fittings shall only begin after the bypass around the meter is connected to the assembly.

3.2 INSTALLATION

- 3.2.1 Connect to fixtures and equipment in accordance with manufacturers instructions.
- 3.2.2 Install tubing close to building structure to minimize furring, conserve headroom and space. Group exposed piping and run parallel to walls.
- 3.2.3 Cut square, ream and clean tubing and tube ends, clean recesses of fittings and assemble without binding.
- 3.2.4 Lay buried tubing in accordance with AWWA Class "B" bedding.
- 3.2.5 Isolate equipment, fixtures and branches with ball valves.
- 3.2.6 New or repaired potable water systems shall be purged of deleterious matter and disinfected prior to utilization. The method to be followed shall be that prescribed by the health authority having jurisdiction or in the absence of a prescribed method as follows:
- .1 The pipe system shall be flushed with clean, potable water until dirty water does not appear at the points of outlet.
 - .2 The system or part thereof shall be filled with a water/chlorine solution containing at least 50 parts per million (50 mg/L) of chlorine, and the system or part thereof shall be valved off and allowed to stand for 24 hours; or the system or part thereof shall be filled with a water/chlorine solution containing at least 200 parts per million (200mg/l) of chlorine and allowed to stand for three (3) hours.
 - .3 Following the required standing time, the system shall be flushed with clean potable water until the chlorine is purged from the system.
 - .4 The procedure shall be repeated where shown by a bacteriological examination that contamination remains present in the system.
- 3.2.7 Compression fittings are not acceptable.
- 3.2.8 All valves packing shall be asbestos free.
- 3.2.9 Provide isolation valves on all main branch feeds to each washroom group.
- 3.2.10 Install all grooved end components as per manufacturer's latest recommendation.

END OF SECTION

PART 1 - GENERAL

1.1 GENERAL

1.1.1 This section of the specification shall be read in conjunction with and shall be governed by the requirements outlined in Section 20 05 11 Mechanical General Requirements of the specification.

1.2 REFERENCE STANDARDS

- 1.2.1 Do the work in accordance with the Ontario Building Code Plumbing Code and local authority having jurisdiction.
- 1.2.2 CSA B70 - 2006 Specifications for Cast Iron Soil Pipe Fittings and Means of Joining.
- 1.2.3 CSA B125 - 2005 Specifications for Plumbing Fittings
- 1.2.4 ASTM B32 - 2008 Specifications for Solder Metal
- 1.2.5 ASTM B306 - 2009 Specifications for Copper Drainage Tube (DWV)
- 1.2.6 ANSI B16.29
- 1.2.7 ASTM B88, ASTM B88M - 2003 Specifications for Seamless Copper Water Tube
- 1.2.8 ASTM A74 - 2009 Specification for Cast Iron Soil Pipe and Fittings
- 1.2.9 ASTM C564 -2009 Specification for Rubber Gasket for Cast Iron Soil Pipe and Fittings

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

- 2.1.1 For all above grade vent, sanitary and storm piping, Type DWV to:
- .1 ASTM B306 - Specification for copper drainage tube (DWV).
 - .2 CSA B158 for cast brass fittings.
 - .3 ANSI B16.29 for wrought copper fittings.
 - .4 Solder: tin-lead, 50:50, to ASTM B32, type 50A - Specification for solder metal.
 - .5 ASTM B88.
 - .6 ASTM C564

2.2 CAST IRON PIPING AND FITTINGS

2.2.1 For above grade storm, sanitary and vent piping, minimum NPS 3, to CSA B70, ASTM A74 with heavy bituminous coating.

2.2.2 For above grade storm, sanitary and vent piping 4" (100 mm) size and larger: Cast iron.

2.2.3 For storm, sanitary and vent piping joints.

.1 Mechanical joints.

.1 Neoprene or butyl rubber compression gaskets for all pipe connections.: to ASTM C564-2009.

.2 SS clamps.

2.3 PUMPED DRAINAGE

2.3.1 Pumped drains shall be galvanized steel.

2.4 DRAINAGE AND VENTS

2.4.1 Piping And Fittings

2.4.2 For buried sanitary, storm and vent piping:

.1 ASTM D2665, ASTM D2949, ASTM B251

.2 ASTM D3034, ASTM F891

.3 CAN/CSA- B181.2 for PVC DWV or

.4 CAN/CSA B182.1- for plastic DWV.

2.4.3 Joints

.1 Solvent weld for PVC: to ASTM D2564.

.2 Solvent weld for ABS: to ASTM D2235.

.3 For sizes above 4" (100mm).

Provide Ring-Tite joints Canron Ring-Tite joints PVC DR35 gravity sewer pipe, with locked in rubber ring sealing feature providing tight flexible seal.

Spigot ends to be supplied complete with bevel.

2.4.4 All PVC piping below grade shall be a minimum of SDR 35.

2.5 CONDENSATE DRAIN PIPING

- 2.5.1 All condensate piping shall be Copper water tube, ASTM B88, Type L for runouts and Type M for mains.

PART 3 - EXECUTION

3.1 INSTALLATION

- 3.1.1 Install piping parallel and close to walls to conserve space, and to grade indicated, and to suit installation of related work.
- 3.1.2 Apply two coats of asphalt paint to pipe laid in, or passing through concrete.
- 3.1.3 Where piping passes through floor or wall below grade pack and seal in concrete complete with Link Seal in accordance with Specification Section 20 05 11.
- 3.1.4 PVC piping shall not be utilized above grade. PVC piping is acceptable for below grade piping where permitted by Code. The PVC piping shall convert to cast iron prior to the point where it penetrates the floor slab.
- 3.1.5 Provide venting to plumbing fixtures and fixture groups in accordance with the Ontario Building Code Plumbing Code and local authorities having jurisdiction.
- 3.1.6 Install buried pipe on 6" (150 mm) bed of clean sand, shaped to accommodate hubs and fittings, to line and grade as indicated. Backfill with clean sand.
- 3.1.7 Install piping parallel and close to walls to conserve space and to grade indicated, and to suit the installation of related work.
- 3.1.8 Apply solvent to male end of joints only.
- 3.1.9 Pipe installation: Pipe shall be installed as specified and indicated on the drawings.
- 3.1.10 The piping system shall be installed in accordance with the manufacturers current published installation procedures.
- 3.1.11 PVC piping shall not be utilized above grade. PVC piping is acceptable for below grade piping where permitted by Code. The PVC piping shall convert to cast iron prior to the point where it penetrates the floor slab.
- 3.1.12 Where piping passes through floor or wall below grade pack and seal in concrete in accordance with Mechanical General Requirements.
- 3.1.13 Provide venting to all plumbing fixtures and fixture groups in accordance to the Ontario Building Code - Plumbing Code and local authorities having jurisdiction.
- 3.1.14 If tests are required by an authority having jurisdiction, perform tests in presence of each governing authority and obtain certification. Repeat tests as often as necessary to obtain certification.

3.1.15 Test pressure shall not exceed 1-1/2 times the maximum rated pressure of the lowest related element in the system.

3.1.16 Remove all fittings which do not withstand test pressure, replace and retest.

3.1.17 Eliminate leaks, or remove and refit defective parts.

3.2 TESTING

3.2.1 The drainage and vent system shall be tested in accordance with the Ontario Building Code - Plumbing Code and tested in accordance with the requirements of the authority having jurisdiction, perform tests in the presence of each governing authority and obtain certification. Repeat tests as often as necessary to obtain certification.

3.2.2 Perform tests before piping is covered or concealed.

3.2.3 Remove all fittings which will not withstand test pressure, and replace after test.

3.2.4 Eliminate leaks, or remove and refit defective parts.

END OF SECTION

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 20 05 11 Mechanical General Requirements.

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 in accordance with Section 20 05 11 shop drawings and product data
- .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
- .6 Armaflex.

2 PRODUCTS

2.1 GENERAL

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

2.2 MINERAL FIBRE BLANKET WITH VAPOUR BARRIER

- .1 Provide external insulation on all new supply and return ductwork served by Heat Recovery Unit HRU-1 and Rooftop Unit RTU-1.
- .2 Provide external insulation on all exhaust ductwork for its entire length.
- .3 Material:
 - .1 Mineral-Fiber Blanket Thermal Insulation: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II, for use to 450 deg. F, with a factory-applied jacket manufactured from foil, reinforcing scrim, and kraft paper (FSK). Minimum density of 3/4 lb./cu.ft., maximum conductivity of 0.43 (BTU-in./hr.-sq.ft.-deg. F) at 200 deg. F.
 - .2 Acceptable Material: Fiberglas, Knauf, Manson.
 - .3 Thickness: 1".

2.3 FIBROUS GLASS RIGID WITH VAPOUR BARRIER

- .1 Apply on all indoor supply rectangular ductwork larger than 30" wide and on all ductwork located outdoors, regardless of size.
- .2 Material:
 - .1 Mineral-Fiber Board Thermal Insulation: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IB, for use to 450 deg. F, with a factory-applied jacket manufactured from foil, reinforcing scrim, and kraft paper (FSK). Minimum density of 3 lb./cu.ft., maximum conductivity of 0.40 (BTU-in./hr.-sq.ft.-deg. F) at 300 deg. F.
 - .2 Acceptable products: Fiberglas AF 530, Manson, Knauf.
 - .3 Thickness: 1"

2.4 CANVAS JACKETS

- .1 Apply in mechanical rooms where rigid insulation is applied: compact, firm ULC listed

heavy plain weave, cotton fabric at 220 g/m sq.

2.5 METAL JACKETING

- .1 At all locations where the ductwork is located outdoors or in heavy abuse areas, use metal jacketing to protect piping or ductwork insulation.
- .2 Jacketing: Aluminum, 0.016 inches thick, embossed surface, with factory bonded moisture barrier.
- .3 Metal Jacketing Bands: 1/2 inch wide, aluminum or stainless.

2.6 EXTERIOR INSULATION

- .1 Cover all joints of the rigid insulation and fastener penetration with 3" wide pressure sensitive All Service Jacket (ASJ) tape. Rub tape hard with a nylon sealing tool. Over the entire surface apply a weave glass reinforcing cloth embedded between two 1/8" thick wet coats of Breather mastic, i.e., B. Foster Seal Fast 6 PM 35-00-4500.

2.7 FASTENINGS

- .1 Tape: self adhesive, 100 mm wide rated under 25 for flame spread and under 50 for smoke development.
- .2 Contact adhesive: quick-setting, non-flammable fire resistive adhesive to adhere fibrous glass to ducts. Flame spread 15 smoke development 0.
 - .1 Acceptable Products Foster 85-20 Asbestos Free, Armstrong 520.
- .3 Lap Seal Adhesive: Quick-setting adhesive for joints and lap sealing of vapour barriers. Flame spread 10 smoke development 0.
 - .1 Acceptable Products Foster 85-75, Asbestos Free, Drion.
- .4 For Canvas:
 - .1 Washable adhesive for cementing canvas lagging cloth to duct insulation.
 - .2 Acceptable Products: Foster 30-36 Asbestos Free.
- .5 Pins:
 - .1 Weld pins 4 mm diameter, with 1 1/2" diameter head for installation through the insulation. Length to suit thickness of insulation.
 - .2 Weld pins: If duct is over 24" wide, use on bottom of duct as well.
 - .3 Acceptable Products: Duro Dyne, Clip-Pin.

3 Execution

3.1 **APPLICATION**

- .1 Apply insulation after required tests have been completed and approved by Consultant. Insulation and surfaces shall be clean and dry when installed and during application of any finish.
- .2 Work shall be preformed by insulation journeymen.
- .3 Apply insulation and coverings on hot equipment while surface is between 50 to 60°C.
- .4 Vapour barriers and insulation to be complete over full length of duct or surface, without penetration for hangers, standing duct seams and without interruption at sleeves.
- .5 Install insulation with smooth and even surfaces.
- .6 Apply insulation materials accessories and finishes to manufacturer's recommendations.
- .7 Apply 1.0mm thick metal corners to all ductwork in mechanical rooms to a height of 7 ft.
- .8 Use stand-offs for all duct mounted accessories.
- .9 The last 3.0 meters of all exhaust ductwork shall be insulated, whether shown on the Drawings or not.

3.2 **DUCT INSULATION**

.1 General:

- .1 Adhere and seal vapour barrier using vapour seal adhesives.
- .2 Stagger longitudinal and horizontal joints, on multi-layered insulation.

.2 Mechanical Fasteners:

- .1 On rectangular ducts, use 50% coverage of insulating cement and weld pins at not more than 14" centres, but not less than 2 rows per side.

3.3 **JACKETS**

- .1 Provide fire retardant coating on canvas jackets.
- .2 Fire retardant coating shall be approved by authority having jurisdiction prior to

application. Consultant reserves right to remove sample of covering for testing.

