

EXTERIOR RENOVATIONS AND ROOF REPLACEMENT
AT
1076 PAPE AVE, TORONTO

FOR

CITY OF TORONTO
TORONTO SHELTERS AND SUPPORT SERVICES (TSSS)

ISSUED FOR TENDER
JULY 2026

TABLE OF CONTENTS

Division 1 General Requirements

01 11 00	Summary of Work
01 14 00	Work Restrictions
01 21 00	Allowances
01 25 00	Alternatives & Substitutions
01 26 00	Contract Modification Procedures
01 29 00	Payment Procedures
01 31 13	Coordination
01 32 00	Construction Progress Documentation
01 33 00	Submittal Procedures
01 40 00	Quality Requirements
01 51 00	Temporary Utilities
01 52 00	Temporary Construction Facilities
01 56 00	Temporary Barriers and Enclosures
01 57 00	Temporary Controls
01 61 00	Common Product Requirements
01 71 00	Examination and Preparation
01 73 00	Execution
01 73 29	Cutting and Patching
01 74 00	Cleaning and Waste Management
01 77 00	Closeout Procedures
01 78 00	Closeout Submittals
01 79 00	Demonstration and Training
01 91 00	General Commissioning Requirements

Division 2 Existing Conditions

02 41 19	Selective Demolition

Division 3 Concrete

Not used

Division 4 Masonry

Not used

Division 5 Metals

05 55 00	Miscellaneous Metals

Division 6 Wood, Plastics and Composites

06 10 00	Rough Carpentry

Division 7 Thermal and Moisture Protection

07 20 00	Building Insulation
07 25 00	Weather Barriers
07 27 26	Air Barrier System
07 44 53	Glass Fiber Reinforced Cladding
07 46 19	Metal Cladding
07 52 00	Modified Bituminous Membrane Roofing

07 62 00	Prefinished Metal Flashing and Trim
07 76 00	Roof Pavers
07 90 20	Sealants

Division 8 Openings

08 36 00	Overhead Garage Doors
08 54 00	Fibreglass Windows
08 80 00	Glazing

Division 9 Finishes

09 29 00	Gypsum Wall Board
09 30 00	Tiling
09 67 00	Epoxy Flooring
09 90 00	Painting

Division 20 Mechanical Support

20 05 10	Demolition
20 05 11	Mechanical General Requirements
20 05 31	Pipe Hangers and Supports
20 05 32	Access Doors
20 05 33	Identification
20 05 60	Piping Insulation
20 06 11	Testing, Adjusting and Balancing

Division 22 Plumbing

22 11 16	Domestic Water Piping
22 13 13	Drainage Piping and Vent

Division 23 Heating, Ventilation and Air Conditioning

23 07 13	Ductwork Insulation
23 11 23	Natural Gas Piping
23 31 13	Metallic Ductwork
23 33 46	Flexible Ducts
23 74 07	Refrigerant Piping

Division 26 Electrical

26 05 00	Common Work Results for Electrical
26 05 01	Basic Materials & Methods

Division 31 Earthworks

31 22 13	Rough Grading
31 23 00	Excavation Backfill Site Grading

Division 32 Exterior Improvements

32 12 16	Asphalt Paving
<i>Refer to grading plan for Asphalt Paving requirements</i>	

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.
- Architectural modifications as required, in service of roofing upgrades.
- New exterior overcladding and replacement of existing fixed/operable windows.
- Exterior asphalt repairs/line painting, new accessible exterior ramp and remediation/repair of existing exterior trellis.
- Interior refurbishment including ceiling repair and replacement of walk-in fridge flooring.
- 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
01 29 00	Payment Procedures
01 31 13	Coordination
01 32 00	Construction Progress Documentation
01 33 00	Submittal Procedures
01 40 00	Quality Requirements
01 51 00	Temporary Utilities
01 52 00	Temporary Construction Facilities
01 56 00	Temporary Barriers and Enclosures
01 57 00	Temporary Controls
01 61 00	Common Product Requirements
01 71 00	Examination and Preparation
01 73 00	Execution
01 73 29	Cutting and Patching
01 74 00	Cleaning and Waste Management
01 77 00	Close Out Procedures
01 78 00	Close Out Submittals
01 79 00	Demonstration and Training
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.
- .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 phrases 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.
- .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.
- .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 AWWA - 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 GENERAL

- .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 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 and elements, as detailed on the Drawings for use in the following locations:
 - .1 Guardrail/handrails at exterior ramps/stairs and roof patio
 - .2 Various fabrications as detailed

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.
- .3 Samples:
 - .1 Provide samples of duplex powder coat finish over hot dip galvanizing, on 100 x 100mm sheet steel (in triplicate).

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 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 All Stainless Steel for interior use to be type 304, brushed satin finish, analysis 18-8.
- .6 All Stainless Steel for exterior use to be type 316, brushed satin finish.
- .7 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.
- .8 Steel Pipe: Hot-dip galvanized, zinc coated, welded and seamless type steel pipe conforming to ASTM A53/A53M.
- .9 Aluminum Plate and Sheet: ASTM B209M, Alloy 6061-T6.
- .10 Aluminum Extrusions: ASTM B221M, Alloy 6063-T6.
- .11 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.

- .12 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.
- .13 Primer Paint: CISC/CPMA 2-75.
- .14 Bolts, Nuts, Washers: Conforms to ASTM A325.
- .15 Welding Materials: Conforms to CSA W59.
- .16 Metal Filler: Polyester based type.
- .17 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.
- .18 Isolation Coating: Acid and alkali resistant bituminous paint.
- .19 Building Paper: Conforms to CAN/CGSB-51.32.
- .20 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 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 Components scheduled for powder coat finish after galvanizing shall be prepared according to ASTM D7803, including:
 - .1 Grind and fill as required to remove all bumps, runs and drips.
 - .2 Remove organic material with mild alkaline, acidic or solvent solution.
 - .3 Rinse and remove cleaning solution; thoroughly dry.
 - .4 Profile all surfaces using either sweep blasting, grinding or zinc phosphate solution.
 - .5 Bake at minimum 30C above temperature used to cure powder coat finish.

2.5 SHOP APPLIED COATINGS AND PROTECTION

- .1 Preparation
 - .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.
- .2 Priming
 - .1 Apply shop coat of primer to all surfaces except areas requiring field welding. Apply by brush, working paint well into surfaces, interstices and cavities. Primer to be zinc rich for exterior applications.

- .2 Primer is to be free of runs, sags, or other collections of primer due to dipping of members into primer.
- .3 Prime field welded areas after erection and touch up shop coat where damaged and barred by erection and handling.

2.6 GENERAL FINISH REQUIREMENTS

- .1 Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" recommendations for applying and designating finishes.
- .2 Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipment.
- .3 Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.7 STEEL FINISHING

- .1 Hot-dip galvanized 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 High Performance Organic Spray Finish:
 - .1 Two (2) Coat PVDF or FEVE Coating on hot-dip galvanized exterior steel railings and handrails.
 - .1 Manufacturer's standard 2 coat, thermo-cured system consisting of specially formulated inhibitive primer and colour topcoat.
 - .2 Apply a minimum of 200 mg of Zinc Phosphate treatment to hot-dip galvanized elements, and allow to cure. Apply Primer at 1.0 +/- 0.20 mils, cure and apply topcoat at recommended thickness.
 - .3 Colour: As selected by Consultant from manufacturer's full product range.
 - .4 Basis of Design Materials: PPG Duranar, or approved equivalent.
- .3 Note all decorative metal handrails/guardrails to be galvanized and high performance organic spray finished.

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 Exterior Guardrails and Handrails:
 - .1 Guardrail (G1) at ramps/stairs (exterior):
 - .1 Galvanized steel guardrail, complete with flat bar top/bottom rails with vertical bar pickets, flat bar vertical balusters
 - .2 Handrails: 43mm diameter handrail on 10mm diameter bar stand offs at heights as per drawings.
 - .3 Mounting: non-shrink epoxy grout into metal stair.
 - .4 Finish: hot dip galvanized.
 - .2 Handrail (H1) at ramps/stairs (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.
- .5 Exterior guard at roof patio
 - .1 Galvanized vertical posts complete with continuous flat bar top rail, and mounting plate at bottom.
 - .1 Complete with flat bar top/bottom rails with vertical bar pickets
 - .2 Fastening: Mechanically fasten post bottom plate into concrete paver, brace top rail/end posts back to adjacent building/parapet.
 - .2 Gate: galvanized steel frame with pin type hinges welded to frame, complete with stop and hasp for padlock
 - .3 Finish: hot dip galvanized + high performance organic paint
- .6 Corner Guards
 - .1 Stainless steel corner guards at exterior corners of GWB framed walls where identified in drawings.

- .1 2" x 2" x 48" L, 16gauge
 - .2 Refer to drawings for locations
- .7 Loose Lintels:
 - .1 Provide and install loose lintels if not by structural steel.
 - .2 Finish: Hot-dip galvanized after fabrication.
- .8 Other Miscellaneous Metal Components:
 - .1 As required and indicated on drawings.
 - .2 Finish: Prime paint for interior components, 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 supply and installation of the following:
 - .1 Mineral Fibre Board Insulation within exterior rainscreen wall cavity
 - .2 Mineral Wool Cavity Wall Insulation Board at parapet walls
 - .3 Concrete Faced Perimeter insulation board

1.2 REFERENCE STANDARDS

- .1 Underwriters Laboratories of Canada (ULC):
 - .1 CAN/ULC S701-11, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering
 - .2 CAN/ULC S702-09-AM1, Standard for Thermal Insulation Mineral Fibre for Buildings
 - .3 CAN/ULC S114-05, Standard Method of Test for Determination of Non-Combustibility in Building Materials
 - .4 CAN/ULC S102-10, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies
- .2 American Society for Testing and Materials (ASTM):
 - .1 ASTM D1621-10, Standard Test Method for Compressive Properties of Rigid Cellular Plastics
 - .2 ASTM D2842-06, Standard Test Method for Water Absorption of Rigid Cellular Plastics
- .3 Canadian General Standards Board (CGSB):
 - .1 CGSB 71-GP-24M, Adhesive, Flexible for Bonding Cellular Polystyrene Insulation
 - .2 CAN/CGSB-37.5, Cutback Asphalt Plastic Cement
 - .3 CAN/CGSB-51.10-92, Mineral Fibre Board Thermal Insulation
- .4 Canadian Standards Association (CSA):
 - .1 CSA A123.3-05 (R2010), Asphalt Saturated Organic Roofing Felt

1.3 SUBMITTALS

- .1 Provide submittals in accordance with Division 01.
- .2 Affidavits:
 - .1 In lieu of samples and inspection procedures when required by CGSB and CAN/ULC Standards, submit affidavits, if requested, that materials supplied under these requirements meet CGSB and CAN/ULC Standards.
- .3 Safety Data Sheets:
 - .1 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.
- .4 Product Data Sheets.