- .3 Coat canvas covering exposed in finished spaces with diluted coat of lagging adhesive. As recommended by insulation manufacturer for priming. Dilution: 2 parts of water to 3 parts of lagging adhesive.
- .4 For all ductwork externally insulated inside of the building, provide 3M VentureClad Insulation Jacketing.

END OF SECTION

1 General

1.1 DESCRIPTION

- .1 Fuel gas systems, including piping, equipment and all necessary accessories as designated in this section.

1.2 SUBMITTALS

- .1 Submit in accordance with Section 20 05 11 Mechanical General Requirements, shop drawings, product data, and samples.
- .2 Manufacturer's Literature and Data:
 - .1 Piping.
 - .2 Strainers.
 - .3 All items listed in Part 2 - Products.
 - .4 Detailed shop drawing of clamping device and extensions when required in connection with the waterproofing membrane or the floor drain.
- .3 At the onset of the project, the Mechanical Contractor is responsible for doing a thorough survey of the existing School and locating all existing gas-fired appliances (indoors and outdoors) and providing the following information to the Engineer in writing:
 - .1 Location and type (rooftop unit, gas unit heater, gas-fired domestic hot water heater, boilers, etc.) of each gas-fired appliance. Locations shall be identified on a large-format (36"x48") print-out of the School Floor Plans and marked in red.
 - .2 Input and output BTU rating of each appliance.
 - .3 Existing gas pipe sizing and routing to all appliances (including what gas pressure is running in each line).
 - .4 Existing gas meter rating.
 - .5 Location of all PRVs.

1.3 APPLICABLE PUBLICATIONS

- .1 The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
 - .1 CAN1-B149.1-M80 for natural gas
 - .2 Ontario Natural Gas Code
 - .3 American National Standards Institute (ANSI):
 - .4 American Society of Mechanical Engineers (ASME): (Copyrighted Society)
 - .1 A13.1-96 Scheme for Identification of Piping Systems
 - .2 B16.3 98 Malleable Iron Threaded Fittings ANSI/ASME
 - .3 B16.9 01 Factory-Made Wrought Steel Butt welding Fittings ANSI/ASME
 - .4 B16.11 01 Forged Steel Fittings, Socket-Welding and Threaded

ANSI/ASME

- .5 B16.15-85(R 1994) Cast Bronze Threaded Fittings ANSI/ASME
- .6 B31.8-01 Gas Transmission and Distribution Piping Systems ANSI/ASME

.5 American Society for Testing and Materials (ASTM):

- .1 A47-99 Ferritic Malleable Iron Castings Revision 1989
- .2 A53-02 Pipe, Steel, Black And Hot-Dipped, Zinc-coated Welded and Seamless
- .3 A183-83(R1998) Carbon Steel Track Bolts and Nuts
- .4 A536-84(R1999) E1 Ductile Iron Castings
- .5 A733-03 Welded and Seamless Carbon Steel and Austenitic Stainless Steel
Pipe Nipples
- .6 B687-99 Brass, Copper, and Chromium-Plated Pipe Nipples

.6 National Fire Protection Association (NFPA)

2 Products

2.1 FUEL GAS PIPING ABOVE-GROUND

.1 Pipe: Black steel, ASTM A53, Schedule 40, seamless as follows:

- .1 ½" to 1½" dia., screwed.
- .2 2" to 10" welded, plain end.

.2 Nipples: Steel, ASTM A733, Schedule 40.

.3 Pipe fittings, screwed, flanged or welded as follows:

- .1 Malleable iron screwed fittings (banded): Class 150 to ANSI B16.3-1977.
- .2 Steel pipe flanges and flanged fittings: to ANSI B16.5-1977.
- .3 Steel butt-welding fittings: to ANSI B16.9-1978.
- .4 Unions, malleable iron, brass to iron, ground seat: to ANSI B16.3-1977.
- .5 Bolts and nuts: to ANSI B18.2.1-1972 and ANSI B18.2.2-1972.
- .6 Nipples, Schedule 40: to ASTM A53-82.

.4 Joints: Provide welded or threaded joints

2.2 JOINTING MATERIAL

- .1 Screwed fittings: pulverized lead paste.
- .2 Welded fittings: to CSA W47.1-1983.
- .3 Flange gaskets: to ANSI B16.21-1978, ANSI B16.20-1973 or ANSI A21.11-1979.

2.3 WATERPROOFING

- .1 Provide at points where pipes pass through membrane waterproofed floors or walls in contact with earth.
- .2 Floors: Provide cast iron stack sleeve with flashing device and a underdeck clamp. After stack is passed through sleeve, provide a waterproofed caulked joint at top hub.

2.4 STRAINERS

- .1 Provide on high pressure side of pressure reducing valves, on inlet side of indicating and control instruments and equipment subject to sediment damage and where shown on drawings. Strainer element shall be removable without disconnection of piping.
- .2 Gas Lines: "Y" type with removable mesh lined brass strainer sleeve.
- .3 Body: Smaller than 80 mm (3 inches), brass or bronze; 80 mm (3 inches) and larger, cast iron or semi steel.

2.5 DIELECTRIC FITTINGS

- .1 Provide dielectric couplings or unions between ferrous and non ferrous pipe.

2.6 GAS EQUIPMENT CONNECTORS

- .1 Flexible connectors with teflon core, interlocked galvanized steel protective casing, AGA certified design.

2.7 GAS PRESSURE REGULATOR VALVE (PRV)

- .1 Supply and install Gas PRVs as shown on the drawings. PRVs shall be reduce pressure from the upstream gas pressure noted on the drawings to the downstream gas pressure noted on the drawings. Provide all piping and accessories necessary to suit connection of the piping to the PRV. PRVs shall be located in strict accordance with the Manufacturer's Recommendations in terms of location of adjacent elements.
- .2 Provide a gas piping support (see Drawing for support detail) within 8" upstream of the regulator as well as within 8" downstream of the regulator.

3 Execution

3.1 INSTALLATION

- .1 General: Comply with the following:
 - .1 Install natural gas piping in accordance with CAN1-B149.1-M80
 - .2 Install branch piping for fuel gas and connect to all fixtures, valves, cocks, outlets, casework, cabinets and equipment.

- .3 Pipe shall be round and straight. Cutting shall be done with proper tools. Pipe, except for plastic and glass, shall be reamed to full size after cutting.
- .4 All pipe runs shall be laid out to avoid interference with other work.
- .5 Slope piping down in direction of flow to low points.
- .6 Use eccentric reducers at pipe size change installed to provide positive drainage.
- .7 Provide clearance for access for maintenance of equipment, valves and fittings.
- .8 Ream pipes, clean scale and dirt, inside and out.
- .9 Cap open ends during construction to prevent entry of foreign material.
- .10 Make connection to equipment with unions or flanges. Install piping to minimize pipe dismantling for equipment removal.
- .11 Provide vents for all gas piping shafts in accordance to code.
- .12 Install valves with stem in horizontal position whenever possible. All valves shall be easily accessible.
- .13 Install union and shut-off valve on pressure piping at connections to equipment.
- .14 Provide cathodic protection on jackets for all buried steel pipes, as per local gas supply company.
- .15 Subcontractor installing buried gas piping shall be approved by the local gas supply company.
- .16 Coordinate with the local gas supply company and the General Contractor the location of gas meter and isolation valves.

3.2 PURGING

- .1 Purge after pressure test in accordance with applicable codes.

3.3 PIPE HANGERS, SUPPORTS AND ACCESSORIES

- .1 All piping shall be supported AS per Section 20 05 11 and Gas Code recommendations.
- .2 Shop Painting and Plating: Hangers, supports, rods, inserts and accessories used for Pipe supports shall be shop coated with red lead or zinc Chromate primer paint. Electroplated copper hanger rods, hangers and accessories may be used with copper tubing.
- .3 Floor, Wall and Ceiling Plates, Supports, Hangers:
 - .1 Solid or split un-plated cast iron.
 - .2 All plates shall be provided with set screws.

- .3 Pipe Hangers: Height adjustable clevis type.
- .4 Adjustable Floor Rests and Base Flanges: Steel.
- .5 Concrete Inserts: "Universal" or continuous slotted type.
- .6 Hanger Rods: Mild, low carbon steel, fully threaded or Threaded at each end with two removable nuts at each end for positioning rod and hanger and locking each in place.
- .7 Riser Clamps: Malleable iron or steel.
- .8 Rollers: Cast iron.
- .9 Self-drilling type expansion shields shall be "Phillips" type, with case hardened steel expander plugs.
- .4 Hangers and supports utilized with insulated pipe and tubing shall have 180 degree (min.) metal protection shield Centered on and welded to the hanger and support. The shield shall be 4 inches in length and be 16 gauge steel. The shield shall be sized for the insulation.
- .5 Miscellaneous Materials: As specified, required, directed or as noted on the drawings for proper installation of hangers, supports and accessories. If the vertical distance exceeds 6 m (20 feet) for cast iron pipe additional support shall be provided in the center of that span. Provide all necessary auxiliary steel to provide that support.
- .6 Install cast escutcheon with set screw at each wall, floor and ceiling penetration in exposed finished locations and within cabinets and millwork.

3.4 PENETRATIONS

- .1 Fire Stopping: Where pipes pass through fire partitions, fire walls, smoke partitions, or floors, install a fire stop that provides an effective barrier against the spread of fire, smoke and gases. Completely fill and seal clearances between raceways and openings with the fire stopping materials.
- .2 Waterproofing: At floor penetrations, completely seal clearances around the pipe and make watertight with sealant
- .3 Piping shall conform to the following:
 - .1 Entire fuel gas piping installation shall be in accordance with requirements of NFPA 54.
 - .2 Install fuel gas piping with plugged drip pockets at low points.

3.5 GAS PRESSURE

- .1 Refer to Section 20 05 11 for gas pressure requirements and associated actions to ensure the adequate operation of the HVAC and heading equipment.

3.6 TESTS

- .1 General: Test system either in its entirety or in sections.
- .2 Fuel Gas System: NFPA 54.

3.7 PAINTING & LABELING

- .1 Paint the entire gas line yellow; where exposed to the outdoors, use outdoor-grade paint. Label the full length of the gas piping as per CSA B149.1-15 Stating 2" PSI gas piping with weatherproof labels.

END OF SECTION

PART 1 - GENERAL

1.1. DESCRIPTION

1.1.1. Hydronic piping to connect HVAC equipment, including the following:

1.1.1.1. Chilled water, condenser water, heating hot water/glycol as applicable to the project.

1.1.2. NO USE OF VICTAULIC OR 'GROOVED END' PRODUCTS WILL BE PERMITTED. All piping 2" and larger shall be welded.

1.2. RELATED WORK

1.2.1. Section 20 05 11, MECHANICAL GENERAL REQUIREMENTS.

1.2.2. Section 23 05 11, COMMON WORK RESULTS FOR HVAC:

1.2.3. Section 23 74 03, HYDRONIC PUMPS

1.3. QUALITY ASSURANCE

1.3.1. Submit prior to welding of steel piping a certificate of Welder's certification. The certificate shall be current and not more than one year old.

1.3.2. All joint couplings, fittings, valves, and specialties shall be the products of a single manufacturer.

1.3.3. All castings used for coupling housings, fittings, valve bodies, etc., shall be date stamped for quality assurance and traceability.

1.4. SUBMITTALS

1.4.1. Submit in accordance with Section 20 05 11, MECHANICAL GENERAL REQUIREMENTS.

1.4.2. Manufacturer's Literature and Data:

1.4.2.1. Pipe and equipment supports.

1.4.2.2. Pipe and tubing, with specification, class or type, and schedule.

1.4.2.3. Pipe fittings, including miscellaneous adapters and special fittings.

1.4.2.4. Flanges, gaskets and bolting.

1.4.2.5. Valves of all types.

1.4.2.6. Strainers.

1.4.2.7. Flexible connectors for water service.

1.4.2.8. All specified hydronic system components.

1.4.2.9. Water flow measuring devices.

1.4.2.10. Gages.

- 1.4.2.11. Thermometers and test wells.
- 1.4.2.12. Air separators.
- 1.4.2.13. Expansion tanks.

1.5. APPLICABLE PUBLICATIONS

1.5.1. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only. American National Standards Institute, Inc.

1.5.2. American Society of Mechanical Engineers/American National Standards Institute, Inc. (ASME/ANSI):

- 1.5.2.1. B1.20.1-83(R2006) Pipe Threads, General Purpose (Inch)
- 1.5.2.2. B16.4 06 Gray Iron Threaded Fittings B16.18-01 Cast Copper Alloy Solder joint Pressure fittings
- 1.5.2.3. B16.23-02 Cast Copper Alloy Solder joint Drainage fittings
- 1.5.2.4. B40.100-05 Pressure Gauges and Gauge Attachments

1.5.3. American Society of Mechanical Engineers (ASME):

- 1.5.3.1. B16.1-98 Cast Iron Pipe Flanges and Flanged Fittings
- 1.5.3.2. B16.3-2006 Malleable Iron Threaded Fittings: Class 150 and 300
- 1.5.3.3. B16.4 2006 Gray Iron Threaded Fittings: (Class 125 and 250)
- 1.5.3.4. B16.5-2003 pipe Flanges and Flanged Fittings: NPS ½ through NPS 24 Metric/Inch Standard
- 1.5.3.5. B16.9-07 Factory Made Wrought Butt Welding Fittings
- 1.5.3.6. B16.11-05 Forged Fittings, Socket Welding and Threaded
- 1.5.3.7. B16.18-01 Cast Copper Alloy Solder Joint Pressure Fittings
- 1.5.3.8. B16.22-01 Wrought Copper and Bronze Solder Joint Pressure Fittings.
- 1.5.3.9. B16.24 06 Cast Copper Alloy Pipe Flanges and Flanged Fittings
- 1.5.3.10. B16.39 06 Malleable Iron Threaded Pipe Unions
- 1.5.3.11. B16.42-06 Ductile Iron Pipe Flanges and Flanged Fittings

1.5.4. American Society for Testing and Materials (ASTM):

- 1.5.4.1. A47/A47M-99 (2004) Ferritic Malleable Iron Castings
- 1.5.4.2. A53/A53M-07 Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
- 1.5.4.3. A126 04 Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
- 1.5.4.4. A183 03 Standard Specification for Carbon Steel Track Bolts and Nuts
- 1.5.4.5. A536 84 (2004) Standard Specification for Ductile Iron Castings
- 1.5.4.6. B32 08 Standard Specification for Solder Metal

- 1.5.4.7. B62 02 Standard Specification for Composition Bronze or Ounce Metal Castings
- 1.5.4.8. B88 03 Standard Specification for Seamless Copper Water Tube

PART 2 - PRODUCTS

2.1. PIPE AND TUBING

- 2.1.1. Chilled Water/Glycol, Condenser Water, Heating Hot Water/Glycol, as applicable to the project:
 - 2.1.1.1. 38 mm (1-1/2") diam and smaller:
 - 2.1.1.1.1. Schedule 40 continuous weld or electric resistance welded black carbon steel conforming to ASTM A53 84a Grade B, with threaded ends.
 - 2.1.1.1.2. Type "L" hard drawn copper tubing conforming to ASTM B88. Type "L" soft annealed copper tubing may be used only within convector enclosures.
 - 2.1.1.2. 50 mm (2") diam and larger
 - 2.1.1.2.1. Schedule 40 continuous weld or electric resistance welded black carbon steel conforming to ASTM A53 84a Grade B, with bevelled ends.
- 2.1.2. Pipe supports, including insulation shields, for above ground piping: Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

2.2. FITTINGS FOR COPPER TUBING

- 2.2.1. Joints 50 mm (2") and smaller:
 - 2.2.1.1. *Solder Joints:* Joints shall be made up in accordance with recommended practices of the materials applied. Apply 95/5 tin and antimony on all copper piping.
 - 2.2.1.2. *Screwed Joints:* Pipe Thread: ANSI B1.20. Lubricant or Sealant: Oil and graphite or other compound approved for the intended service.
- 2.2.2. Joints 65 mm (2½") and larger:
 - 2.2.2.1. Bronze Flanges and Flanged Fittings: ASME B16.24.
 - 2.2.2.2. Fittings: ASME B16.18 cast copper or ASME B16.22 solder wrought copper.

2.3. FITTINGS FOR STEEL PIPE

- 2.3.1. 38 mm (1-1/2 inches) and Smaller: Screwed or welded joints.
 - 2.3.1.1. Butt welding: ASME B16.9 with same wall thickness as connecting piping.
 - 2.3.1.2. Forged steel, socket welding or threaded: ASME B16.11.
 - 2.3.1.3. 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.
- 2.3.2. 50 mm (2 inches) and Larger: Welded or flanged joints.
 - 2.3.2.1. Butt welding fittings: ASME B16.9 with same wall thickness as connecting piping. Elbows shall be long radius type, unless otherwise noted.
 - 2.3.2.2. Welding flanges and bolting: ASME B16.5:
 - 2.3.2.3. 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).
 - 2.3.2.4. Flange bolting: Carbon steel machine bolts or studs and nuts, ASTM A307, Grade B.

2.4. DIELECTRIC FITTINGS

- 2.4.1. Provide where copper tubing and ferrous metal pipe are joined.
- 2.4.2. 50 mm (2 inches) and Smaller: Threaded dielectric union, ASME B16.39.
- 2.4.3. 65 mm (2 1/2 inches) and Larger: Flange union with dielectric gasket and bolt sleeves, ASME B16.42.
- 2.4.4. Temperature Rating, 99 degrees C (210 degrees F).

2.5. UNION

- 2.5.1. 50 mm (2") diam and smaller:
 - 2.5.1.1. All brass construction with ground joint and either solder joint or screwed ends as required.
 - 2.5.1.2. Class 150 black malleable iron construction with brass to iron ground joint and screwed ends, conforming to ASTM A197 and ANSI/ASME B1.20.1.
 - 2.5.1.3. Provide dielectric unions or couplings at all connections between copper tubing and ferrous piping or equipment.

2.6. FLANGES

- 2.6.1. Class 150 forged steel slip-on or weld-neck raised face type conforming to ASTM A181 Grade 1 and ANSI/ASME B16.5. Remove raised face where flanges connect to Class 125 cast iron valves.
- 2.6.2. Hinged, two piece, shouldered or keyed cast malleable iron
- 2.6.3. Conforming to ASTM A47 Grade 32510 with elastomeric gasket suitable for service and lock bolt.

2.7. GASKETS AND BOLTS

2.7.1. Gaskets

- 2.7.1.1. 1.6 mm (1/16") Garlock 3200 with SBR binder or equivalent asbestos free material.

2.7.2. Bolts

- 2.7.2.1. Semi finished hex head machine bolts and semi finished hex nuts, both of carbon steel conforming to ASTM A307 Class A.

2.8. PLUGS

- 2.8.1. 50 mm (2") diam and smaller: Class 3000 screwed, square head, machined from solid steel or forging to ASTM A105 Grade 2.

2.9. SCREWED JOINTS

- 2.9.1. Pipe Thread: ANSI B1.20.
- 2.9.2. Lubricant or Sealant: Oil and graphite or other compound approved for the intended service.

2.10. VALVES

- 2.10.1. Asbestos packing is not acceptable.

- 2.10.2. All valves of the same type shall be products of a single manufacturer.

- 2.10.3. Provide chain operators for valves 150 mm (6 inches) and larger when the centerline is located 2400 mm (8 feet) or more above the floor or operating platform.

- 2.10.4. *Standard of Acceptance: Apollo, Armstrong, Bell & Gossett, Belimo, Crane, Nibco*

2.10.5. Shut-Off Valves

- 2.10.5.1. Ball Valves (Pipe sizes 50 mm [2"] and smaller): MSS-SP 110, screwed or solder connections, brass or bronze body with chrome-plated ball with full port and Teflon seat at 2760 kPa (400 psig) working pressure rating. Provide stem extension to allow operation without interfering with pipe insulation.
- 2.10.5.2. Butterfly Valves (Pipe Sizes 65 mm [2½"] and larger): Provide stem extension to allow 50 mm (2 inches) of pipe insulation without interfering with valve operation. MSS SP 67, flange lug type or grooved end rated 1205 kPa (175 psig) working pressure at 93 degrees C (200 degrees F). Valves shall be ANSI Leakage Class VI and rated for bubble tight shut-off to full valve pressure rating. Valve shall be rated for dead end service and bi-

directional flow capability to full rated pressure. Not permitted for direct buried pipe applications. Construction:

- 2.10.5.2.1. Body: Cast iron, ASTM A126, Class B. Malleable iron, ASTM A47 electro-plated, or ductile iron, ASTM A536, Grade 65 45 12 electro-plated.
- 2.10.5.2.2. 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.
- 2.10.5.2.3. Actuators: Field interchangeable. Valves for balancing service shall have adjustable memory stop to limit open position.
- 2.10.5.2.4. Valves 150 mm (6 inches) and smaller: Lever actuator with minimum of seven locking positions, except where chain wheel is required.
- 2.10.5.2.5. Valves 200 mm (8 inches) and larger: Enclosed worm gear with handwheel, and where required, chain wheel operator.

2.10.5.3. Gate Valves (Contractor's Option in lieu of Ball or Butterfly Valves):

- 2.10.5.3.1. 50 mm (2 inches) and smaller: MSS SP 80, Bronze, 1034 kPa (150 psig), wedge disc, rising stem, union bonnet.
- 2.10.5.3.2. 65 mm (2 1/2 inches) and larger: Flanged, outside screw and yoke. MSS SP 70, iron body, bronze mounted, 861 kPa (125 psig) wedge disc.

2.10.5.4. Globe and Angle Valves

2.10.5.4.1. Globe Valves

- 50 mm (2 inches) and smaller: MSS SP 80, bronze, 1034 kPa (150 lb.) Globe valves shall be union bonnet with metal plug type disc.
- 65 mm (2 1/2 inches) and larger: 861 kPa (125 psig), flanged, iron body, bronze trim, MSS SP 85 for globe valves.

2.10.5.4.2. Angle Valves:

- 50 mm (2 inches) and smaller: MSS SP 80, bronze, 1034 kPa (150 lb.) Angle valves shall be union bonnet with metal plug type disc.
- 65 mm (2 1/2 inches) and larger: 861 kPa (125 psig), flanged, iron body, bronze trim, MSS SP 85 for angle.

2.10.5.4.3. Check Valves

- *Swing Type Check Valves*
- 50 mm (2 inches) and smaller: MSS SP 80, bronze, 1034 kPa (150 lb.), 45 degree swing disc.
- 65 mm (2 1/2 inches) and larger: 861 kPa (125 psig), flanged, iron body, bronze trim, MSS SP 71 for check valves.
- *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. Check valves incorporating a balancing feature may be used.
- Body: MSS-SP 125 cast iron, ASTM A126, Class B, or steel, ASTM A216, Class WCB, or ductile iron, ASTM 536, flanged, grooved, or wafer type.
- Seat, disc and spring: 18 8 stainless steel, or bronze, ASTM B62. Seats may be elastomer material.

2.10.5.4.4. Water Flow Balancing Valves: For flow regulation and shut off. Valves shall be line size rather than reduced to control valve size. Provide a readout kit including flow meter, readout probes, hoses, flow charts or calculator, and carrying case.

- *Valves 1/2" to 2" diam:*

Valves are to be of the 'Y' pattern, equal percentage globe-style and provide three functions: 1) Precise flow measurement, 2) Precision flow balancing, 3) Positive drip-tight shut-off.

Valve shall provide multi-turn, 360° adjustment with micrometer type indicators located on the valve handwheel. Valves shall have a minimum of five full 360° handwheel turns. 90° 'circuit-setter' style ball valves are not acceptable. Valve handle shall have hidden memory feature, which will provide a means for locking the valve position after the system is balanced.

Valves shall be furnished with precision machined venturi built into the valve body to provide highly accurate flow measurement and flow balancing. The venturi shall have two, 1/4" threaded brass metering ports with check valves and gasketed caps located on the inlet side of the valve. Valves shall be furnished with flow smoothing fins downstream of the valve seat and integral to the forged valve body to make the flow more laminar. The valve body, stem and plug shall be brass. The handwheel shall be high-strength resin.

- *Valves 2-1/2" to 12" diam:*
Valves are to be of the 'Y' pattern, equal percentage globe-style and provide three functions: 1) Precise flow measurement, 2) Precision flow balancing, 3) Positive drip-tight shut-off.
Valve shall provide multi-turn, 360° adjustment with micrometer type indicators located on the valve handwheel. Valves shall have a minimum of five full 360° handwheel turns. 90° 'circuit-setter' style ball valves are not acceptable. Valve handle shall have hidden memory feature, which will provide a means for locking the valve position after the system is balanced.
Valves shall be furnished with precision machined venturi built into the valve body to provide highly accurate flow measurement and flow balancing. The venturi shall have two, 1/4" threaded brass metering ports with check valves and gasketed caps located on the inlet side of the valve. Valves shall be furnished with flow smoothing fins downstream of the valve seat and integral to the forged valve body to make the flow more laminar. The valve body, stem and plug shall be brass. The hand wheel shall be high-strength resin.
- *Standard of acceptance: Armstrong, T&A, Bell and Gossett*

2.11. STRAINERS

2.11.1. Basket or Y Type.

- 2.11.1.1. 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 for 100 mm (4 inches) and larger: 3.2 mm (0.125 inch) diameter perforations.
- 2.11.1.2. Suction Diffusers: Specified in Section 23 74 03, HYDRONIC PUMPS.