1.4 DELIVERY, STORAGE, HANDLING AND PROTECTION

- .1 Store insulation materials in dry areas, protected from wetting, sunlight and traffic. Store insulation board flat, on a flat surface, and to prevent edge damage and placing of materials on top of stored boards.
- .2 Ensure that insulation board and adhesives are stored at a minimum temperature of 4 deg C for twelve (12) hours before installation, and that freezable adhesives are stored only at temperatures above 0 deg C at all times.
- .3 Do not expose rigid insulation board to sunlight after installation. Protect it with black polyethylene or tarpaulin cover as recommended by manufacturer if permanent covering is not completed within twenty-four (24) hours.

2 Products

2.1 MANUFACTURERS

- .1 Basis-of-Design Products: Products named in this Section were used as the basis-of-design for the project; additional manufacturers offering similar products may be incorporated into the work of this Section provided they meet the performance requirements established by the named products and provided they submit requests for substitution five (5) days in advance of Bid Closing.
- .2 Acceptable Manufacturers of foam based insulation: Subject to compliance with requirements specified in this Section, manufacturers offering products that may be incorporated into the Work include the following:
 - .1 Plastifab
 - .2 Owens-Corning Canada
 - .3 Dow Canada
 - .4 T. Clear Corp.
 - .5 Beaver Plastics Ltd.
 - .6 Or approved equivalent.
- .3 Acceptable Manufacturers of mineral wool based insulation: Subject to compliance with requirements specified in this Section, manufacturers offering products that may be incorporated into the Work include the following:
 - .1 Rockwool Inc
 - .2 Owens Corning Canada
 - .3 Powerwool
 - .4 Or approved equivalent

2.2 INSULATION MATERIALS

- .1 Mineral Wool Cavity Wall Insulation Board (INS-01):
 - .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.
 - .1 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.

- .2 Moisture sorption: 1 % maximum to ASTM C1104/C1104M.
- .3 Fungi resistance: Zero mould growth to ASTM C1338.
- .4 Profile: square edges, thickness as required to meet design insulation values indicated on drawings.
 - .1 Black mat facer at outboard insulation layer within open-joint rainscreen conditions and as indicated on drawings.
- .2 Basis of Design Material:
 - .1 CavityRock by ROCKWOOL Inc.,
 - .2 or approved equivalent
- .2 Mineral Wool Cavity Wall Batt Insulation (INS-02):
 - .1 Unfaced, semi-rigid mineral slag batt insulation in accordance with CAN/ULC S702-09, Type 1; having a nominal RSI of 0.67/25 mm; rated non-combustible in accordance with CAN/ULC S114-05 and having a flame spread rating of 5 or less in accordance with CAN/ULC S102; density 32 kg/m³; square edges, thickness as required to meet design insulation values indicated on drawings or as required to fill insulated spaces where not indicated.
 - .2 Basis of Design Materials:
 - .1 ROCKWOOL Inc., COMFORTBATT
 - .2 Thermafiber, SAFB (2.5 pcf Density)
 - .3 Or approved equivalent.
- .3 Concrete Faced Perimeter Insulation Board (INS-04):
 - .1 Construction:
 - .1 Perimeter Foundation Insulation: Extruded polystyrene board to ASTM C578 (CAN/ULC-S701) Type IV, rigid, closed cell, with integral high density skin, complete with integral 8mm (5/16") thick latex-modified concrete facing.
 - .2 Board Size: 610mm x 1220mm x 59mm (24" x 48" x 2-5/16").
 - .3 Edges: Tongue and groove sides, square edge ends.
 - .4 Thermal Resistance (ASTM C 518): Long term aged R-value of 5/1" (0.03 sm K/W / 1mm).
 - .5 Foam Compressive Strength: ASTM D1621, minimum: 35 psi (240 kPa).
 - .6 Compressive Strength Total: ASTM D1621, minimum 40 psi (275.6 kPa).
 - .7 Water Absorption (ASTM D2842): <0.1 (0.7% by volume maximum).
 - .8 Water Vapor Permeance (ASTM E96): 0.8 (50 ng/Pas m).
 - .2 Basis of Design Material:
 - .1 WallGUARD Concrete Faced Insulated Perimeter Wall Panels by T. Clear Corp.

2.3 INSULATION FASTENERS AND CLIPS

- .1 Low Thermal Conductivity Insulation Fasteners (conventional insulation stick pins are not acceptable):
 - .1 High density polyethylene (HPDE) plastic fastener with holding diameter of 60mm

- .2 Depth of Fastener: shaft length to suit insulation thickness/substrate, as recommended by the Insulation Fastener Manufacturer.
- .3 Basis of Design Material:
 - .1 InsulFast I-F by Ramset
 - .2 FPR by Friulsider
 - .3 or approved equivalent.
- .2 Concrete Faced Perimeter Insulation Fasteners: Manufacturer's standard concealed fasteners with groove mounting plate and fastening spline.
- .3 Thermally Broken Insulation Clips: Stainless steel, adjustable clips, complete with a thermal break pad at the back (insulation/moisture barrier interface). Clips include cut-outs that represent 15% to 20% of the clip volume, reducing quantity of conductive material, further reducing the effects of thermal bridging in wall systems.
 - .1 Adjustable clips are a two-piece design; Stainless steel pieces, "L" shaped. The inner piece of the clip fits inside the outer piece, allowing the exact depth of the clip to be adjusted on-site by the installers.
 - .2 Basis of Design Materials: ACS-A Thermal Clip by Soprema, or approved equivalent.
 - .3 Size: Required to suit depth of Insulation, allowing fastening to structural support.

2.4 ACCESSORIES

- .1 Felt Slip Sheet: No. 15 asphalt saturated, organic, unperforated felt conforming to CSA A123.3-05 (R2010).
- .2 Slip Sheet Mastic: Cut back asphalt plastic cement conforming to CAN/CGSB-37.5.

3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: Verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for water-resistive barrier installation in accordance with manufacturer's written recommendations.
 - .1 Visually inspect substrate in presence of Consultant.
 - .2 Ensure surfaces are free of snow, ice, frost, grease and other deleterious materials.
 - .3 Inform Consultant of unacceptable conditions immediately upon discovery.
 - .4 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Consultant.
- .2 Start of insulation installation indicates installer's acceptance of substrate installation conditions.

3.2 PREPARATION

- .1 Clean substrates of substances harmful to insulations; remove projections that interfere with insulation attachment.
- .2 Proceed with installation only after unsatisfactory conditions have been corrected.
- .3 Insulation fastener manufacturer to conduct pull test in existing concrete/masonry substrate to confirm adequate penetration depth and pull out strength.

3.3 INSULATION INSTALLATION

- .1 Rainscreen Insulation INS-01: Install insulation and accessories in accordance with manufacturer's written instructions applicable to products and application indicated and as follows:
 - .1 Use insulation that is undamaged, dry, and unsoiled.
 - .2 Maintain continuous thermal insulation, vapour barrier and air tightness for building spaces and elements, and as follows:
 - .1 Saw cut and trim insulation neatly to fit spaces; fill voids with foamed-in-place insulation compatible with installed insulation.
 - .2 Butt edges and ends tight between intermittent/thermally broken clip system.
 - .3 Fit insulation tight against mechanical, electrical and other items protruding through the plane of insulation
 - .4 Use insulation free of broken or chipped edges
 - .5 Apply insulation in multiple layers to produce thickness indicated, offset joints between insulation layers.
 - .6 Hold insulation firmly against substrate using low thermal conductivity insulation fasteners spaced in accordance with manufacturers recommended spacing and pattern where required (frequency of fasteners to be minimized to reduce thermal bridging).
- .2 Cavity Wall Insulation INS-02: Install batt insulation in locations and thicknesses shown. Seal joints to prevent transfer of moisture.
 - .1 Use insulation that is undamaged, dry and unsoiled.
 - .1 Install insulation to maintain continuity of thermal protection to building elements and spaces.
 - .2 Cut insulation to fit around electrical boxes, pipes, ducts, openings, corners and all protruding obstructions occurring on the surface to be insulated and seal with adhesive.
 - .3 Keep insulation minimum of 75mm (3") away from heat emitting devices.
 - .4 Trim and cut insulation neatly to fit spaces. Butt joints tightly, offsetting vertical joints. In multiple layer application, offset both vertical and horizontal joints.
- .3 Board Insulation INS-04: Install board insulation to vertical surfaces with adhesive applied in accordance with manufacturer's written instructions, and as follows:
 - .1 Exterior Application: Extend boards as indicated on Drawings to top of footing, installed on exterior face of perimeter foundation wall.
 - .2 Install insulation fasteners as indicated above.
 - .3 Protect below grade insulation on vertical surfaces from damage during backfilling by applying protection board; set in adhesive according to insulation manufacturer's written instructions.
 - .4 Layout concrete-faced insulation boards to maximize board sizes. Do not use boards less than 152mm (6") wide.
 - .5 Install concrete faced insulation board system in orientation as indicated or to maximize full sheets. Complete with fastening clips and cap flashing in accordance with manufacturer's installation guidelines.

3.4 ADJUSTING AND CLEANING

- .1 At completion of installation remove off site all excess material and debris. Leave in clean, neat condition.
- .2 Make good all defects to this installation or defects to other Work caused by this installation.

3.5 PROTECTION

- .1 Protect installed board insulation from damage due to harmful weather exposures, physical abuse, and other causes.
- .2 Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION

1 General

1.1 SUMMARY

- .1 This Section includes requirements for supply and installation of weather barriers and accessories, installed behind open-joint cladding.

1.2 REFERENCE STANDARDS

- .1 American Society for Testing of Materials (ASTM):
 - .1 ASTM D882-2010, Standard Test Method for Tensile Properties of Thin Plastic Sheeting.
 - .2 ASTM E84-2010b, Standard Test Method for Surface Burning Characteristics of Building Materials.
 - .3 ASTM E96/96M-2010, Standard Test Methods for Water Vapor Transmission of Materials.
 - .4 ASTM E2178-2003, Standard Test Method for Air Permeance of Building Materials.
- .2 Air Barrier Association of America (ABAA):
 - .1 ABAA 2011, Installer's Certification Program.
 - .2 ABAA 2012, Water-resistive Barrier Installation Guideline.
- .3 American Association of Textile Chemists and Colorists (AATCC)
 - .1 AATCC 42 2007, Water Resistance: Impact Penetration Test.