2.12. HEAT EXCHANGER FOR HVAC SERVICE (FLUID TO FLUID):

- 2.12.1.1. Furnish a plate and frame heat exchanger to meet the operating conditions as indicated in the attached schedule.
- 2.12.1.2. The exchanger shall be designed, constructed and tested in accordance with Section VIII, Division I of the ASME Pressure Vessel Code, and shall be code stamped. Pressure vessels provided for installation in Canada shall be marked with the appropriate CRN number.
- 2.12.1.3. Preference will be given to single pass designs with all system connections to be located on the face of the fixed cover plate.

- 2.12.1.4. The plate and frame heat exchanger's fixed and movable covers shall be designed to provide sufficient uniform thickness to withstand all loading. Stiffeners and welded reinforcements shall not be permitted. Any plate within the exchanger's plate pack shall be replaceable without the need to remove other plates.
- 2.12.1.5. The heat exchanger plate material shall be stainless steel type AISI 316L.
- 2.12.1.6. A roller bearing shall be provided on the movable cover for all units with port sizes 3" or larger. The frame assembly shall be of bolted construction. Welding to the pressure retaining components is not permitted.
- 2.12.1.7. The frame assembly design shall allow the addition of a minimum of 10% additional plates.
- 2.12.1.8. Each plate shall be pressed from a homogenous metal sheet in one step. Each plate channel shall be designed to allow full design pressure on one side with no pressure on the adjacent plate channel. Contact between adjacent plates is required to optimize structural integrity and elimination of vibration.
- 2.12.1.9. Gaskets shall be designed to indicate leakage across the sealing gaskets prior to the intermixing of fluids.
- 2.12.1.10. The suspension and guidance method in the design of the plates, frame, carrying and guide bars shall mechanically align the plates during tightening. Gasket surfaces shall be used for sealing not for plate alignment. The carrying and guide bar surfaces in contact with the plate pack shall be stainless steel. All other carbon steel surfaces except the bolts shall be epoxy painted.
- 2.12.1.11. An aluminum or optional 304 stainless steel OSHA shroud could be provided. A comprehensive operations and maintenance manual and ASME nameplate shall be attached on the face of the fixed cover.
- 2.12.1.12. Connections less than or equal to 2-inch shall be NPT type. Connections larger than 2-inch shall be of studded port design. Each studded port shall be lined with a fluid compatible material to prevent process fluid from coming in contact with the painted cover.
- 2.12.1.13. The exchanger shall be hydrostatically tested in accordance with the requirements of the ASME Code Section VIII Div 1, para. UG-99. A computer generated submittal and specification sheet indicating the criteria used in each unit's selection shall be submitted for approval.

2.13. HYDRONIC SYSTEM COMPONENTS

- 2.13.1. Air Purger: Cast iron or fabricated steel, 861 kPa (125 psig) water working pressure, for in line installation. *Standard of Acceptance: Amtrol, Armstrong*
- 2.13.2. Tangential Air Separator: ASME Pressure Vessel Code construction for 861 kPa (125 psig) working pressure, flanged tangential inlet and outlet connection, internal perforated stainless steel air collector tube designed to direct released air into expansion tank, bottom blowdown connection. Provide a removable stainless steel strainer element having 5 mm (3/16 inch) perforations and free area of not less than five times the cross sectional area of connecting piping. *Standard of Acceptance: Amtrol, Armstrong.*
- 2.13.3. Diaphragm Type Expansion Tank: Full acceptance type, ASME Pressure Vessel Code construction for 861 kPa (125 psig) working pressure, welded steel shell, rust proof coated, with a flexible elastomeric diaphragm suitable for a maximum operating temperature of 116 degrees C (240 degrees F). Tank shall be equipped with system connection, drain connection, standard air fill valve and be factory pre charged to a minimum of 83 kPa (12 psig). Capacity: as indicated on the equipment schedules. *Standard of Acceptance: Amtrol, Armstrong.*
- 2.13.4. Pressure Reducing Valve (Water): Diaphragm or bellows operated, spring loaded type, with minimum adjustable range of 28 kPa (4 psig) above and below set point. Bronze, brass or iron body and bronze, brass or stainless steel trim, rated 861 kPa (125 psig) working pressure at 107 degrees C (225 degrees F). *Standard of Acceptance: Watts, Bell and Gossett.*
- 2.13.5. Pressure Relief Valve: Bronze or iron body and bronze or stainless steel trim, with testing lever. Comply with ASME Code for Pressure Vessels, Section 8, and bear ASME stamp.
- 2.13.6. Automatic Air Vent Valves: Automatic air vent should be used only on air separators and similar applications in mechanical rooms. When used, pipe outlet to floor drain to prevent damage from leaks. Cast iron or semi steel body, 1034 kPa (150 psig) working pressure, stainless steel float, valve, valve seat and mechanism, minimum 15 mm (1/2 inch) water connection and 6 mm (1/4 inch) air outlet. Air outlet shall be piped to the nearest floor drain.
- 2.13.7. Radiator/Convactor Automatic Air Vent: N/A

2.14. GLYCOL FILL TANK

2.14.1. Glycol auto fill unit complete with expansion tank to control and provide expansion and maintain the glycol system pressure by providing glycol make-up automatically upon a drop in system pressure

2.14.2. Construction

- 2.14.2.1. Polypropylene Tank 200 liter (53 gallon) capacity
- 2.14.2.2. Pump construction: all bronze
- 2.14.2.3. Water fill connection: ball valve - 304 SS ball, brass body
- 2.14.2.4. Glycol fill connection: ball valve - 304 SS ball, brass body
- 2.14.2.5. Contacts for BAS remote indication for: high level/low level/pump run

2.14.3. The glycol autofill shall be provided with the following standard features:

- 2.14.3.1. The unit shall monitor and maintain the minimum system pressure at all times
- 2.14.3.2. Low mixture cut-out level switches shall monitor the status of the mixing tank
- 2.14.3.3. Level switches shall be 24 volt maximum to ensure intrinsic electrical safety
- 2.14.3.4. Pump suction isolation valve
- 2.14.3.5. Pump suction strainer
- 2.14.3.6. Single phase power connection
- 2.14.3.7. 45 psi (300 kPa) fill pressure

2.14.4. Standard of Acceptance: Armstrong GLA Series

2.15. WATER FILTERS AND POT CHEMICAL FEEDERS

2.15.1. See section 23 25 00, HVAC WATER TREATMENT

2.16. GAGES, TEMPERATURE, PRESSURE AND COMPOUND

2.16.1. See section 23 05 11 COMMON WORK RESULTS FOR HVAC

2.16.2. Provide brass lever handle union cock. Provide brass/bronze pressure snubber for gages in water service.

2.16.3. Range of Gages: Provide range equal to at least 150 percent of normal operating range.

2.17. WATER FILTERS AND POT CHEMICAL FEEDERS

2.17.1. See section 23 25 13, CHEMICAL TREATMENT – CLOSED LOOPS

2.18. PRESSURE/TEMPERATURE TEST PROVISIONS

- 2.18.1. Pete's Plug: 6 mm (1/4 inch) MPT by 75 mm (3 inches) long, brass body and cap, with retained safety cap, nordelself closing valve cores, permanently installed in piping where shown, or in lieu of pressure gage test connections shown on the drawings.

2.19. FIRESTOPPING MATERIAL

- 2.19.1. Refer to Section 23 05 11, COMMON WORK RESULTS FOR HVAC

PART 3 - EXECUTION

3.1. GENERAL

- 3.1.1. 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 Board. Coordinate with other trades for space available and relative location of HVAC equipment and accessories to be connected. Pipe location on the drawings shall be altered by contractor where necessary to avoid interferences and clearance difficulties.
- 3.1.2. 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.
- 3.1.3. Support piping securely. Refer to Section 23 05 11, COMMON WORK RESULTS FOR HVAC.
- 3.1.4. 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.
- 3.1.5. 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.

- 3.1.6. Offset equipment connections to allow valving off for maintenance and repair with minimal removal of piping.
- 3.1.7. 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.
- 3.1.8. Provide manual or automatic air vent at all piping system high points and drain valves at all low points. Install piping to floor drains from all automatic air vents.
- 3.1.9. Connect piping to equipment as shown on the drawings and as recommended by the manufacturer.
- 3.1.10. Install components furnished by others such as:
 - 3.1.10.1. Water treatment pot feeders and condenser water treatment systems.
 - 3.1.10.2. Flow elements (orifice unions), control valve bodies, flow switches, pressure taps with valve, and wells for sensors.
 - 3.1.10.3. 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.
- 3.1.11. Firestopping: Fill openings around uninsulated piping penetrating floors or fire walls, with firestop material. For firestopping insulated piping refer to Section 23 07 11, INSULATION – HVAC SYSTEMS.
- 3.1.12. Where copper piping is connected to steel piping, provide dielectric connections.

3.2. PIPE JOINTS

- 3.2.1. Welded: Beveling, spacing and other details shall conform to ASME B31.1 and AWS B2.1. See Welder's qualification requirements under "Quality Assurance" in Section 23 05 11, COMMON WORK RESULTS FOR HVAC and STEAM GENERATION.
- 3.2.2. 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.
- 3.2.3. 125 Pound Cast Iron Flange (Plain Face): Mating flange shall have raised face, if any, removed to avoid overstressing the cast iron flange.

3.2.4. Solvent Welded Joints: As recommended by the manufacturer.

3.3. BRAZING

3.3.1. Flux shall not be allowed to penetrate to the inside of the pipe. The outside of the tube and fittings shall be cleaned by washing with hot water in order to remove any residual flux.

3.3.2. During the brazing of the pipe connections, except when performing final connections and emergency repairs, the interior of the pipe shall be maintained with a nitrogen atmosphere. This shall be done by purging the pipe a sufficient number of times to remove all air and oxygen and by maintaining a small purge flow.

3.4. EXPANSION JOINTS (BELLOWS AND SLIP TYPE)

3.4.1. N/A

3.5. LEAK TESTING ABOVEGROUND PIPING

3.5.1. Inspect all joints and connections for leaks and workmanship and make corrections as necessary, to the satisfaction of the Resident Engineer. Tests may be either of those below, or a combination, as approved by the Resident Engineer.

3.5.2. An operating test at design pressure, and for hot systems, design maximum temperature.

3.5.3. A hydrostatic test at 1.5 times design pressure. For water systems the design maximum pressure would usually be the static head, or expansion tank maximum pressure, plus pump head. Factory tested equipment (convertors, exchangers, coils, etc.) need not be field tested. Isolate equipment where necessary to avoid excessive pressure on mechanical seals and safety devices.

3.6. FLUSHING AND CLEANING PIPING SYSTEMS

3.6.1. Water Piping: Clean systems as recommended by the suppliers of chemicals specified in Section 23 25 00, HVAC WATER TREATMENT.

3.6.2. Initial flushing: 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 down stream 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 Resident Engineer.

3.6.3. Cleaning: Using products supplied in Section 23 25 00, HVAC WATER TREATMENT, 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.

3.6.4. Final Flushing: 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.

3.7. WATER TREATMENT

3.7.1. Install water treatment equipment and provide water treatment system piping.

3.7.2. Close and fill system as soon as possible after final flushing to minimize corrosion.

3.7.3. Charge systems with chemicals specified in Section 23 25 00, HVAC WATER TREATMENT.

3.7.4. Utilize this activity, by arrangement with the Resident Engineer, for instructing VA operating personnel.

3.8. OPERATING AND PERFORMANCE TEST AND INSTRUCTION

3.8.1. Refer to PART 3, Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

3.8.2. Adjust red set hand on pressure gages to normal working pressure.

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 of Section 20 05 11 Mechanical General Requirements.

1.2 DESCRIPTION

- 1.2.1 Ductwork and accessories for HVAC including the following:
1.2.1.1 Supply air, return air, outside air, exhaust, and relief systems.

1.3 DEFINITIONS

- 1.3.1 SMACNA Standards as used in this specification means the HVAC Duct Construction Standards, Metal and Flexible.
1.3.2 Seal or Sealing: Use of liquid or mastic sealant, with or without compatible tape overlay, or gasketing of flanged joints, to keep air leakage at duct joints, seams and connections to an acceptable minimum.
1.3.3 Duct Pressure Classification: SMACNA HVAC Duct Construction Standards, Metal and Flexible.
1.3.4 Exposed Duct: Exposed to view in a finished room, and/or exposed to weather.