1.3 ADMINISTRATIVE REQUIREMENTS

- .1 Co-ordination: Co-ordinate work of this Section with work of other trades for proper time and sequence to avoid construction delays.
- .2 Pre-Construction Conference: Arrange a site meeting, to coincide with regular bi-weekly site meetings.
 - .1 Notify attendees two (2) weeks prior to meeting and ensure meeting attendees include as minimum:
 - .1 Owner;
 - .2 Consultant;
 - .3 Water-resistive barrier installer;
 - .4 Manufacturer's Technical Representative.
 - .2 Ensure meeting agenda includes review of methods and procedures related to water-resistive barrier installation including co-ordination with related work.
 - .3 Record meeting proceedings including corrective measures and other actions required to ensure successful completion of work and distribute to each attendee within one (1) week of meeting.

1.4 SUBMITTALS

- .1 Provide submittals in accordance with Division 01.
- .2 Action Submittals:
 - .1 Product Data: Submit product data including manufacturer's literature for water-resistive barrier membrane and accessories, indicating compliance with specified requirements and material characteristics.

- .1 Submit list on water-resistive barrier manufacturer's letterhead of materials, components and accessories to be incorporated into Work.
- .2 MSDS report.
- .3 Include product names, types and series numbers.
- .4 Include contact information for manufacturer and their representative for this Project.
- .2 Samples:
 - .1 Submit duplicate 305mm x 305mm (12" x 12") sample of membrane.
 - .2 Submit duplicate 305mm (12") long samples of seam tape and each type of flashing materials.
- .3 Test Reports:
 - .1 Submit test reports showing compliance with specified performance characteristics and physical properties including air permeance, water vapour permeance and structural performance.
 - .2 Submit ICC-ESR documentation demonstrating compliance with ICC-AC 38 Acceptance Criteria for Water-Resistive Barriers.
- .4 Field Reports: Submit manufacturer's field reports within three (3) days of each manufacturer representative's site visit and inspection.
- .5 Installer Qualifications:
 - .1 Submit verification of manufacturer's approval of installer, or letter verifying installer's experience with work similar to work of this Section.
- .3 Closeout Submittals
 - .1 Operation and Maintenance Data: Supply maintenance data for water-resistive barrier materials for incorporation into manual specified in Division 01.
 - .2 Record Documentation:
 - .1 List materials used in water-resistive barrier work.
 - .2 Warranty: Submit warranty documents specified.

1.5 QUALITY ASSURANCE

- .1 Installer Quality Assurance: Manufacturer's approval of installer, or minimum two (2) years' experience with work similar to work of this Section.
 - .1 Ensure all accessories such as seam tape, flashing membranes, fasteners and sealants come from same source as water-resistive barrier membrane.

1.6 MOCK-UP

- .1 Provide mock-ups in accordance with Division 01.
- .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, and as follows:
 - .1 Locate mock-ups in the location and of the size indicated or, if not indicated, as directed by Consultant.
 - .2 Notify Consultant 7 days in advance of the dates and times when mock-ups will be constructed.
 - .3 Demonstrate the proposed range of aesthetic effects and workmanship.

- .4 Include examples of window frame, door frame, interior corner, exterior corner and common protrusions or penetrations of membranes.
- .5 Obtain Consultant's acceptance of mock-ups before proceeding with construction of work of this Section.
- .6 Maintain mock-ups during construction in an undisturbed condition, as a standard for judging the completed Work.
- .7 Accepted mock-ups may form a part of the completed Work.

1.7 ENVIRONMENTAL CONDITIONS

- .1 Weather barrier shall to be applied to surfaces that are either wet, oily, frosted, dirty or contaminated in any way.
- .2 Ambient Conditions: Apply air and vapour membrane to substrate surfaces that are within manufacturer's installation temperature threshold range accounting for wind cooling and apparent temperature when actual temperature is approaching manufacturer's minimum temperature threshold.

1.8 DELIVERY, STORAGE, HANDLING AND PROTECTION

- .1 Delivery and Acceptance Requirements:
 - .1 Deliver material in accordance with Division 01.
 - .2 Deliver materials and components in manufacture's original packaging with identification labels intact and in sizes to suit project.
- .2 Storage and Handling Requirements: Store materials off ground and protected from exposure to harmful weather conditions and at temperature conditions recommended by manufacturer.
 - .1 Ensure materials are protected from sunlight and UV radiation.
- .3 Packaging Waste Management:
 - .1 Separate and recycle waste packaging materials.
 - .2 Remove waste packaging materials from site and dispose of packaging materials at appropriate recycling facilities.
 - .3 Collect and separate for disposal paper and plastic material in appropriate on-site storage containers for recycling in accordance with Waste Management Plan.

1.9 WARRANTY

- .1 Manufacturer's Warranty: Submit, for Owner's acceptance, manufacturer's standard warranty document executed by authorized company official. Manufacturer's warranty is in addition to and not intended to limit other rights Owner may have under Contract Conditions.
 - .1 Ten (10) years limited material warranty.
- .2 Installer's Warranty: Submit installers warranty stating that weather barrier and accessories are installed in accordance with manufacturer's recommendations and that membrane, transitions and through-wall flashing membranes, primers, mastics, adhesives and sealants are sourced from one manufacturer.

2 Products

2.1 MANUFACTURERS

- .1 Basis-of-Design products are named in this Section; form the basis-of-design materials for the project; additional manufacturers offering similar products may be incorporated into the work of this Section provided they submit requests a minimum of five (5) days in advance of Bid Closing.

- .2 Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - .1 Dörken Systems Inc.,
 - .2 Pro Clima/Solitex
 - .3 SRP Air Outshield
 - .4 Or approved equivalent.

2.2 MATERIALS

- .1 Vapor permeable water-resistive barrier with highly tear-resistant thermo-bonded non-woven polyester substrate, and waterproof acrylic highly UV resistant coating.
 - .1 Include factory applied self-adhesive strip at longitudinal edges of barrier membrane.
- .2 Design Criteria:
 - .1 Water Vapor Permeance: To ASTM E96 (Procedure A), 204 perms minimum.
 - .2 Water Impact Penetration Resistance: To AATCC 42, no water passing.
 - .3 Air Permeance: To ASTM E2178, 0.9 L/(s x m²) @ 75 Pa.
 - .4 Tear Resistance: To ASTM D 1922, 1916 g minimum.
 - .5 Dry Tensile Strength: To ASTM D882, MD 47.4 lb/in², CD 28.7 lb/in² minimum.
 - .6 Elongation at Break: To ASTM D882, MD 40 %, CD 45 % minimum.
 - .7 Fire Rating Characteristics to ASTM E84:
 - .1 Rating: NFPA Class A, IBC Class A minimum.
 - .2 Flame Spread: 10 maximum.
 - .3 Smoke Developed: 145 maximum.
- .3 Water-resistive Barrier for Walls: 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.
 - .1 Service Life Expectancy: Twenty-five (25) years.
 - .2 Weight: 5.5 lb/100 ft², 270 g/m², 44 lb/roll nominal.
 - .3 Colour: Black.
 - .4 Basis of Design Materials: Dörken Systems Inc., DELTA®-FASSADE S (or approved equivalent).
- .4 Accessories:
 - .1 Seam tape: In accordance with water-resistive barrier manufacturer's written recommendations.
 - .1 Basis of Design Materials: Dörken Systems Inc., DELTA®-FASSADE TAPE (or approved equivalent).
 - .2 Flashings: Self-adhering, water-resistive flashing membrane in accordance with water-resistive barrier manufacturer's written recommendations.
 - .1 Basis of Design Materials: Dörken Systems Inc., DELTA®-FASSADE FLASHING (or approved equivalent).
 - .3 Fasteners: Water and vapour resistant fasteners in accordance with water-resistive barrier manufacturer's written recommendations.

- .1 41mm (1-5/8") corrosion-resistant screw with 50mm (2") minimum diameter plastic caps, unless otherwise recommended by the manufacturer.
- .4 Sealants and Adhesives: Elastomeric sealant and adhesive in accordance with water-resistive barrier manufacturer's written recommendations, and Section 07 92 00.
 - .1 Ensure sealants are UV resistant and compatible with adjacent materials.
 - .2 Basis of Design Materials: Dörken Systems Inc., DELTA®-THAN (or approved equivalent).
- .5 Primers: In accordance with flashing manufacturer's written recommendations.
- .6 Flexible Membrane Through-wall Flashing: Self-adhering, butyl-rubber based flashing membrane.
 - .1 Basis of Design Materials: Dörken Systems Inc., DELTA®-TW FLASHING (or approved equivalent).

3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: Verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for water-resistive barrier installation in accordance with manufacturer's written recommendations.
 - .1 Visually inspect substrate in presence of Consultant.
 - .2 Inform Consultant of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Consultant.

3.2 PREPARATION

- .1 Prepare surfaces in accordance with manufacturer's written requirements for type of substrate; free from voids, spalled areas, loose aggregates or sharp points; clean surfaces to remove contaminants that could affect bond such as grease or wax, dust, dirt and debris.
- .2 Ensure step flashings and kick-out flashings are installed before beginning installation of water-resistive barrier membrane.
- .3 Ensure protrusions that may penetrate water-resistive barrier membrane are removed before beginning installation.

3.3 INSTALLATION

- .1 Install water-resistive barrier before installation of windows and doors in accordance with manufacturer's written recommendations.
- .2 Do installation in accordance with ABAA written recommendations for installation of water-resistive barriers.
- .3 Unroll water-resistive barrier with printed side out, wrapping entire building, including rough openings for windows, doors and other protrusions or penetrations.
 - .1 Install water-resistive barrier plumb and level to exterior face of sheathing, or directly to framing members in accordance with manufacturer written recommendations.
 - .2 Ensure water-resistive barrier is installed with textured side facing substrate.

- .4 Start installation of water-resistive barrier at building corner, leaving 150mm to 305mm (6" to 12") of membrane extended beyond corner.
- .5 Install horizontally starting at bottom of wall.
 - .1 Overlap water-resistive barrier membrane as follows:
 - .1 Exterior Corners: 305mm (12") minimum.
 - .2 Vertical and horizontal seems: 150mm (6") minimum.
 - .3 Other seams, joints or at protrusions and penetrations: 150mm (6") minimum.
- .6 Attachment of Water-resistive Barrier Membrane to Substrate:
 - .1 Attach water-resistive barrier to steel studs through exterior sheathing with mechanical fasteners, and elastomeric adhesive in accordance with manufacturer's written recommendations.
 - .1 Secure using fasteners and custom caps spaced 157mm (18") maximum vertically on center along stud line and 610mm (24") maximum on center, horizontally.
 - .2 Ensure fasteners penetrate securely through metal studs 19mm (3/4") minimum.
 - .3 Install fasteners 150mm (6") from sill and frame of window and door openings.
 - .4 Ensure fasteners are installed 229mm (9") minimum from window or door head.