1.4 QUALITY ASSURANCE

- 1.4.1 Fire Safety Code: Comply with NFPA 90A.
1.4.2 Duct System Construction and Installation: Referenced SMACNA Standards are the minimum acceptable quality.
1.4.3 Duct Sealing, Air Leakage Criteria, and Air Leakage Tests: Ducts shall be sealed as per duct sealing requirements of SMACNA HVAC Air Duct Leakage Test Manual for duct pressure classes shown on the drawings.
1.4.4 Duct accessories exposed to the air stream, such as dampers of all types (except smoke dampers) and access openings, shall be of the same material as the duct or provide at least the same level of corrosion resistance.

1.5 SUBMITTALS

- 1.5.1 Submit in accordance with the Mechanical General Requirements:
.1 Rectangular ducts:
.1 Schedules of duct systems, materials and selected SMACNA construction alternatives for joints, sealing, gage and reinforcement.
.2 Sealants and gaskets.
.3 Access doors.
1.5.2 Round and flat oval duct construction details:
.1 Manufacturer's details for duct fittings.
.2 Sealants and gaskets.
1.5.3 Access sections.
1.5.4 Volume dampers, back draft dampers.

- 1.5.5 Upper hanger attachments.
- 1.5.6 Fire dampers, fire doors, and smoke dampers with installation instructions.
- 1.5.7 Sound attenuators, including pressure drop and acoustic performance.
- 1.5.8 Flexible ducts and clamps, with manufacturer's installation instructions.
- 1.5.9 Flexible connections.
- 1.5.10 Instrument test fittings.
- 1.5.11 Details and design analysis of alternate or optional duct systems.

1.6 APPLICABLE PUBLICATIONS

- 1.6.1 The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- 1.6.2 Air Moving and Conditioning Association (AMCA):
 - .1 500D-98 Laboratory Method of Testing Dampers for Rating
 - .2 500L-99 Laboratory Method of Testing Louvers for Rating
- 1.6.3 American Society for Testing and Materials (ASTM):
 - .1 A653-01 Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy coated (Galvannealed) by the Hot-Dip process
 - .2 A1011-02 Standard Specification for Steel Sheet and Strip Hot rolled Carbon structural, High-Strength Low-Alloy and High Strength Low-Alloy with Improved Formability
 - .3 B209-01 Standard Specification for Aluminum and Aluminum Alloy Sheet and Plate
 - .4 C1071-00 Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material)
 - .5 E84-01 Standard Test Method for Surface Burning Characteristics of Building Materials
- 1.6.4 National Fire Protection Association (NFPA):
 - .1 90A-99 Standard for the Installation of Air Conditioning and Ventilating Systems
 - .2 96-01 Ventilation Control and Fire Protection of Commercial Cooking Operations
- 1.6.5 Sheet Metal and Air Conditioning Contractors National Association (SMACNA):
 - .1 2nd Edition – 1995 HVAC Duct Construction Standards, Metal and Flexible
 - .2 1st Edition - 1985 HVAC Air Duct Leakage Test Manual
 - .3 6th Edition – 1992 Fibrous Glass Duct Construction Standards

PART 2 - PRODUCTS

2.1 DUCT MATERIALS

- 2.1.1 General: Except for systems specified otherwise on drawings, construct ducts, casings, and accessories of galvanized sheet steel, ASTM A527, coating G90.

2.2 GALVANIZED STEEL - RECTANGULAR DUCTWORK

- 2.2.1 G-90 coated galvanized of lock-forming grade conforming to ASTM A653 and A924 Standards. Minimum yield strength for steel sheet and reinforcements shall be 30,000 PSI (207 kPa).
- 2.2.2 Thickness: to ASHRAE and SMACNA.
- 2.2.3 Fabrication: to ASHRAE and SMACNA.
- 2.2.4 Joints: to ASHRAE and SMACNA or proprietary manufactured duct joint. Proprietary

- manufactured flanged duct joint shall be considered to be a class B seal.
- .1 Standard of Acceptance: Namasco Ductmate; Exanno Nexus.
- 2.2.5 Fittings
- .1 Fabrication: to SMACNA.
- .2 Radiused elbows: standard radius.
- .3 Square elbows: over 16" with double thickness vanes. Not to be used unless specifically shown on drawings.
- .4 Main supply duct branches with splitter damper. If splitter damper is not used, provide branch and main duct balancing damper.
- .5 Sub branch duct with 45° entry and balancing damper on branch.
- 2.2.6 Transitions:
- .1 Diverging: 20° maximum included angle.
- .2 Converging: 30° maximum included angle.
- 2.2.7 Offsets: radiussed elbows as indicated.
- 2.2.8 Obstruction deflectors: maintain full cross- sectional area. Maximum included angles as for transitions.

2.3 SEALING CLASSIFICATION

- .1 Sealing classification as follows:

Seal Class	Sealing Requirements	Applicable Static Pressure Construction Class	Allowable Leakage Rate
A	All traverse joints, longitudinal seams and duct wall penetrations	4" w.g. (1000 Pa) -4" w.g. (-1000 Pa)	1% of total system design at system operating pressure 4"(1000 Pa)
B	All transverse joints and longitudinal seams	Up to 3" w.g. (750 Pa) -3" w.g. (-750 Pa) and less	1% of total system design at 3" w.g. (750 Pa)
C	All transverse joints only	Up to 2" w.g. (500 Pa) -2" w.g. (500 Pa) and less	1.5% of total system design at 2" w.g. (500 Pa)
D	Not sealed	Up to 1" w.g. (250 Pa) -1" w.g. (-250 Pa) and less	5% of total system design at 1" w.g. (250 Pa)

2.4 PRESSURE CLASSIFICATIONS

- .1 Ductwork material shall be constructed in accordance with SMACNA ratings for the following pressure classifications. Seal classifications shall be in accordance with the following table:

Ductwork	Operating Pressure	Seal Classification	Remarks
All supply ductwork	Up to 2". w.g. (500 Pa)	B	

All return ductwork	Up to 1 " w.g. (250 Pa)	B	
All exhaust ductwork	Up to -1" w.g. (-250 Pa)	B	
All Other Ductwork	Up to 0.5" w.g. (125 Pa)	D	

2.5 SEALANT AND TAPE

- 2.5.1 Joint Sealing: Refer to SMACNA HVAC Duct Construction Standards, paragraph S1.9.
- 2.5.2 Sealant: Elastomeric compound, gun or brush grade, maximum 25 flame spread and 50 smoke developed (dry state) compounded specifically for sealing ductwork as recommended by the manufacturer. Generally provide liquid sealant, with or without compatible tape, for low clearance slip joints and heavy, permanently elastic, mastic type where clearances are larger. Oil base caulking and glazing compounds are not acceptable because they do not retain elasticity and bond.
- 2.5.3 Tape: Use only tape specifically designated by the sealant manufacturer and apply only over wet sealant. Pressure sensitive tape shall not be used on bare metal or on dry sealant.
- 2.5.4 Gaskets in Flanged Joints: Soft neoprene.
- 2.5.5 Approved factory made joints such as DUCTMATE SYSTEM may be used.

2.6 DUCT CONSTRUCTION AND INSTALLATION

- 2.6.1 Follow SMACNA HVAC Duct Construction Standards.
- 2.6.2 Where specified, all ductwork shall be made liquid tight with continuous external weld for all seams and joints. Provide neoprene gaskets at flanged connections. Where ducts are not self-draining back to the equipment, provide low point drain pocket with copper drainpipe to sanitary sewer. Provide access door in side of duct at drain pockets.
- 2.6.3 Casings and Plenums
- .1 Construct in accordance with SMACNA HVAC Duct Construction Standards Section 6, including curbs, access doors, pipe penetrations, eliminators and drain pans. Access doors shall be hollow metal, insulated, with latches and door pulls, 500 mm (20 inches) wide by 1200 - 1350 mm (48 54 inches) high. Provide view port in the doors where shown. Provide drain for outside air louver plenum. Outside air plenum shall have exterior insulation. Drain piping shall be routed to the nearest floor drain.
- 2.6.4 Volume Dampers
- .1 Opposed blade, multi louver type as detailed in SMACNA Standards. Refer to SMACNA Detail Figure 2-12 for Single Blade and Figure 2.13 for Multi-blade Volume Dampers.
- 2.6.5 At the onset of the project, the Sheet Metal Contractor shall submit a sketch demonstrating and confirming the ability to transition the ductwork from the unit to the size shown on the Drawing within the Roof Curb. Advise of any issues prior to fabrication.
- 2.6.6 For all down-discharge rooftop unit, any elbows or transitions within 60' of the unit shall be equipped with turning vanes.

2.7 HANGERS AND SUPPORTS

- 2.7.1 Strap hangers: of same material as duct but next sheet metal thickness heavier than duct.
- 2.7.2 Hanger configuration: to ASHRAE and SMACNA. Maximum size duct supported by straphanger: 500mm.
- 2.7.3 Hangers: galvanized steel angle with black galvanized steel rods to ASHRAE and SMACNA following table:

Duct Size (mm)	Angle Size (mm)	Rod Size (mm)
up to 750	25 x 25 x 3	6
751 to 1500	40 x 40 x 3	10
1501 to 2400	50 x 50 x 5	10
2401 and over	50 x 50 x 6	10

2.7.4 Upper hanger attachments:

- .1 For concrete: manufactured concrete inserts.
 - .1 Standard of Acceptance: Myatt fig 485.
- .2 For concrete after concrete pour:
 - .1 Expanded concrete anchors shall be made of steel.
 - .2 Powder actuated fasteners shall only be utilized for slabs that are thicker than 100 mm (4") and shall not be utilized in lightweight aggregate concretes.
 - .3 Holes for expanding fasteners shall be drilled either by a carbide bit or by the teeth on the fastener itself. Expansion shield shall be "set" by driving it into the hole and expanding it with a conical plug.
- 2.7.3 For steel joist: manufactured joist clamp or steel plate washer.
 - .1 Standard of Acceptance: Grinnell fig 61 or 86 for joist clamps.
- 2.7.4 For steel beams: manufactured beam clamps:
 - .1 Standard of Acceptance: Grinnell fig. 60
- 2.7.5 For round ductwork the duct shall be supported as follows:
 - .1 For duct dimensions 900 mm (36") single hangers are acceptable.
 - .2 For duct dimensions over 900 mm (36") hanger rods shall be provided on both sides of the duct.
 - .3 Minimum hanger sizes shall be in accordance with table 4-2 of SMACNA.
- 2.7.6 Loading on trapeze bars shall be in accordance with Table 4-3 of SMACNA.

2.8 DUCT ACCESS DOORS, PANELS AND SECTIONS

- 2.8.1 Provide access doors, sized and located for maintenance work, upstream and downstream of:
- .1 Each duct mounted coil.
 - .2 Each fire damper (for link service), smoke damper and automatic control damper.

- .3 Each duct mounted smoke detector.
- 2.8.2 Openings shall be as large as feasible in small ducts, 300 mm by 300 mm (12 inch by 12inch) minimum where possible. Access sections in insulated ducts shall be double wall, insulated. Transparent shatterproof covers are preferred for un insulated ducts.
- 2.8.3 For rectangular ducts: Refer to SMACNA HVAC Duct Construction Standards (Figure 2 12).
- 2.8.4 For round and flat oval duct: Refer to SMACNA HVAC duct Construction Standards (Figure2-11).

2.9 FIRE DAMPERS

- 2.9.1 Galvanized steel, interlocking blade type, UL listing and label, 1 1/2 hour rating, 70 degrees C (160 degrees F) fusible line, 100 percent free opening with no part of the blade stack or damper frame in the air stream.
- 2.9.2 Fire dampers in wet air exhaust shall be of stainless steel construction, all others may be galvanized steel.
- 2.9.3 Provide sleeves and mounting angles, minimum 1.9 mm (14 gage), required to provide installation equivalent to the damper manufacturer's UL test installation.
- 2.9.4 Submit manufacturer's installation instructions conforming to ULC rating test.
- 2.9.5 Combination fire and smoke dampers: Multi louver or curtain type units meeting all requirements of both dampers shall be used where shown and may be used at the Contractor's option where applicable.
- 2.9.6 Standard of Acceptance: Nailor, Ruskin

2.10 INSTALLATION

- 2.11.1 Fabricate and install ductwork and accessories in accordance with referenced SMACNA Standards:
- 2.11.2 Drawings show the general layout of ductwork and accessories but do not show all required fittings and offsets that may be necessary to connect ducts to equipment, boxes, diffusers, grilles, etc., and to coordinate with other trades. Fabricate ductwork based on field measurements. Provide all necessary fittings and offsets at no additional cost to the Owner. Coordinate with other trades for space available and relative location of HVAC equipment and accessories on ceiling grid. Duct sizes on the drawings are inside dimensions which shall be altered by Contractor to other dimensions with the same air handling characteristics where necessary to avoid interferences and clearance difficulties.
- 2.11.3 Provide duct transitions, offsets and connections to dampers, coils, and other equipment in accordance with SMACNA Standards, Section II. Provide streamliner, when an obstruction cannot be avoided and must be taken in by a duct. Repair galvanized areas with galvanizing repair compound.
- 2.11.4 Supply and install volume control dampers on all branch take-offs (applicable to supply, return and exhaust ductwork) whether shown on the drawing or not.
- 2.11.5 Provide bolted construction and tie rod reinforcement in accordance with SMACNA Standards.
- 2.11.6 Construct casings, eliminators, and pipe penetrations in accordance with SMACNA Standards, Chapter 6. Design casing access doors to swing against air pressure so that pressure helps to maintain a tight seal.
- 2.11.7 Install duct hangers and supports in accordance with SMACNA Standards, Chapter 4.

- 2.11.8 Install fire dampers in accordance with the manufacturer's instructions to conform to the installation used for the rating test.
- 2.11.9 Seal openings around duct penetrations of floors and fire rated partitions with fire stop material as required by NFPA 90A.
- 2.11.10 Where diffusers, registers and grilles cannot be installed to avoid seeing inside the duct, paint the inside of the duct with flat black paint to reduce visibility.
- 2.11.11 Control Damper Installation:
 - .1 Provide necessary blank off plates required to install dampers that are smaller than duct size. Provide necessary transitions required to install dampers larger than duct size.
 - .2 Assemble multiple sections dampers with required interconnecting linkage and extend required number of shafts through duct for external mounting of damper motors.
 - .3 Provide necessary sheet metal baffle plates to eliminate stratification and provide air volumes specified. Locate baffles by experimentation, and affix and seal permanently in place, only after stratification problem has been eliminated.
 - .4 Install all damper control/adjustment devices on stand-offs to allow complete coverage of insulation.
- 2.11.12 Air Flow Measuring Devices (AFMD): Install units with minimum straight run distances, upstream and downstream as recommended by the manufacturer.
- 2.11.13 Protection and Cleaning: Adequately protect equipment and materials against physical damage. Place equipment in first class operating condition, or return to source of supply for repair or replacement, as determined by the Consultant. Protect equipment and ducts during construction against entry of foreign matter to the inside and clean both inside and outside before operation and painting. When new ducts are connected to existing ductwork, clean both new and existing ductwork by mopping and vacuum cleaning inside and outside before operation.
- 2.11 DUCT LEAKAGE TESTS AND REPAIR**
- 2.12.1 Ductwork leak test shall be performed for the entire air distribution supply and return system including fans, coils and filter section designated as static pressure class 750 Pa (3 inch W.G.) and above.
- 2.12.2 All supply ductwork less than 500 Pa (2 inch W.G) shall also be tested to the air distribution equipment or terminal device (where applicable).
- 2.12.3 Test procedure, apparatus and report shall conform to SMACNA Leakage Test manual. The maximum leakage rate allowed is 4 percent of the design air flow rate.
- 2.12.4 All ductwork shall be leak tested first before enclosed in a shaft or covered in other inaccessible areas.
- 2.12.5 All tests shall be performed in the presence of the Consultant and the TAB agency. The Test and Balance agency shall measure and record duct leakage and report to the Consultant and identify leakage source with excessive leakage.
- 2.12.6 If any portion of the duct system tested fails to meet the permissible leakage level, the Contractor shall rectify sealing of ductwork to bring it into compliance and shall retest it until acceptable leakage is demonstrated to the Consultant.
- 2.12.7 All tests and necessary repairs shall be completed prior to insulation or concealment of ductwork.
- 2.12.8 Make sure all openings used for testing flow and temperatures by TAB Contractor are sealed properly.

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METALLIC DUCTWORK
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END OF SECTION

PART 1 **GENERAL**

1.1 **GENERAL**

- .1 This section of the Specification shall be read in conjunction with and shall be governed by the requirements outlined in Section 20 05 11 Mechanical General Requirements.

1.2 **REFERENCE STANDARDS**

- .1 Comply with requirements of:
 - 1. ULC S110M - Fire Tests for Air Ducts
 - 2. UL 181-2008 - Standards for Safety, Factory Made Air Ducts and Air Connectors
 - 3. NFPA 90A-2009 - Standard for the Installation of Air Conditioning and Ventilating Systems
 - 4. NFPA 90B-2009 - Standard for the Installation of Warm Air Heating and Air Conditioning Systems
 - 5. SMACNA – 2005 - HVAC Duct Construction Standards - Second Edition

1.3 **SUBMITTALS**

- .1 Submit shop drawings in accordance with Section 20 05 11 Mechanical General Requirements.

1.4 **CERTIFICATION OF RATINGS**

- .1 Catalogue or published ratings shall be those obtained from tests carried out by the manufacturer or Independent Testing Agency signifying adherence to Codes and Standards.
- .2 Product Requirements.

PART 2 **PRODUCTS**

2.1 **GENERAL**

- .1 Factory fabricated.
- .2 Pressure drop coefficients listed below are based on sheet metal duct pressure drop coefficient of 1.00.
- .3 Fire retardant type insulation materials, coverings and adhesives with maximum flame spread rating of 25 and maximum smoke developed rating of 50 when tested in accordance with CAN/ULC-S102 and NFPA 255-2006. Materials tested in accordance with ASTM C411-05 shall not flame, smoulder, glow or smoke at temperature to which exposed in

service. Flexible duct system shall meet OBC requirements for smoke and flame spread for return air plenums.

2.2 METALLIC-INSULATED

.1 Spiral wound flexible aluminum with 1" (25 mm) external insulation.

.2 Performance:

- Temperature range: -40°F to 250°F (-40°C to 120°C)
- Minimum bend radius: 1.5 x diameter
- Vinyl sleeve outer covering
- Maximum working pressure: 12" (3000 Pa)
- Class 1 duct material

PART 3 EXECUTION

3.1 DUCT INSTALLATION

.1 Install where indicated and in accordance with preferred method of SMACNA and the following:

1. Connections:

- a. Duct Sizes 300 mm (12") and Under:
 - i. Provide a minimum of three (3) #8 sheet metal screws equally spaced to hold the flexible duct.
- b. Duct sizes above 300 mm (12"):
 - i. Provide a minimum of five (5) #8 sheet metal screws equally spaced to hold the flexible duct.
- c. Screws shall be located at least 1/2" (12 mm) from the end of the duct.
- d. The collar to which the flexible duct is attached shall be a minimum 2" (50 mm) in length.
- e. Cover entire joint with tape and seal as specified in Section 15801.

2. Supports:

- a. Support shall be in accordance with SMACNA.
- b. The maximum amount of sag for flexible duct shall not exceed 1/2" (12 mm) per foot. Provide additional supports as required.

3. Length:

- a. Maximum length of flexible duct: 1500 mm (5 ft.).
- b. Minimum length of flexible duct connecting to light fixture troffers or ceiling diffusers shall be 72" (1800 mm).

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 20 05 11.
- .2 Definitions
 1. Refrigerating system: Combination of interconnected refrigerant-containing parts constituting one closed refrigeration circuit in which a refrigerant is circulated for the purpose of extracting heat.
 2. Low side means the parts of a refrigerating system subjected to evaporator pressure.
 3. High side means the parts of a refrigerating system subjected to condenser pressure.
 4. Brazed joint: A gas-tight joint obtained by the joining of metal parts with alloys which melt at temperatures higher than 427 degrees C (800 degrees F) but less than the melting temperatures of the joined parts.
- .3 Quality Assurance
 1. Comply with ASHRAE Standard 15, Safety Code for Mechanical Refrigeration. The application of this Code is intended to assure the safe design, construction, installation, operation, and inspection of every refrigerating system employing a fluid which normally is vaporized and liquefied in its refrigerating cycle.
 2. Comply with ASME Boiler and Pressure Vessel Code: Section IX: Welding and Brazing Qualifications.
 3. This section of the specification shall be read in conjunction with and shall be governed by the requirements outlined in Section 20 05 11 of the specification.
- .4 Submittals
 1. Sizing of refrigerant lines shall be by the air conditioning equipment manufacturer, based on the total developed length of pipes, site-measured. Final pipe sizing shall be shown on the submittal documents.
 2. Shop Drawings: Sufficient information for components noted, including valves and refrigerant piping accessories, piping schematics, clearly presented, shall be included to determine compliance with drawings and specifications for components noted below:
 1. Tubing and fittings, including pipe sizes for each coil and condensing unit.
 2. Valves

3. Strainers
 4. Moisture-liquid indicators
 5. Filter-driers
 6. Flexible metal hose
 7. Liquid-suction interchanges
 8. Oil separators (when specified)
 9. Gages
 10. Pipe and equipment supports.
 11. Flexible elastomeric pipe insulation
 12. Refrigerant and oil
 13. Pipe/conduit roof penetration cover
 14. Soldering and brazing materials
 15. Indoor supports arrangement and manufacture
 16. Roof pipe supports and manufacture.
-
3. Layout of refrigerant piping and accessories, including flow capacities, valves locations, and oil traps slopes of horizontal runs, floor/wall penetrations, and equipment connection details.
 4. Certification: Copies of certificates for welding procedure, performance qualification record and list of welders' names and symbols.
 5. Design Manual: Furnish two copies of design manual of refrigerant valves and accessories.
 6. The Contractor, as a part of the Shop Drawing submission, shall submit the refrigerant pipe sizing and design with the written approval of the Manufacturer of the system that the refrigerant pipe sizing and design is compliant with the Manufacturer's recommendations.

PART 2 PRODUCTS

2.1 PIPING AND FITTINGS

- .1 Refrigerant Piping
 1. Copper refrigerant tube, ASTM B280, cleaned, dehydrated and sealed, marked ACR on hard temper straight lengths. Coils shall be tagged ASTM B280 by the manufacturer.
- .2 Soldering:
 1. Solder joints: Wrought copper fittings, ANSI B16.22.
 2. Solder, refrigerant tubing: Cadmium free, AWS A5.8, 45 percent silver brazing alloy, Class Bag-5.
 3. Solder, water and drain: 95-5 tin-antimony, ASTM B32 (95TA).

4. Flanges and flanged fittings: ANSI B16.24.
- .3 Refrigeration Valves:
1. Stop Valves: Brass or bronze alloy, packless, or packed type with gas tight cap, frost proof, backseating.
 2. Pressure Relief Valves: Forged brass with nonferrous, corrosion resistant internal working parts of high strength, cast iron bodies conforming to ASTM A126, Grade B. Set valves in accordance with ASHRAE Standard 15.
 3. Solenoid Valves: ARI 760, UL-listed, two-position, direct acting or pilot-operated, moisture and vapor-proof type of corrosion resisting materials, designed for intended service, and solder-end connections. Fitted with suitable NEMA 250 enclosure of type required by location.
 4. Thermostatic Expansion Valves: Brass body with stainless-steel or non-corrosive non ferrous internal parts, diaphragm and spring-loaded (direct-operated) type with sensing bulb and distributor having side connection for hot-gas bypass and external equalizer. Size and operating characteristics as recommended by manufacturer of evaporator and factory set for superheat requirements. Solder-end connections. Testing and rating in accordance with ASHRAE Standard 17.
 5. Check Valves: Brass or bronze alloy with swing or lift type, with tight closing resilient seals for silent operation; designed for low pressure drop, and with solder-end connections. Direction of flow shall be legibly and permanently indicated on the valve body.
 6. Strainers: Designed to permit removing screen without removing strainer from piping system, and provided with screens 80 to 100 mesh in liquid lines up to 30 mm (1-1/8 inch), 60 mesh in liquid lines over 30 mm (1-1/8 inch), and 40 mesh in suction lines. Provide strainers in liquid line serving each thermostatic expansion valve, and in suction line serving each refrigerant compressor not equipped with integral strainer.
 7. Refrigerant Moisture/Liquid Indicators: Double-ported type having heavy sight glasses sealed into forged bronze body and incorporating means of indicating refrigerant charge and moisture indication. Provide screwed brass seal caps.
 8. Refrigerant Filter-Dryers: ULC listed, angle or in-line type, as shown on drawings. Conform to ASHRAE Standard 63. Heavy gage steel shell protected with corrosion-resistant paint; perforated baffle plates to prevent desiccant bypass. Size as recommended by manufacturer for service and capacity of system with connection not less than the line size in which installed. Filter driers with replaceable filters shall be furnished with one spare element of each type and size.