3.4 SITE QUALITY CONTROL

- .1 Field Inspection: Coordinate field inspection in accordance with Division 01.
- .2 Manufacturer's Services:
 - .1 Coordinate manufacturer's services.
 - .1 Manufacturer review work involved in handling, installation, protection, and cleaning of water-resistive barrier and components, and submit written reports in acceptable format to verify compliance of Work with Contract conditions.
 - .2 Manufacturer's Field Services: Provide manufacturer's field services consisting of product use recommendations and periodic site visits for product installation review in accordance with manufacturer's instructions.
 - .1 Report any inconsistencies from manufacturer's recommendations immediately to Consultant.
 - .3 Schedule site visits to review work at stages listed:
 - .1 As required by consultant.
 - .2 Obtain reports within three (3) days of review and submit immediately to Consultant.

3.5 CLEANING AND PROTECTION

- .1 Progress Cleaning: Perform cleanup as work progresses in accordance with Division 01.
 - .1 Leave work area clean end of each day.
- .2 Final Cleaning: Upon completion, remove surplus materials, rubbish, tools, and equipment.
- .3 Waste Management:

- .1 Coordinate recycling of waste materials.
- .2 Collect recyclable waste and dispose of or recycle field generated construction waste created during construction or final cleaning related to work of this Section.
- .3 Remove recycling containers and bins from site and dispose of materials at appropriate facility.
- .4 Protect installed products and components from damage during construction.
- .5 Repair damage to adjacent materials caused by water-resistive barrier installation.

END OF SECTION

1 General

1.1 SUMMARY

- .1 Supply labour, materials, plant, tools and equipment to complete the Work as shown on the Drawings and as specified herein, including, but not limited to the following:
 - .1 Materials and installation methods of vapour permeable air barrier membrane system.
 - .2 Materials and installation methods to bridge and seal the following air leakage pathways and gaps:
 - .1 Connections of the walls to the roof air barrier. Connections of the walls to the foundations, seismic and expansion points, openings and penetrations of window frames, store front, and other envelope systems, door frames, piping, conduit, duct and similar penetrations, masonry ties, screws, bolts and similar penetrations. All other leakage pathways in the building envelope.
 - .3 Provide all components necessary for a complete Air Barrier System (AB-01/02), including but not limited to:
 - .1 Adhesives/Primers
 - .2 Fluid Applied, Vapor Permeable Air & Water Barrier Membrane
 - .3 Sheet and Liquid Transition Membranes
 - .4 Sealant
 - .5 Flexible thru-wall flashings

1.2 PERFORMANCE REQUIREMENTS

- .1 Provide a vapour permeable air barrier constructed to perform as a continuous air and vapour barrier, and as liquid water drainage plane flashed to discharge any incidental condensation or water penetration.
- .2 The building envelope shall be designed and constructed to control air leakage into, or out of the conditioned space, for a targeted post-retrofit air leakage rate of 1.0 L/s/m² at 50 Pa., as indicated in Section 01 83 16 Airtightness Testing Exterior Enclosure Requirements.
- .3 Field records including positive and negative pressure air change test results performed according to Section 01 83 16, construction progress documentation as indicated in Section 01 32 33, inspections schedule and evidence of reviews.
- .4 The air barrier shall be joined in an airtight and flexible manner to the air barrier material of adjacent systems, allowing for the relative movement of systems due to thermal and moisture variations and creep. Connection shall be made between:
 - .1 Foundations and walls.
 - .2 Walls and windows or doors.
 - .3 Different wall systems.
 - .4 Wall and roof.
 - .5 Wall and roof over unconditioned space.
 - .6 Walls, floor and roof across construction, control and expansion joints.
 - .7 Walls, floors and roof to utility, pipe and duct penetrations.
 - .8 All penetrations of the air barrier and paths of air infiltration/exfiltration shall be made airtight.

- .5 Sequence work to permit installation of materials in conjunction with related materials and seals.

1.3 QUALITY ASSURANCE

- .1 Work in this Section is to be carried out by a skilled applicator approved by manufacturer and in strict accordance with manufacturer's printed instructions. Upon request, provide written confirmation or certification from the vapour permeable air barrier manufacturer that the installer has been trained and is recognized by the manufacturer as suitable for the execution of the work.
- .2 Perform Work in accordance with the manufacturer's written instructions of the air barrier membrane and this specification.
- .3 Maintain one (1) copy of the manufacturer's written instructions on site.
- .4 Compounds used in this section shall be sourced from one (1) manufacturer, including sheet membrane, air barrier sealants, primers, mastics and adhesives.
- .5 Pre-Installation Conference:
 - .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 personal before commencement of work for this Section.
 - .2 Review preparation and installation procedures and co-ordinating and scheduling required with related work.
 - .3 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 the vapour permeable air barrier membrane, including the following:
 - .1 Tour, inspect and discuss condition of substrate, penetrations and preparatory work performed by other trades.
 - .2 Review surface preparation, minimum curing period and installation procedures.
 - .3 Review special details and flashings.
 - .4 Review required submittals, both completed and yet to be completed.
 - .5 Review and finalize construction schedule related to work and verify availability of materials, installer's personnel, equipment and facilities needed to make progress and avoid delays.
 - .6 Review required inspections, testing, protection and repair procedures.
 - .7 Review weather and forecasted weather conditions, and procedures for coping with unfavourable conditions.
- .6 Arrange for a Manufacturer's Representative to:
 - .1 Visit the site and discuss any special requirements, procedures and unique conditions, prior to commencement of work.
 - .2 Inspect substrate surfaces and recommend solutions to accommodate requirements for surface preparation of the existing coating and any adverse conditions. Provide letter stating substrate is suitable for installation of specified system.
 - .3 Periodically visit and inspect the installation and report unsatisfactory conditions to the Contractor.

- .4 Attend final inspection and to submit written certification that the products, systems and assemblies have been installed in accordance with the manufacturer's requirements.
- .7 Inspection and Testing:
 - .1 Cooperate and coordinate with the Owner's inspection and testing agency. Do not cover any installed vapour permeable air barrier membrane until any required inspections, testing approvals have been completed.
 - .2 Contractor and membrane manufacturer's representative shall conduct at least three ASTM D4541 Adhesion test at random mock-up locations, demonstrating membrane achieves minimum pull strength of 16 PSI.

1.4 SUBMITTALS

- .1 Provide submittals in accordance with Division 01.
- .2 Documentation:
 - .1 Prior to commencing the Work, submit documentation from an approved independent testing laboratory certifying that the air leakage and vapour permeance rates of the air barrier membranes, including primary membrane and transition sheets, exceed the requirements of the OBC.
 - .2 Prior to commencing the Work submit copies of manufacturer's current ISO certification. Membrane, primers, sealants, adhesives and associated auxiliary materials shall be included.
 - .3 Prior to commencing the Work submit references clearly indicating that the membrane manufacturer/installer has successfully completed projects on an annual basis of similar scope and nature for a minimum of fifteen (15) years. Submit references for a minimum of ten (10) projects.
 - .4 Prior to commencing the Work submit manufacturer's complete set of standard details for the air barrier membrane system showing a continuous plane of air tightness throughout the building envelope.
 - .5 Prior to commencing work provide a material checklist, complete with application rates and minimum thickness of primary membranes.
- .3 Shop Drawings:
 - .1 Show the locations and extent of the vapour permeable air barrier system including details of typical conditions, intersections with other envelope systems and materials, membrane counter-flashings and details showing how gaps in construction will be bridged and how miscellaneous penetrations such as conduits, pipes, etc. are sealed.
- .4 Samples:
 - .1 Submit to Consultant for approval, samples of materials and components to be used in vapour permeable air barrier system, prior to fabrication of work together with name of manufacturer and technical literature. Submit 305mm x 305mm (12" x 12") samples of vapour permeable air barrier membrane.
- .5 Safety Data Sheets:
 - .1 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.

1.5 ENVIRONMENTAL CONDITIONS

- .1 Vapour permeable air barrier membrane is not to be applied to surfaces that are either wet, oily, frosted, dirty or contaminated in any way.
- .2 Maintain surface of substrates and ambient temperatures constantly between 38 deg C and 5 deg C during application and curing of primers and adhesives for flexible vapour

permeable air barrier membrane flashings, except as permitted otherwise by Consultant in writing.

1.6 MOCK-UPS

- .1 Provide mock-ups in accordance with Section 01 43 39.
- .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.

1.7 DELIVERY, STORAGE, HANDLING AND PROTECTION

- .1 Coordinate deliveries with construction schedule and arrange for proper storage areas.
- .2 Deliver materials to the job site in undamaged and original packaging indicating the name of the manufacturer and product.
- .3 Store materials in a clean, dry and protected area, off the floor or ground, in their original containers, sealed and undamaged. Manufacturer's labels are to be easily visible and undamaged. Store rolled materials on end.
- .4 Store liquid membrane materials, adhesives and primers at minimum 5 degree C, and store away from open flames, sparks and excessive heat as liquid membrane materials and primers are flammable because of solvent content.
- .5 Care and precaution are to be exercised by the applicator so as not to damage the work of other trades. Applicator is responsible to take all necessary precautions to protect work of other trades during application.
- .6 In addition to the above, store modified bituminous sheet type flexible vapour permeable air barrier membrane flashings as follows;
 - .1 Store rolls of membrane tape in accordance with manufacturers written instructions.
 - .2 Store materials away from direct heat or open flame.
 - .3 Store rolls away from direct sunlight until ready for use.
 - .4 For installation in cold weather, store rolls of membrane in heated storage trailer for minimum of 24-hours with the temperature kept at 21 degree C and remove for application with as little exposure as possible to low ambient temperatures.
- .7 The vapour permeable air barrier membrane is not designed for permanent exposure, but can be left exposed for up to a maximum of thirty (30) days. As soon as possible after the membrane has cured, protect vapour permeable air barrier membrane from damage by work of other Sections.

1.8 WARRANTY

- .1 Warrant the work of this Section against defects in materials and workmanship in accordance with the General Conditions, but for a period of two (2) years and agree to repair and replace faulty materials or work which becomes evident during the warranty period, without cost to the Owner. Provide the Owner with a written warranty to this effect.