9. Flexible Metal Hose: Seamless bronze corrugated hose, covered with bronze wire braid, with standard copper tube ends.
10. Oil Separators: Provide for condensing units, where determined as necessary by the equipment manufacturer. All welded steel construction with capacity to eliminate a minimum of 95 percent of the oil from the hot gas flowing through it. Provide manufacturer's published ratings for minimum and maximum refrigeration tonnage corresponding to this oil separating efficiency. Conform to ASHRAE Standard 69. Separator shall be equipped with a float valve to prevent return of the hot gas to crankcase, and shall have isolating stop valves so it can be opened and serviced without pumping out any other part of the system. ASME construction or ULC listed.

2.2 PIPE SUPPORTS

- .1 See Drawings for the typical pipe support detail.

2.3 REFRIGERANT AND OIL

- .1 Provide required refrigerant and oil for proper system operation.

2.4 REFRIGERANT PIPE INSULATION

- .1 All refrigerant piping shall be insulated with not less than 3/4" inch elastomeric closed cell insulation as manufactured by Armaflex Armacell series. The insulation shall conform to the OBC requirements for smoke and flame development. Insulation shall be complete with UV resistant aluminum sleeve jacket and sealant.
- .2 All refrigerant piping insulation mounted outdoors (on the roof) shall be coated with water-based acrylic enamel as manufactured by Armaflex WB finish series. Apply as per the manufacturer's instruction.
- .3 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

2.5 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 inches 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: 1/2 inch wide, aluminum or stainless.

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Install refrigerant piping and refrigerant containing parts in accordance with the manufacturer's instructions, ASHRAE Standard 15 and ANSI B31.5. Refrigerant piping shall be brazed with 15 percent silver solder in accordance with AWS A5.8.
- .2 Prior to installing the refrigerant piping, inspect the available ceiling space and select the most direct route, with minimal interference with the existing utilities and building elements.
- .3 Drill adequate openings through the existing interior partitions, floors and roof to allow for the passage of the refrigerant piping. Where required allow for access doors. For roof penetrations, refer to details on the drawings.
- .4 Make good all surfaces affected by the work.
- .5 Horizontal runs shall be sloped toward compressor to insure oil return. Install piping as short as possible, with a minimum number of joints, elbow and fittings.
- .6 The lines should be installed so that they will not obstruct services access to the indoor coil, air handling system or filter.
- .7 Install piping with adequate clearance between pipe and adjacent walls and hangers to allow for service and inspection. Space piping, including insulation, to provide 25 mm (one inch) minimum clearance between adjacent piping or other surface. Use pipe sleeves through walls, floors, and ceilings, sized to permit installation of pipes with full thickness insulation.
- .8 Swab fittings and valves with manufacturer's recommended cleaning fluid to remove oil and other compounds prior to installation.
- .9 Install hangers and supports per Section 20 05 11, ANSI B31.5 and the refrigerant piping manufacturer's recommendations.
- .10 Protect refrigerant system during construction against entrance of foreign matter, dirt and moisture; have open ends of piping and connections to compressors, condensers, evaporators and other equipment tightly capped until assembly.
- .11 Under no circumstances shall the refrigerant compressor be used to evacuate the system. The evacuation shall be accomplished by the use of a vacuum pump at an ambient temperature not less than 35OF to ensure removal of all moisture and non-condensable gases.
- .12 Pass nitrogen gas through the pipe or tubing to prevent oxidation as each joint is brazed. Cap the system with a reusable plug after each brazing operation to retain the nitrogen and prevent entrance of air and moisture.

- .13 Pipe relief valve discharge to outdoors for systems containing more than 45 kg (100 pounds) of refrigerant.
- .14 Firestopping: Fill openings around uninsulated piping penetrating floors or fire walls, with firestop material.
- .15 Apply flexible cellular insulation and fabricate fittings in accordance with the manufacturer's written instructions. Use proper size material. Do not stretch or strain insulation. To avoid undue compression of insulation, provide cork stoppers or wood inserts at supports as recommended by the insulation manufacturer.
- .16 Where possible, slip insulation over the pipe or tubing prior to connection, and seal the butt joints with adhesive. Where the slip-on technique is not possible, slit the insulation and apply it to the pipe sealing the seam and joints with contact adhesive. Optional tape sealing, as recommended by the manufacturer, may be employed.
- .17 Apply two coats of weather-resistant finish as recommended by the manufacturer to insulation exposed to outdoor weather.

3.2 TENDER PROCESS

- .1 All refrigerant pipe sizing is to be completed by the Manufacturer of the VRF/Fan Coil System at the time of pricing. All sizing is to be provided to the Mechanical Contractor prior to bid submission. The Mechanical/Refrigeration Contractor is responsible for including all costs associated with supplying and installing a complete refrigerant/VRF system in the Base Tender Price. Include for all components necessary (filters, dryers, sight glasses, valves, etc.) for a complete refrigerant/VRF system in the Base Tender Price.

3.3 FIELD QUALITY CONTROL

- .1 Prior to initial operation examine and inspect piping system for conformance to plans and specifications and ASME 31.5.
- .2 The Manufacturer of the Fan Coil/VRF System is responsible for site reviewing the installation process throughout construction (a minimum of three (3) visits are required) and a final review upon completion of the full installation and prior to start-up. The Manufacturer of the Fan Coil/VRF System shall certify and provide written confirmation that the refrigeration system, including the piping, has been installed in strict accordance with the Manufacturer's recommendations.

3.4 FIELD TESTS

- .1 After completion of piping installation and prior to initial operation, conduct test on piping system according to ASME B31.5. Furnish materials and equipment required for tests. Perform tests in the presence of the consultant. If the test fails, correct defects and perform the test again until it is satisfactorily done and all joints are proved tight.

- .2 The high and low side of each system shall be tested and proved tight at not less than the lower of the design pressure or the setting of the pressure-relief device protecting the high or low side of the system, respectively.
- .3 Test Medium: A suitable dry gas such as nitrogen or shall be used for pressure testing. The means used to build up test pressure shall have either a pressure-limiting device or pressure-reducing device with a pressure-relief device and a gage on the outlet side. The pressure relief device shall be set above the test pressure but low enough to prevent permanent deformation of the system components.

3.5 SYSTEM TEST AND CHARGING

- .1 System Test and Charging: As recommended by the equipment manufacturer or as follows:
 - 1. Connect a drum of refrigerant to charging connection and introduce enough refrigerant into system to raise the pressure to 70 kPa (10 psi) gage. Close valves and disconnect refrigerant drum. Test system for leaks with halide test torch or other approved method suitable for the test gas used. Repair all leaking joints and retest.
 - 2. Connect a drum of dry nitrogen to charging valve and bring test pressure to design pressure for low side and for high side Test entire system again for leaks.
 - 3. Evacuate the entire refrigerant system by the triplicate evacuation method with a vacuum pump equipped with an electronic gage reading in mPa (microns). Pull the system down to 665 mPa (500 microns) and hold for four hours then break the vacuum with dry nitrogen (or refrigerant). Repeat the evacuation two more times breaking the third vacuum with the refrigeration to be charged and charge with the proper volume of refrigerant.

END OF SECTION

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ELECTRICAL SPECIFICATIONS INDEX

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SECTION

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26 05 00

Common Work Results for Electrical

26 05 01

Basic Materials & Methods

END OF SECTION

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 the Electrical Contractor.

1.3 WORK INCLUDED

- .1 Sections of these Electrical Specifications are not intended to delegate functions nor to delegate 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, The Electrical Contractor.
- .2 Supplementary to definitions established are:
 - 1. "Concealed" means hidden from normal sign in furred spaces, shafts, ceiling spaces, walls, or partitions. Wiring, raceways, and electrical boxes for all new or relocated devices shall be concealed.
 - 2. "Exposed" means work normally visible, including work in equipment rooms, tunnels, and similar spaces.
 - 3. "Provide" (and all tenses) means supply and install for a complete, operational, and code-compliant system, including all devices/equipment as specified complete with wiring, raceways, electrical boxes, and all other accessories or components required for a complete, operational, and code-compliant installation.
 - 4. "Install" (and all tenses) means secure in position, connect as specified, test, and verify.
 - 5. "Supply" means to supply all devices/equipment to the responsible trade.
 - 6. "Remove" means to isolate, disconnect, disassemble, remove, and dispose of all devices, equipment, wiring, raceways, and connections to other equipment. Patch and make good all surfaces affected by the removal. Remove and dispose of all redundant material off site

- .3 Where used, wordings such as "approved, to approval, as directed, permitted, permission, accepted, acceptance", shall mean: approved, directed, permitted, 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 with latest rules, regulations and definitions of 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.
- .3 All ESA Costs shall be included in the Electrical Contractor's Base Tender Price.

1.9 CERTIFICATES

- .1 Furnish necessary certificates as evidence that work installed conforms with laws and

regulations of authorities having jurisdiction.

1.10 GUARANTEE - WARRANTY

- .1 All material and labour provided as a part of the project shall be warrantied for a period of twelve (12) months starting from the Date of Substantial Completion for the Project.

1.11 SPECIFICATIONS, DRAWINGS & 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 The Base Tender Price shall be submitted based on the Base Specified Manufacturer as listed on the Drawings and/or Specifications. Any manufacturers listed as "equal" or "equivalent" may be proposed as an alternate to the Base Specified Manufacturer prior to Contract Execution with written approval only by the Consultant and Owner. Any changes to the Manufacturer of any materials/labour after execution of the Project Contract is not permitted.
- .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.

1.13 INTERFERENCE DRAWINGS

- .1 Prepare and submit complete interference drawings (in PDF format) to avoid and/or resolve conflict of trades and to coordinate the work of the Electrical Division with that of all other Trades. Submission of interference drawings shall be done no later than 20 business days after the Project has officially begun. The cost of producing the interference drawings shall be included for in the Base Tender Price.
- .2 Interference drawings shall indicate exact arrangements, of all areas and equipment to scale with dimensions.
- .3 Cooperate with work of the Mechanical Contractor and provide data requested and as required in the preparation of interference drawings for the work of The Mechanical Contractor.
- .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 detail 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 two (2) sets of documents and clearly mark in RED 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 AutoCad 2004 drawings. The cost of transferring all redline markups from the PDFs to the CAD files is the responsibility and cost of the Contractor.
- .6 Consultants shall be responsible for reviewing As-Built information provided by Contractor. Revise drawings to suit any comments until acceptable for submission to the Owner.
- .7 The Contractor is responsible for incorporating all information from Project Addenda, Contemplated Changes Notices, Site Instructions, Change Directives and as-found existing conditions into CAD format at no extra cost to the Contract.

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 AND 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 with 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.
- .6 Include all efforts for the tracing and verifying of all branch circuits and panels as required to complete the scope of work proposed on the drawings.

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 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 Owner in detail prior to commencing any work.

7. The Electrical Contractor must review and submit shop drawings for all materials to be supplied as a part of the Contract 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. The Shop Drawings must be reviewed and ensured for compliance with the Contract Documents by the Electrical Contractor and General Contractor prior to submission; confirmation of review and confirmation that the submittal is in compliance with the Contract Documents is the responsibility of the Electrical Contractor and General Contractor to include in writing with each Shop Drawing Submittal. Any non-conformance of the Submittal with the Contract Documents identified by the Electrical Consultant will require a resubmission of the Shop Drawing Submittal by the Electrical Contractor prior to review. The Electrical Contractor shall bear all costs of any review by the Electrical Consultant beyond the Original Shop Drawing Submission at a cost of \$250.00 CAD + HST per resubmission.
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 are not permitted. 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 access panel ratings shall match that of the surface in which it is being installed. All access panels requiring supply/install as a part of the project work shall be included for in the Base Tender Price.
12. All wiring shall be of minimum #12 gauge copper, except as otherwise noted or as required based on the intended use of the device/equipment. 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.
13. 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.
14. 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.
15. 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.

16. Demolition: remove all exposed conduits, branch wiring, outlets, etc. from surfaces being demolished.
17. 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.
18. All work shall be done with minimum possible interruption to the existing building systems and in the time schedule permitted by the Owner. Consult with the project supervisor prior to pricing. Complete the project within the allocated schedule.
19. Paint all exposed conduit and backboxes, inside and outside of the building, to match the surrounding colour. Minimize exterior conduit run where feasible.
20. All backboxes installed indoors shall be recessed. All backboxes installed outside shall be recessed.
21. 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.
22. Unless otherwise explicitly stated in writing in the Contract Documents, all materials, labour, scope and descriptions of work described in the Contract Documents is the responsibility of the Electrical Contractor to supply and install as a part of the Base Tender Price. No materials and/or labour is to be completed under the Project Allowances unless explicitly noted as such in the Contract Documents.
23. All new raceways and wiring installed shall be concealed in the existing/new partitions and/or above drop ceilings. No exposed run of raceway/wiring will be permitted whatsoever in the new construction area.
24. All demolition and new work shall be completed in strict accordance with the Contract Documents with no deviations unless instructed by the Electrical Consultant in writing prior to execution of the work. The Electrical Consultant is not responsible, nor required, to accept any work (regardless of its compliance with code) not completed in accordance with the Contract Documents. The Electrical Contractor will be responsible, at his/her cost, of furnishing a Sealed Letter from a Professional Engineer licensed in the Province of Ontario to accept and assume responsibility for all work not completed in accordance with the Contract Documents. The cost of obtaining this letter and the retaining of the Engineer, including all associated inspection charges, is the sole responsibility of the Contractor.
25. Unless otherwise noted, all devices, equipment, material, supplies, etc. shown on the drawings or otherwise required for a fully operational system as described/illustrated on

the Drawings shall be supplied and installed under this Project. It shall not be assumed that any of the devices, equipment, material, supplies, etc. shown on the Drawings are to be provided (in part or in whole) by any other Party.

26. Leave two (2) full sets of As-Built Drawings in full size (36"x48") on site at the conclusion of the project; handover to the Caretaker.
27. Panel directories shall include room numbers and names to identify the location of the device/equipment; obtain the finalized room numbering from the Architect at the time of preparation.

1.25 CLOSEOUT DOCUMENTS

- .1 Coordinate with the General Contractor to submit a comprehensive Closeout Document Package incorporating documents from all trades in one consolidated package. Closeout Documents shall consist of one (1) 3-ring binder hard copy and 3 USBs/CDs. The Electrical Section of the Closeout Documents shall consist of the following:
 - (a) Electrical Contractor Warranty Letter, signed and dated. Warranty shall be for a period of twelve (12) months starting on the Date of Substantial Completion.
 - (b) Project Shop Drawings, in consecutive order of the Consultant's number scheme.
 - (c) O&M Manuals for all equipment supplied on the project.
 - (d) ESA Inspection & 'Final' Certificates.
 - (e) Red-Line As-Built (by the Electrical Contractor) and CAD As-Built (completed by the Electrical Consultant in 2004 Format).
 - (f) Fire Alarm Verification Report.

1.26 TRAINING & DEMONSTRATION

- .1 At the completion of the project, provide a complete training and walkthrough of all new and/or replaced electrical systems provided as part of the project. Participants of the training and walkthrough will be established by the Owner. Responsibilities including the following:
 - (a) Demonstrate to the appointed Staff the intent of all new devices, equipment and system and how to operate them and maintain them in accordance with the Manufacturer's Requirements.
 - (b) Provide end-to-end training on how to use the new devices, equipment and systems installed for the Building's day-to-day operations.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCES

- .1 Conform to Section 26 05 00 Common Work Results for Electrical.

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) 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 of gland watertight EMT type with factory-installed insulated throats and provide compression type EMT couplings (cast fittings/set-screws are not acceptable) to be forged steel.
- .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.
- 5 All feeder cables shall be XLPE RW90.
- 6. All underground feeders and branch circuits run from and to outdoor environment shall be XLPE RWU90.

2.3 DEVICES

- .1 Wiring devices unless otherwise specified herein, or noted, shall be as manufactured by Hubbell, Leviton or Pass & Seymour.
- .2 Light Switches for shall be of low-voltage type as scheduled on the Drawings.
- .3 Occupancy sensors shall be of low-voltage type as scheduled on the Drawings.
- .4 Key-operated switches shall be of low-voltage type as scheduled on the Drawings.
- .5 Standard 15 Ampere, 120 volt duplex receptacles generally shall be specification grade Hubbell, Black, CSA #5-15R and tamperproof type throughout the Area of Work.
- .6 Special purpose receptacles as noted on the drawings shall be Hubbell Conforming to CSA configurations (Table 46 and Table 47 of Canadian Electrical Code) for non-locking and locking receptacles. Provide attachment cap for each special purpose receptacle.
- .7 "Range" receptacles shall be CSA Type 14-50R, 50 amp. 3 pole, 4 wire, grounding 125/250V flush receptacle. Provide the above with 5 foot rubber cord set, 50 amp. and connect equipment.
- .8 Receptacles with integral ground fault interrupter shall be Hubbell No. GF-5252 or approved equal.
- .9 Service receptacle shall be Hubbell No. 5262-RD.

- .10 Clock receptacle shall have recessed fitting. Leviton No. 5261/CH. Mount as per the Modular Control Panel detail.

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.

2.6 PANELBOARDS

- .1 See Section 26 05 20 for details.

2.7 SWITCHES

- .1 Provide fusible and non-fusible switches, NEMA Type 'HD' with quick-make, quick-break contacts, horsepower-rated where required, to match the motor protected. Provide holders to accept specified fuses. Switches to include mechanical cover interlocks and line side barriers.
- .2 Where applicable and available, switches shall be CSA "Approved For High Service Factor".
- .3 Provide safety disconnect switches adjacent to motors and other equipment when required by regulations.

2.8 FUSES

- .1 Provide fuse holders in fusible equipment with a complete set of proper size Form 1, HRC Nema J or L current limiting fuses. Fusible equipment so provided shall be adapted to reject CSA Standard C22.2 No. 59 fuses. Fuses shall be Federal Pioneer - "Econolim".
- .2 Provide one complete set of spare fuses for each rating and type used, unless otherwise scheduled.

- .3 Apply Thomas & Betts "Kopr/Shield" conductive anti-seize compound to all fuse ferrules and holders.

2.9 CLOCKS AND PROGRAM BELLS

- .1 Clocks to be synchronized analogue type 12" round surface mount on the Modular Control Panel with a white face, Black Finish Case, 12/24 hour, seep second hand, stem for correcting extended through bottom of housing, 120VAC.

Clock shall be American Time R54BHAV904-WEB complete with mounting bracket/hanger or approved equal.

- .2 Program Bells shall be fully recessed, in a recessed stainless steel wall box complete with stainless steel, vandal resistant grille for physical proection. The Contractor shall verify the existing bell circuit voltage and wiring and ensure that the proposed device will suit the existing voltage and wiring configuration. Bells shall be of vibrating type, NEMA 3R rated, 10" size and CSA Certified.

Bell shall be Edwards 340-10N5 (verify voltage and AC/DC configuration of the existing bells on site prior to ordering; order new to match the existing) complete with recessed wall box and stainless steel grille c/w brushed stainless finish.

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, center of outlet to finished floor, except for exposed masonry construction, shall generally be as follows:

Light Switches - 1100 mm
Receptacles - 450 mm

Television Outlets - 400 mm
Data/Telephone Outlets - 400 mm
Manual Fire Alarm Stations – 1,150 mm
Panelboards – 2,000 mm to top of trim for standard panels.
Clocks - 2000 mm or 300 mm below ceiling (except where mounted in a Control Panel).
Thermostats – 1,200 mm
Fire Alarm Audible Temporal Pattern Horn/Strobes – As per CAN/ULC-S524.

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 EXCAVATION & BACKFILL

- .1 Provide necessary excavating and backfilling inside and outside building required for work of this Division, performed as specified under another Division of the work, except as modified below.
- .2 Keep excavations free from water, pump as necessary.
- .3 Excavation for underground services shall be to required depths and dimension and shall be prepared as required, so that no portion of any conduit, bears directly against any rock or other hard surface.
- .4 Remove and dispose of all surplus excavated material.
- .5 Backfill promptly after approval of work. Prevent damage to or displacement of walls, piping, conduits, waterproofing and other work.
- .6 For direct buried conduit and cable in all soil conditions excavate to 150 mm (6") below and a minimum of 200 mm (8") to either side of the cable run. Fill back with a bedding

of sand.

- .7 Backfill trenches within building, with clean sharp sand in individual layers of maximum 150 mm (6") thickness, compacted to a density of 100% Standard Proctor. Hand compact the first layers up to a compacted level of minimum one foot. Hand or machine compact the balance up to grade, using approved equipment.
- .8 Backfill trenches outside buildings with granular 'A' gravel in layers not exceeding 150 mm (6") thickness, compacted to 100% Standard Proctor density up to grade level; manual compaction up to 450 mm (18") and mechanical compaction, using approved equipment, for the balance.
- .9 Make good work where damaged by excavation and filling work of this Division. Repair any subsequent settlement of fill placed under this Division and pay all costs in replacement of other work damaged by such settlement and restoration.

3.6 CONCRETE WORK

- .1 Provide concrete work where required for work of this Division in accordance with applicable requirements specified in Concrete Division 3.
- .2 Provide concrete Lighting Standard Bases, required for the work of this Division. Refer to detail on drawings.
- .3 Provide concrete Duct Banks required for the work of this Division. Refer to detail on drawing for typical construction details.
- .4 Reinforced concrete duct banks shall be keyed into sides of foundation walls. Extend and connect reinforcing steel of duct banks to reinforcing steel of foundation wall construction to prevent failure at the junction of the pipe support and wall.
- .5 Provide 100 mm (4") high housekeeping pads for all floor mounted electrical equipment, such as switchboard, distribution panels and transformer, etc.

3.7 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.

3.8 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.

3.9 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.

3.10 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.

3.11 CONDUIT, RACEWAYS AND WIREWAYS

- .1 Wire and cable shall be installed in conduit as follows:
 - Rigid galvanized steel conduit shall be used:
 - .1 Where noted and required by regulations.
 - .2 Where subject to mechanical damage.
 - .3 For all exposed conduit work.
 - .2 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 of gland watertight EMT type with factory-installed insulated throats and provide compression type EMT couplings (cast fittings/set-screws are not acceptable) to be forged steel.

- .3 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.
- .4 Fasten every conduit and cable to structure by means of approved conduit clamps or clips. Wire lashing is not acceptable.
- .5 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).
- .6 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.
- .7 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.
- .8 Conduit installed at the roof level of exposed structures, shall be run tight to roof deck, above purlins and beams.
- .9 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.
- .10 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.
- .11 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.
- .12 Wiring, boxes, conduit fittings, etc., in hazardous areas shall conform with Ontario Electrical Code, covering explosion-proof areas. Provide conduit seals where required by these regulations.
- .13 Provide housekeeping curbs around exposed conduits feeding panels, disconnect switches, starters, etc. penetrating floors in front of walls.

3.12 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 Number 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-jacketted "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. Vulkan 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.

3.13 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 Paint the full length of conduits (installed above accessible and inaccessible ceilings) and main pull and junction boxes (excluding obvious outlet boxes) as per the following colour scheme:

- Lighting	Yellow
- Lighting Controls	Orange
- Power	Blue
- Fire Alarm	Red
- Telephone/Data	Green
- Public Address, Sound and Clock System	Purple

All conduits shall be painted with minimum three (3) coats of paint along the full circumference of the conduit for a clean and consistent finish. Conduits shall be painted prior to installation.

- .9 In addition, each box shall be identified with a system and service designator of logic reference to the service.

3.14 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.

3.15 PANELBOARDS

- .1 Provide handle locking devices on circuit breakers feeding Plumbing, Heating, Ventilating equipment and controls and all auxiliary systems, time switches, and other devices as noted. Paint handles white, to permanently identify location and function. Provide 30 spare handle locking devices for future use.
- .2 Circuit numbers on drawings do not necessarily correspond to the numbers on the lighting panels. Circuits sharing a common neutral shall not be connected to the same main. Panel circuit breakers which are used directly for the switching of lighting fixtures shall be grouped in consecutive numbers commencing at breaker number one.
- .3 Use "Panduit" lok-strap cable ties for panelboard branch wiring.
- .4 Provide empty conduits from flush panelboards, and others as noted, terminating in accessible ceiling spaces, sized to accommodate spare and space breaker provisions. One 25 mm (1") conduit for each three spare breakers or spaces.

3.16 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 Mechanical Contractor's 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 unfused safety disconnect switches, fastened to exterior of roof mounted units, to approval.
- .9 Connect high temperature thermostats "Firestats" provided in ductwork by the Mechanical Contractor, to exhaust fan systems, to provide fan shutdown on activation.

3.17 GROUNDING & BONDING - GENERAL

- .1 Ground and bond 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.

3.18 FIRESTOPPING & 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 firestopping protection of openings through floors and fire rated walls and ceiling assemblies. Refer to Architectural Drawings for rated surfaces.
- .3 Caulk spaces between conduit, cables, bus ducts, raceways, cabletrays 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