2 Products

2.1 MATERIALS – PRIMARY AIR BARRIER

- .1 Fluid-applied, Vapour Permeable Air Barrier System (AB-01): One-component, water-based, elastomeric emulsion membrane, designed to provide a vapor permeable air and water barrier when applied above-grade wall assemblies, having the following properties.
 - .1 Color: Graphite
 - .2 Solids Content:
 - .1 By Weight: 63%
 - .2 By Volume: 53%
 - .3 Service Temperature:
 - .1 Low Temperature: -40 degrees F (-40 degrees C)
 - .2 High Temperature: +180 degrees F (+80 degrees C)
 - .4 Application Temperature:
 - .1 Low Temperature: +20 degrees F (-6 degrees C)
 - .2 High Temperature: +122 degrees F (+50 degrees C)
 - .5 Tensile Strength (ASTM D412): 104 psi (717 kPa)
 - .6 Elongation (ASTM D412): 420%
 - .7 Low Temperature Flexibility @ -22 degrees F (-30 degrees C) (ASTM D1970): Pass
 - .8 Freeze-Thaw Resistance (ASTM D2243): Pass; 10 cycles
 - .9 Nail Sealability (ASTM D1970): Pass
 - .10 VOC Content: 100 grams/liter max.
 - .11 Water Absorption (ASTM D471, modified): 5.6%
 - .12 Water Vapor Permeance (ASTM E96 B) @ 40 mils nominal dry film: 14 perms
 - .13 Air Permeability:
 - .1 Assembly Air Leakage (ASTM E2357): Pass
 - .2 Building Material (ASTM E2178): 0.0001 cfm/ft2 (0.0005 L/s.m2)
 - .14 Chemical Resistance: Resists salt solutions, mild acids and alkalis. Non-resistant to oils, grease or solvents
 - .15 Fire Testing (NFPA 285): Complies in various assemblies
 - .16 Flame Spread/Smoke Development (ASTM E84): 10/15
 - .17 Resistance to Mold, Mildew, and Fungal Growth (ASTM D5590): No growth
 - .18 Basis of Design Product:
 - .1 AirBloc 17MR by Henry Company, or
 - .2 approved equivalent.

2.2 AUXILIARY MATERIALS

- .1 Transition Membranes (AB-02):
 - .1 Self-Adhering flashings:
 - .1 Non-vapor permeable, self-adhered water resistive air and vapor barrier membrane consisting of an SBS rubberized asphalt compound, which is

integrally laminated to a blue engineered thermoplastic film, having the following properties:

- .1 Water Vapor Permeance (ASTM E96, Method A): .86 perms
- .2 Air Leakage of Air Barrier Assemblies (ASTM E2357): Pass
- .3 Air Leakage (ASTM E2178): <0.0005 L/s/m² @ 75Pa
- .4 Water Tightness (CAN/CGSB-37.58-M86): Pass.
- .5 Nail Sealability (ASTM D1970): Pass.
- .6 Tensile Strength:
 - .1 Membrane (ASTM D412-modified): 500 psi minimum
 - .2 Film (ASTM D828): 5000 psi minimum
- .7 Elongation (ASTM D412-modified): 200% minimum
- .2 Basis of Design Product:
 - .1 Blueskin SA, or
 - .2 Approved equivalent
- .2 Sheathing Joint Membranes:
 - .1 Vapor permeable, self-adhered water resistive air barrier membrane consisting of an engineered film and patented, permeable adhesive technology with split-back poly-release film, having the following properties:
 - .1 Air Leakage (ASTM E2178): <0.02 L/s/m² @ 75Pa
 - .2 Water Vapor Permeance (ASTM E96, Method A): 29 perms
 - .3 Air Leakage of Air Barrier Assemblies (ASTM E2357): Pass
 - .4 Resistance to Water Penetration (ICC-ES AC 38): Pass.
 - .5 Nail Sealability (ASTM D1970): Pass
 - .6 Surface Burning Characteristics (ASTM E84):
 - .1 Class A
 - .2 Flame Spread/Smoke Development (ASTM E84): 0/105
 - .7 Tensile Strength (ASTM D828): 182N MD/129N CD
 - .8 Cycling and Elongation (ICC-ES AC48): Pass
 - .2 Basis of Design Product:
 - .1 Blueskin VP160, or
 - .2 Approved equivalent
- .2 Adhesives and Primers:
 - .1 As recommended by manufacturer to suit site conditions.
- .3 Building Envelope Sealant:
 - .1 Moisture cure, medium modulus polymer modified sealing compound, having the following properties:
 - .1 Complies with Fed. Spec. TT-S-00230C, Type II, Class A.
 - .2 Complies with ASTM C920, Type S, Grade NS, Class 35.
 - .3 Elongation: 450 – 550%.

- .4 Remains flexible with aging.
 - .2 Basis of Design Product:
 - .1 HE925 BES Sealant, or
 - .2 Approved Equivalent
 - .4 Self-Adhesive Thru-Wall Flashing Membrane:
 - .1 Non-vapor permeable, self-adhered water resistive air and vapor barrier membrane consisting of an SBS rubberized asphalt compound, which is integrally laminated to a blue engineered thermoplastic film, having the following properties:
 - .1 High Temperature Stability - Flow Resistance (ASTM D5147): Pass
 - .2 Air leakage (ASTM E283): 0.005 L/s.m² @ 75 Pa
 - .3 Water vapor permeance (ASTM E96, Method B): 0.03 perms
 - .4 Low temperature flexibility (CGSB 37-GP-56M): Pass
 - .2 Basis of Design Product: Blueskin TWF
 - .5 Reinforcing Fabric (Joint Treatment Mesh):
 - .1 150mm (6") wide, open weave 20/10 mesh, glass fibre yarn saturated with synthetic resins, reinforcing fabric weighing minimum of 2.5 oz/sq.yd., and conforming to CGSB 37-GP-63M
 - .1 Basis of Design Product: Yellow Jacket 990-06 by Henry Company, or approved equivalent.
 - .6 Substrate Cleaners:
 - .1 Petroleum spirits thinner or low flash petroleum spirits (mineral spirits) conforming to CAN/CGSB-1.4-2000, or xylene thinner (xylol) conforming to CAN/CGSB-1.49-M.
 - .7 Packing Insulation:
 - .1 Loose, glass fibre or mineral fibre insulation, 1.0 lbs./cu.ft. density, and conforming to CAN/CGSB-51.11.
- 3 Execution
- 3.1 EXAMINATION
 - .1 The installer shall examine conditions of substrates, areas and other conditions under which the vapour permeable air barrier system will be applied for compliance with requirements.
 - .2 Verify that surfaces and conditions are ready to accept the Work of this section. Surfaces shall be sound, dry, even and free of oil, grease, dirt, excess mortar or other contaminants. Concrete surfaces shall be cured and dry, smooth without large voids, spalled areas or sharp protrusions. Masonry joints shall be flush and completely filled with mortar, and all excess mortar sitting on masonry ties shall have been removed. Verify substrate is visibly dry and free of moisture.
 - .3 Notify the Consultant in writing of any discrepancies. Commencement of work or any parts thereof shall mean acceptance of the prepared substrate.
 - .4 Do not proceed with application of vapour permeable air barrier membrane when rain is expected within 16-hours.
- 3.2 GENERAL
 - .1 Ensure continuity of the air seal throughout the scope of this section.

- .2 Components and membrane materials must be obtained as a single-source from the membrane manufacturer to ensure total system compatibility and integrity.
- .3 Install all materials in accordance with the manufacturer's written directions, unless otherwise specified herein.

3.3 SURFACE PREPARATION

- .1 Clean, prepare and treat substrates according to manufacturer's written instructions. Surfaces to be coated must be smooth, clean, dry, firm to the touch and free from oil, grease, dirt, excess mortar and other contaminants.
 - .1 Brushing and/or scraping of substrates may be required to adequately prepare surface.
 - .2 Remove all poorly bonded, existing surface coating prior to installing work of this Section.
 - .3 Thoroughly wash metal surfaces with mineral spirits or xylol and wipe dry with clean rags.
- .2 Vapour permeable air barrier membrane is not to be applied over lightweight, cast-in-place concrete containing high moisture or certain curing compounds. Cast-in-place concrete should be cured for a minimum of two (2) weeks prior to application of vapour permeable air barrier membrane.
- .3 Concrete surfaces shall be free of large voids and spalled areas. Fill all spalled concrete areas, form-tie holes/voids and open mortar joints in concrete block with mortar to produce a smooth, even surface. Allow to cure properly before proceeding.

3.4 JOINT AND PROTRUSION TREATMENTS

- .1 Prepare only enough vapour permeable air barrier membrane compound as required for joint and protrusion treatments and can be used within compound's usable pot life. Mix vapour permeable air barrier membrane with a double blade agitator attached to a 13mm (1/2") drill in strict accordance with the manufacturer's written instructions.
- .2 Exterior sheathing board inside/outside corners: Embed minimum 305mm (12") wide, continuous strip of reinforcing fabric in vapour permeable air barrier membrane, centred over corner.
- .3 Fill joints up to 6mm (1/4") wide in exterior grade sheathing board and joints in between panels of exterior grade plywood with trowel application of vapour permeable membrane or mastic as recommended by manufacturer ensuring that joints are completely filled.
- .4 Where joints in exterior grade sheathing board are over 6mm (1/4") wide, ensure joints are completely filled with a vapour permeable membrane or mastic and apply continuous flexible air barrier membrane flashing or mesh as specified herein, lapped a minimum of 75mm (3") and fully adhered to both sides of substrate.
- .5 Where joints/cracks up to 6mm (1/4") wide occur in concrete or masonry, fill joints/cracks with a thick trowel application of vapour permeable air barrier membrane or mastic, ensuring that joints are completely filled.
- .6 Where joints/cracks in concrete or masonry are over 6mm (1/4") wide, apply a vapour permeable membrane or mastic as recommended by manufacturer ensuring that joints are completely filled.
- .7 Ensure continuity of air barrier membrane by working air barrier membrane over all exterior sheathing board fasteners and around all masonry ties and anchors and other items.

3.5 APPLICATION - AIR BARRIER MEMBRANE FLASHINGS

- .1 Apply primer to all substrate areas where flexible air barrier membrane flashings are to be applied. Apply primer using lambs wool roller at rate 100 sq.ft. to 300 sq.ft./gallon (2.044 to 6.131 sq.m./gallon) depending on porosity of substrates. Allow primer to "tack

- up" for approximately 30-minutes prior to application of flexible air barrier membrane flashings.
- .2 Do not use solvent-based primer where it may be in contact with polystyrene insulation.
 - .3 Install flexible air barrier membrane flashings in strict accordance with the manufacturer's written instructions unless otherwise specified herein.
 - .4 Ensure a uniform, continuous air barrier effect. Where air barrier membranes are to be provided under other Sections, co-ordinate the work such that air barrier membrane continuity is achieved.
 - .5 Provide air tight seals at penetrations in flexible air barrier membrane flashings.
 - .6 Apply flexible air barrier membrane flashings to extend air barrier membrane at peripheries of the installation as required to facilitate joining and sealing of the air barrier provided in adjacent construction, lapping joints minimum of 75mm (3"), extending membrane onto adjacent concrete/metal substrates not less than 150mm (6"), centred over joints.
 - .7 Apply continuous flexible air barrier membrane flashings at expansion and deflection joints within framing members, lapping joints minimum of 75mm (3"), extending membrane onto adjacent concrete/metal substrates which have no applied air barrier not less than 150mm (6"), centred over joints.
 - .8 Flexible Weather Barriers:
 - .1 Provide continuous 457mm (18") side flexible weather barrier membrane in exterior masonry cavity walls at expansion joints.
 - .2 Install flexible weather barrier membrane to substrate with adhesive, in strict accordance with manufacturer's instructions.
 - .3 Loop down flexible weather barrier into expansion/control joints approximately two (2) times the width. Lap joints minimum 150mm (6") and seal. Ensure that flexible weather barrier lap joints which are looped into expansion /control joints are sealed with adhesive. Seal tops and bottoms of membrane barrier at change in construction to present continuous, uninterrupted flexible weather barrier.
 - .4 Pack joint with loose batt insulation with face of insulation down two (2) times the width of expansion from face interior wythe.

3.6 APPLICATION - AIR BARRIER MEMBRANE - LIQUID APPLIED

- .1 Install fluid applied membrane air barrier in accordance with Air Barrier Manufacturer published literature to ensure an air and watertight fluid applied membrane air barrier assembly.
- .2 Areas to receive vapour permeable air barrier membrane are as follows:
 - .1 On all new / existing substrates, behind all rainscreen cladding.
 - .2 Prepare only enough vapour permeable air barrier membrane compound as can be used within compound's usable pot life. Mix vapour permeable air barrier membrane with a double blade agitator attached to a 13mm (1/2") drill in strict accordance with the manufacturer's written instructions.
 - .3 Apply vapour permeable air barrier membrane to substrates in a continuous coating at a rate of 27 - 45 litres/9.29 sq.m. (6 to 10 gal./100 sq.ft.) by roller, spray or trowel methods, producing a minimum wet film thickness of 100 wet mils.
 - .4 Ensure that application of vapour permeable air barrier membrane overlaps all flexible air barrier membrane flashings, dampproof course/thru-wall flashings a minimum of 75mm (3").

- .5 Where masonry anchors/fasteners pass through the air barrier membrane, ensure continuity of air barrier by applying vapour permeable air barrier membrane all around/over masonry anchors.
- .6 Refer to Air Barrier Manufacturer detail drawings for installation procedures including, but not limited to, the following:
 - .1 Inside corners
 - .2 Outside corners
 - .3 Crack treatment
 - .4 Penetrations
 - .5 Rough openings
 - .6 Control joints
 - .7 Expansion joints
 - .8 Changes in substrate

3.7 FIELD QUALITY CONTROL

- .1 Final inspection of fluid applied membrane air barrier assembly shall be carried out by the Air Barrier Manufacturer as required by warranty
- .2 Prior to membrane being covered, notify the Consultant 48 hours prior to allow for review.

3.8 PROTECTION AND CLEAN-UP

- .1 Protect membrane to avoid damage from other trades, and construction materials during subsequent operations.
- .2 Cap and protect exposed walls against wet weather conditions during and after application of membrane for a minimum of 24 hours.
- .3 If the vapour permeable air barrier cannot be covered within thirty (30) days after installation, apply temporary UV protection such as dark plastic sheet or tarpaulins. Contact material manufacturer for further recommendations.
- .4 Clean spillage and soiling on adjacent construction that will be exposed in the finished work using cleaning agents and procedures recommended by the manufacturer of the affected construction.
- .5 Remove any masking materials after installation.
- .6 Applicator is responsible for the removal of surplus and waste material incurred during application.
- .7 Equipment and tools can be cleaned using mineral spirits or xylol.

END OF SECTION

1 General

1.1 SUMMARY

- .1 This Section includes requirements for glass-fiber-reinforced (GFRG) cementitious panels, complete with a system of weather barrier, girts, flashings and trims, and fasteners to provide a complete cladding system.
- .2 Provide specified system with labour, materials, and equipment required to fabricate and erect (GRFC) cementitious panels, including cutting and penetrations, accessories, flashings, trims and closures necessary for a complete installation.

1.2 REFERENCE STANDARDS

- .1 American Society for Testing and Materials (ASTM):
 - .1 ASTM A653/A653M-11, Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process, Physical (Structural) Quality.
 - .2 ASTM A755/A755M-11, Standard Specification for Steel Sheet, Metallic Coated by the Hot-Dip Process and Prepainted by the Coil-Coating Process for Exterior Exposed Building Products.
 - .3 ASTM C1186-08, Standard Specification for Flat Fibre Cement Sheets.
- .2 Canadian Standards Association (CSA):
 - .1 CSA CAN/CSA S16-09, Design of Steel Structures
 - .2 CSA S136-07, North American Specification for the Design of Cold Formed Steel Structural Members
- .3 Canadian General Standards Board (CGSB):
 - .1 CGSB 1.108-M89, Bituminous Solvent Type Paint
- .4 The Society for Protective Coatings (SSPC)
 - .1 SSPC Guide 14, Guide for the Repair of Imperfections in Galvanized, Organic, or Inorganic Zinc-Coated Steel Using Organic Zinc-Rich Coatings

1.3 SUBMITTALS

- .1 Provide submittals in accordance with Division 01.
- .2 Product data: Submit copies of manufacturer's Product data indicating:
 - .1 Performance criteria, compliance with appropriate reference standard, characteristics, limitations.
 - .2 Product transportation, storage, handling and installation requirements.
- .3 Shop Drawings:
 - .1 Submit fully dimensioned shop drawings to Consultant showing construction, assembly, elevations, sections and interfacing with work of other Sections.
 - .2 No work of this Section shall be fabricated until shop drawings and all other related submittals, documentation, certifications and samples as required by this Section, have been reviewed by the Consultant.
 - .3 Details shall indicate panel thicknesses, areas to be sealed and sealant materials, gaskets, type of joints, flashings, trim, finishes, fasteners, all anchorage assemblies and components and erection details.
 - .4 Shop drawings shall bear the seal of an engineer registered to practice in the place of Work, employed by the (GRFC) cementitious panel manufacturer, and shall include complete design calculations for the system and documentation in

regard to the reactions of the panels due to thermal expansion and contraction, positive and negative wind pressure and assurance that the thermal movement and wind forces have sufficient attachments, supports, bracing and anchorage.

- .1 Contractor is to perform field testing of the proposed anchors for the new cladding system at existing substrate/backup wall. Testing shall be in conformance with ASTM E488/E488M and tested to a maximum pull out strength determined by the shop drawings engineer but with a minimum safety factor of 3. Conduct a minimum of 6 tests to include at least 2 different floors and 3 different elevations.
- .4 Samples:
 - .1 Submit to the Consultant for approval, samples of materials and components to be used in the system, prior to fabrication of work together with name of manufacturer and technical literature.
 - .2 Submit 305mm x 305mm (12" x 12") samples of (GRFC) cementitious panels, and full size samples of thermal clips.
- .5 Verification Samples:
 - .1 Submit two (2) full size panels of (GRFC) cementitious panels.
- .6 Safety Data Sheets:
 - .1 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.
- .7 Operation and Maintenance Data: Submit manufacturers written instructions for maintenance procedures, include name of original installer and contact information in accordance with Division 01.

1.4 PRE-INSTALLATION CONFERENCE

- .1 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 personal before commencement of work for this Section; agenda for meeting will include; but not be limited to, the following:
 - .1 To discuss expectations for fit and finish of cladding system, quality of workmanship for installation of air/vapour retarders and insulation and relationship of the cladding system to adjacent components.
- .2 Manufacturer's representative shall also provide frequent inspection visits during the course of work of this Section to assure quality and competence of membrane installation and panel alignment

1.5 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 Manufacturer: Obtain materials from a single manufacturer having a minimum of five (5) years experience and technical support personnel that can provide technical review to panel fabricator to address specific installation requirements.
 - .2 Fabricator: Use fabricator having shop and equipment required to factory fabricate panels to shapes and configurations indicated, having experience with projects of similar complexity and extent, and certified by manufacturer.
 - .3 Installer: Use an experienced installer who has completed (GRFC) cementitious panel installations similar in material, design, and extent to that indicated for this project, and with a record of successful in-service performance.
- .2 Retain a professional engineer, registered in the province of the Work, to design fabrication and erection of the Work of this Section in accordance with applicable Building Code and Contract Document requirements including, but not limited to, the following:

- .1 Seal and signature to shop drawings and design submittals requiring structural engineering.
- .2 Field review of installed components.
- .3 Conform to the requirements of the local Building Code, local by-laws and Authorities having jurisdiction.

1.6 MOCK-UP

- .1 Provide mock-ups in accordance with Division 01.
- .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, and as follows:
 - .1 Locate mock-ups in the location and of the size indicated or, if not indicated, as directed by Consultant.
 - .2 Notify Consultant 7 days in advance of the dates and times when mock-ups will be constructed.
 - .3 Demonstrate the proposed range of aesthetic effects and workmanship.
 - .4 Include examples of window frame, door frame, interior corner, exterior corner and common protrusions or penetrations of membranes.
 - .5 Obtain Consultant's acceptance of mock-ups before proceeding with construction of work of this Section.
 - .6 Maintain mock-ups during construction in an undisturbed condition, as a standard for judging the completed Work.
 - .7 Accepted mock-ups may form a part of the completed Work.

1.7 STORAGE, DELIVERY, HANDLING AND PROTECTION

- .1 Co-ordinate deliveries to comply with construction schedule and arrange ahead for 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.
- .3 Assembled units and/or their component parts shall be transported, handled and stored in a manner to preclude damage. Accessory materials required for erection at the Site shall be delivered to the Site in manufacturer's labelled containers. Remove all units or components which are cracked, bent, chipped, scratched or otherwise unsuitable for installation and replace with new.
- .4 Provide safe and adequate equipment on the Site to execute the work of this Section, hoisting, scaffolding, staging, safety protection equipment, tools, plant and other equipment required for the completion of the work of this Section.
- .5 Delivered damaged materials or materials which do not comply with this Section shall be rejected by Consultant, removed from the Site and replaced with acceptable materials at Contractor's expense.
- .6 Adequately protect the structure and work of all other trades during delivery, storage, handling and erection of the work of this Section.
- .7 (GRFC) cementitious panels being hoisted to the working level shall be adequately banded and carefully slung employing steel wire rope.

- .8 Bundles shall be tag lined during the ascent of the hoisting operation. Precaution shall be taken to avoid damage to (GRFC) cementitious panels and to prevent marring of exposed surfaces.
- .9 (GRFC) cementitious panels, after being positioned, shall be adequately secured in place as quickly as possible and prior to leaving the job site at the end of the working day.
- .10 Loose bundles of (GRFC) cementitious panels shall be adequately secured at the completion of each working day.
- .11 Scaffolds, platforms, ladders, and the like, required by the erector for installation of (GRFC) cementitious panels shall be properly secured to prevent accidental movement or collapse.

1.8 SITE CONDITIONS

- .1 Site Measurements: Verify dimensions by site measurements before fabrication and indicate measurements on shop drawings where glass fibre reinforced cement composite wall panels are indicated to fit around other construction; coordinate fabrication schedule with construction progress to avoid delaying the Work.
- .2 Established Dimensions: Establish dimensions and proceed with fabricating glass fibre reinforced cement composite wall panels without site measurements where site measurements cannot be made without delaying the Work; coordinate construction to ensure that actual site dimensions correspond to established dimensions; allow for trimming and fitting.

1.9 WARRANTY

- .1 Manufacturer Warranty: Submit manufacturers standard ten (10) year warranty covering loss of colour, and physical and mechanical properties arising from installation, fabrication or manufacture of (GRFC) cementitious panels.

2 Products

2.1 MANUFACTURERS

- .1 Basis-of-Design Products: Products named in this Section were used as the basis-of-design for the project; additional manufacturers offering similar products may be incorporated into the work of this Section.
- .2 Acceptable Materials and Manufacturers: Subject to compliance with requirements specified in this Section and as established by the Basis-of-Design Materials.
 - .1 FibreC GlassFibre Reinforced Concrete Panels (Concrete Skin) by Rieder Sales GmbH, as distributed by Sound Solutions (basis of design).
 - .2 Or approved equivalent.

2.2 MATERIALS

- .1 (GRFC) Cementitious Panels (GFRC-01):
 - .1 Standard panel dimensions:
 - .1 3600mmH x 1310mmW x 13mm thick;
 - .2 Texture: Standard.
 - .3 Reinforcement by alkaline-resistant glass fibres in the matrix, 2-layer textile glass fabric (each longitudinally and cross-wise) and short fibres.
 - .4 Dead weight of Panel: Between 26 - 31.5 kg/m² (depending on shade).
 - .5 Bending tension resilience > 18 N/mm²
 - .6 Elasticity modulus approx. 10,000 N/mm²

- .7 Fire Rating: Class A - Not flammable.
- .8 Crystalline silica < 0% - Not detectable.
- .9 Surface Protection: Transparent hydrophobic coating.
- .10 Colour and Texture: As selected by the Consultant, from the manufacturer's standard product line.
- .1 Colour: carry one colour in Bid Price from Bricky colour range.

2.3 WEATHER BARRIER SYSTEM

- .1 As per Specification 07 25 00

2.4 ACCESSORIES

- .1 Fastening Method - Exposed Fastening with Rivet:
 - .1 Visible attachment with rivets for aluminium substructure.
 - .2 Attachment with fixed and sliding points, fixed points must be produced with sleeves.
- .2 Attachments:
 - .1 Façade rivet of aluminium with head painting, head diameter 14/16mm, length depending on substructure and panel thickness.
 - .2 Rivet Mandrel: Non-corrosive steel.
 - .3 Fixed point sleeve of aluminium, outer diameter 7.7mm, length depending on panel thickness.
- .3 Joints: Open Joints using manufacturer's standard trims; Weather Barrier: As specified in Section 07 25 00.
- .4 Corner Trims: None required; Manufacturers standard open corner.
- .5 Joint Sealant: Colour matched to panel, as specified in Section 07 92 00.
- .6 Metal Flashing: Prefinished steel as specified in Section 07 62 00.

2.5 CLIP AND RAIL FRAMING SYSTEM

- .1 Thermally Isolated Clips: intermittent clip system consisting of Z-shaped stainless steel clip with a high-density polyisocyanurate thermal break pad at attachment to substrate. Clip body to be provided with cut-outs that represent 15% to 20% of the clip volume in order to reduce the quantity of conductive material and further reduce the effects of thermal bridging.
 - .1 Clip Depth: Fixed and/or adjustable based on depth of scheduled cavity insulation, and to suit field conditions.
 - .2 Vertical Clip Spacing: As recommended by clip manufacturer, and indicated on stamped Shop Drawings.
 - .3 Basis of Design Product:
 - .1 ACS-S/ACS-A Thermal Clips by Soprema
 - .2 EA RVRs TClip, by Engineered Assemblies,
 - .3 or approved equivalent.
- .2 Secondary Framing: vertical and/or horizontal girts, sub-girts, hat channels or Z bars fastened to thermally isolated clips. Exact profile as shown in drawings and to suit installation requirements.
 - .1 Gauge: 18 gauge minimum or as engineered by cladding contractor.

- .3 Fasteners: Mechanical fasteners used on underlayment; stainless steel self tapping screws, type and length to suit application and securement plates to the approval of the Consultant.

3 Execution

3.1 EXAMINATION

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

3.2 INSTALLATION

- .1 Erect (GRFC) cementitious panels in accordance with manufacturer's instructions.
- .2 Erect (GRFC) cementitious panels in straight lines, true, level and plumb. All vertical and horizontal panel joints shall be supported continuously by a framing member.
- .3 Use abrasive carborundum saw blades and carbide tipped masonry drills for making modifications to panels on site. Paint all exposed cut edges.
- .4 Securely fasten (GRFC) cementitious panels to subframing; fastener type and frequency as per reviewed shop drawings.
- .5 Cut and flash wall penetrations with metal flashing.
- .6 Do not install chipped, cracked, blemished, stained, or otherwise defective units.
- .7 Caulk between abutting cementitious siding and at joints between cementitious siding and adjoining construction to meet specified requirements of Section 07 92 00 of this Specification.
- .8 Site Tolerances: Erection tolerances apply to each individual panel and shall not be accumulative.
 - .1 Vertical position: plus/minus 1/8".
 - .2 Horizontal position: plus/minus 1/8".
 - .3 Deviation from plumb: 1/8" maximum each plane.
 - .4 Racking of face: 1/4" maximum.
 - .5 Racking in elevation: nil
 - .6 Offset from true alignment between two identical abutting end to end or in line: 0.3 mm.

3.3 REPAIR

- .1 Remove damaged, cracked, broken, defectively finished, or tool marked components and replace with new.
- .2 Refinish (GRFC) cementitious panels in field with compatible materials and only with agreement of Architect.

3.4 CLEANING

- .1 Clean surfaces of work exposed to view. Remove deposits of foreign material, dirt, soil, and stains. Rinse thoroughly with clean water after cleaning.
- .2 Protect adjoining work from damage during cleaning.
- .3 Should specified cleaning methods be insufficient, proceed with other methods only with agreement of the Consultant.

END OF SECTION

1 General

1.1 SUMMARY

- .1 This Section includes requirements for prefinished metal siding, complete with a system of girts, flashings and trims, using sheet metals and exposed fasteners, on the following installation applications:
 - .1 Exterior Wall Cladding in multiple profile types as scheduled.
- .2 Provide specified system with labour, materials, and equipment required to fabricate and erect siding including cutting and penetrations, accessories, flashings, trims and closures and fasteners necessary for a complete installation.

1.2 REFERENCE STANDARDS

- .1 American Architectural Manufacturers Association (AAMA):
 - .1 AAMA 605.2, Voluntary Specification for High Performance Coatings on Architectural Panels and Extrusions.
- .2 American Society for Testing and Materials (ASTM):
 - .1 ASTM A653/A653M-11, Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process, Physical (Structural) Quality.
 - .2 ASTM A755/A755M-11, Standard Specification for Steel Sheet, Metallic Coated by the Hot-Dip Process and Prepainted by the Coil-Coating Process for Exterior Exposed Building Products.
- .3 Canadian Sheet Steel Building Institute (CSSBI):
 - .1 CSSBI 20M-08, Standard for Sheet Steel Cladding for Architectural, Industrial and Commercial Building Applications.
 - .2 CSSBI S8-08, Quality and Performance Specification for Prefinished Sheet Steel Used for Building Products.
- .4 Canadian Standards Association (CSA):
 - .1 CSA CAN/CSA S16-09, Design of Steel Structures
 - .2 CSA S136-07, North American Specification for the Design of Cold Formed Steel Structural Members
- .5 Canadian General Standards Board (CGSB):
 - .1 CGSB 1.108-M89, Bituminous Solvent Type Paint
- .6 The Society for Protective Coatings (SSPC)
 - .1 SSPC Guide 14, Guide for the Repair of Imperfections in Galvanized, Organic, or Inorganic Zinc-Coated Steel Using Organic Zinc-Rich Coatings

1.3 SUBMITTALS

- .1 Submit manufacturer's product specifications, standard details, certified product test results, and general recommendations, as applicable to materials and finishes for each component and for total panel assemblies.
- .2 Shop Drawings:
 - .1 Submit fully dimensioned shop drawings to Consultant showing construction, assembly, elevations, sections and interfacing with work of other Sections.
 - .2 No work of this Section shall be fabricated until shop drawings and all other related submittals, documentation, certifications and samples as required by this Section, have been reviewed by the Consultant.

- .3 Details shall indicate metal thicknesses, areas to be sealed and sealant materials, gaskets, type of joints, flashings, trim, finishes, fasteners and welds, all anchorage assemblies and components and erection details.
- .4 Shop drawings shall bear the seal of an engineer registered to practice in the place of Work, employed by the preformed metal siding manufacturer, and shall include complete design calculations for the system and documentation in regard to the reactions of the metal siding due to thermal expansion and contraction, positive and negative wind pressure and assurance that the thermal movement and wind forces have sufficient attachments, supports, bracing and anchorage.
 - .1 Contractor is to perform field testing of the proposed anchors for the new cladding system at existing substrate/backup wall. Testing shall be in conformance with ASTM E488/E488M and tested to a maximum pull out strength determined by the shop drawings engineer but with a minimum safety factor of 3. Conduct a minimum of 6 tests to include at least 2 different floors and 3 different elevations.
- .3 Samples:
 - .1 Submit to the Consultant for approval, samples of materials and components to be used in the system, prior to fabrication of work together with name of manufacturer and technical literature.
 - .2 Submit 305mm x 305mm (12" x 12") samples of metal siding, and full size samples of thermal clips.
- .4 Verification Samples:
 - .1 Submit two (2) full size panels of metal siding.
- .5 Safety Data Sheets:
 - .1 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 Qualifications:
 - .1 Manufacturer 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 preformed metal siding systems shall be by workers especially trained and experienced in this type of work. Have a qualified representative at the job site to direct the work of this Section at all times.
 - .3 Retain a professional engineer, registered in the province of the Work, to design fabrication and erection of the Work of this Section in accordance with applicable Building Code and Contract Document requirements including, but not limited to, the following:
 - .1 Seal and signature to shop drawings and design submittals requiring structural engineering.
 - .2 Field review of installed components.
 - .4 Conform to the requirements of the local Building Code, local by-laws and Authorities having jurisdiction.

1.5 PRE-INSTALLATION CONFERENCE

- .1 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 personal before commencement of work for this Section; agenda for meeting will include; but not be limited to, the following:

- .1 To discuss expectations for fit and finish of wall system, quality of workmanship for installation of air/vapour retarders and insulation and relationship of wall system to adjacent components.
- .2 Manufacturer's representative shall also provide frequent inspection visits during the course of work of this Section to assure quality and competence of membrane installation and panel alignment

1.6 DESIGN REQUIREMENTS

- .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 sheet cladding to span continuously over at least four structural supports (three spans) and design fastening to structural supports to sustain factored loads in accordance with CAN/CSA S136-07.
- .3 Calculate live load deflections in accordance with CSSBI 20M-08, as modified by the requirements of this Section.
- .4 Provide for movement of components without causing buckling, failure of joint seals, undue stress on fasteners when subject to seasonal temperature range from -40°C to $+50^{\circ}\text{C}$, and wind loads noted above.
- .5 Final review and acceptance of work completed by this Section shall be carried out by the manufacturer's representative, the Consultant, Contractor and the Subcontractor.

1.7 MOCK-UP

- .1 Provide mock-ups in accordance with Division 01.
- .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, and as follows:
 - .1 Locate mock-ups in the location and of the size indicated or, if not indicated, as directed by Consultant.
 - .2 Notify Consultant 7 days in advance of the dates and times when mock-ups will be constructed.
 - .3 Demonstrate the proposed range of aesthetic effects and workmanship.
 - .4 Include examples of window frame, door frame, interior corner, exterior corner and common protrusions or penetrations of membranes.
 - .5 Obtain Consultant's acceptance of mock-ups before proceeding with construction of work of this Section.
 - .6 Maintain mock-ups during construction in an undisturbed condition, as a standard for judging the completed Work.
 - .7 Accepted mock-ups may form a part of the completed Work.

1.8 STORAGE, DELIVERY, HANDLING AND PROTECTION

- .1 Co-ordinate deliveries to comply with construction schedule and arrange ahead for 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.
- .3 Assembled units and/or their component parts shall be transported, handled and stored in a manner to preclude damage. Accessory materials required for erection at the Site shall be delivered to the Site in manufacturer's labelled containers. Remove all units or components which are cracked, bent, chipped, scratched or otherwise unsuitable for installation and replace with new.
- .4 Provide safe and adequate equipment on the Site to execute the work of this Section, hoisting, scaffolding, staging, safety protection equipment, tools, plant and other equipment required for the completion of the work of this Section.
- .5 Delivered damaged materials or materials which do not comply with this Section shall be rejected by Consultant, removed from the Site and replaced with acceptable materials at Contractor's expense.
- .6 Adequately protect the structure and work of all other trades during delivery, storage, handling and erection of the work of this Section.
- .7 Preformed metal siding components being hoisted to the working level shall be adequately banded and carefully slung employing steel wire rope.
- .8 Bundles shall be tag lined during the ascent of the hoisting operation. Precaution shall be taken to avoid damage to metal siding components and to prevent marring of exposed surfaces.
- .9 Preformed metal siding components, after being positioned, shall be adequately secured in place as quickly as possible and prior to leaving the job site at the end of the working day.
- .10 Loose bundles of preformed metal siding components shall be adequately secured at the completion of each working day.
- .11 Scaffolds, platforms, ladders, and the like, required by the erector for installation of metal siding components shall be properly secured to prevent accidental movement or collapse.

1.9 PROJECT CONDITIONS

- .1 Make thorough examination of drawings and details. Determine the intent, extent, materials, and conditions of interfacing with work of other Sections and be fully cognizant of requirements.
- .2 Inspect substrate surfaces on which the work of this Section is erected for any irregularities detrimental to the application and performance of the work of this Section. Confirm conditions satisfactory before proceeding.
- .3 Co-ordinate and verify, by measurement at the job site, all dimensions affecting work of this Section. Notify Consultant, in writing, of all dimensions and/or conditions at variance with those on the reviewed shop drawings, Contract Documents and/or detrimental to the proper and timely installation of materials. Direction regarding correction measures shall be obtained from Consultant prior to fabrication of the item affected. Insure the compatibility of adjacent items in relationship to the work of this Section.
- .4 Do not perform work of this Section during period of rain, fog, sleet or snow, or upon surfaces covered with dust, water, dew, ice, frost or snow.
- .5 Report to Consultant in writing, defects of work prepared by other trades and unsatisfactory Site conditions. Commencement of application implies acceptance of surfaces and conditions.

1.10 COORDINATION

- .1 Coordinate work of this section with the requirements of Section 07 62 00, for specific requirements for supply of prefinished sheet metal flashing materials to other sections of the work as follows:
 - .1 Supply prefinished sheet metal flashings required for the project, regardless of sheet metal thickness and colour.
 - .2 Provide prefinished sheet metal flashings to installing trades, tension levelled and guillotine sheared to length ready for brake forming, fabrication and installation by installing trades.
 - .3 Coordinate with installing trades during bid period and provide unit prices for materials based on specified thickness and colour of flashing materials required under their respective scopes of work; installing trades will be responsible for carrying cost for flashing materials in their scope of work in their Bid Price.
 - .4 Requirements of this portion of the scope of work do not apply to extruded aluminum or other pre-manufactured flashing materials normally supplied by installing trades (i.e.: extruded aluminum curtain wall flashing and sills, preformed roof penetrations, non-prefinished sheet metal products).
 - .5 Subcontractor responsible for supply of metal wall and soffit cladding will only be responsible for fabrication and installation of flashings relating to their scope of work.

1.11 WARRANTY

- .1 Warrant the work of this Section against defects in materials and workmanship in accordance with General Conditions, but for a period of five (5) 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 upon written notification by the Owner. Remedy shall include labour, materials, equipment and services required to make good defective work, and to replace components and finishes and the Owner's property damaged or disturbed in the course of remedying defects.

2 Products

2.1 MANUFACTURERS

- .1 Basis of Design Products: Products named in this Section were used as the basis of design for the project; additional manufacturers offering similar products may be incorporated into the work of this Section.
- .2 Acceptable Preformed Metal Siding Profile: Subject to compliance with requirements specified in this Section, profiles that may be incorporated into the Work include; but are not limited to, the following:
 - .1 Corrugated Exterior Wall Cladding (MTL-01):
 - .1 34-1/2" wide wall sheet, complete with equally spaced 7/8" deep corrugations.
 - .1 Basis of Design Profile: 7/8" Corrugated by Vic West, (or approved alternate).
 - .2 Material thickness: 22-gauge.
 - .3 Orientation: Vertical profile.

- .4 Colour: Custom colour to be selected by Consultant.

2.2 MATERIALS - CLADDING

- .1 Steel:
- .1 Sheet steel conforming to ASTM A653/A653M-11, structural quality, Grade 'A' with a minimized spangle zinc coating of Z275 conforming to ASTM A653/A653M-11 shall be used for girts, sub-girts, Z-bars, brackets, battens, retention clips, cleats, fascias, preformed metal siding panels, closures and
 - .2 Metal siding shall be of required base steel nominal thickness to meet design requirements. Metal flashings, fascias, copings, cap flashings, closures and the like shall be base steel nominal thickness of 24 gauge and thicker to suit application to prevent oil-canning.
- .2 Finish:
- .1 Preformed metal siding and related metal flashings shall be prefinished coil coated material in accordance with Technical Bulletin No. 7 "Prefinished and Post Painted Galvanized Sheet Steel for Exterior Building Products" of the Canadian Sheet Steel Building Institute (CSSBI), prefinished to CSSBI 10,000 Series or WeatherX finish requirements, (or approved alternate). Colours shall be as indicated on drawings and where not indicated, as selected later by Consultant from manufacturer's full available colours range, including manufacturer's extended colours range.
 - .2 Flatstock Material: Minimum 0.024" (24 gauge) thick or thicker to suit design requirements, coil coated sheet steel, prefinished to CSSBI 10,000 Series or WeatherX finish requirements, (or approved alternate). Colours shall be as indicated on drawings, and where not indicated, as selected later by Consultant from manufacturer's full available colours range, including manufacturer's extended colours range.

2.3 CLIP AND RAIL FRAMING SYSTEM

- .1 Thermally Isolated Clips: intermittent clip system consisting of Z-shaped stainless steel clip with a high-density polyisocyanurate thermal break pad at attachment to substrate. Clip body to be provided with cut-outs that represent 15% to 20% of the clip volume in order to reduce the quantity of conductive material and further reduce the effects of thermal bridging.
- .1 Clip Depth: Fixed and/or adjustable based on depth of scheduled cavity insulation, and to suit field conditions.
 - .2 Vertical Clip Spacing: As recommended by clip manufacturer, and indicated on stamped Shop Drawings.
 - .3 Basis of Design Product:
 - .1 ACS-S/ACS-A Thermal Clips by Soprema
 - .2 EA RVRS TClip, by Engineered Assemblies,
 - .3 or approved equivalent.
 - .4 Secondary Framing: vertical and/or horizontal girts, sub-girts, hat channels or Z bars fastened to thermally isolated clips. Exact profile as shown in drawings and to suit installation requirements.
 - .1 Gauge: 18 gauge minimum or as engineered by cladding contractor.
 - .5 Fasteners: Mechanical fasteners used on underlayment; stainless steel self tapping screws, type and length to suit application and securement plates to the approval of the Consultant.

2.4 ACCESSORIES

- .1 Weather Barrier: As indicated in Section 07 25 00.
- .2 Sealing Tape: Macro-polyisobutylene preformed sealant tape designed for use in metal cladding assemblies.
- .3 Sealants and Gaskets:
 - .1 Sealants and gaskets shall be of types to allow for maximum movements anticipated, maintaining life cycle expectancy, adhesion and flexibility under temperature ranges of -25 degree C up to +80 degree C, without undue softening or deleterious effects.
 - .2 At sidelaps and end laps of panels, as required, factory applied butyl tape, or polyvinyl chloride "wedge fit" type extrusions.
 - .3 Perimeter Sealant: Multi-component, chemical curing epoxidized polyurethane type sealant conforming to ASTM C920-11, 'DYMERIC 240' by Tremco (Canada) Ltd., or 'Sonolastic NP2' by BASF Construction Chemicals, (or approved alternate). Colour as selected later by Consultant. Provide primers, bond breakers and cleaning agents as recommended by the sealant manufacturer.
- .4 Screws, Bolts, Nuts, Washers, Rivets and Other Fastening Devices:
 - .1 Exposed fasteners used on exterior facing panels, flashing and all trim members shall be Series 400 stainless steel and nylon coloured coated head to match substrate colour, Atlas "Colormate", (or approved alternate).
- .5 Bituminous Paint:
 - .1 Conforming to CAN/CGSB-1.108-M, Type 2.
- .6 Field Touch-Up Paint:
 - .1 Zinc rich anti-corrosion primer, conforming to SSPC Guide 14, and approved by the coil coating manufacturer. Top coating of type and colour to match finish sheet and to comply with VOC regulations identified in South Coast Air Quality Management District (SCAQMD).

2.5 FABRICATION

- .1 Co-ordinate and verify, by measurement at the job site, all dimensions affecting the Work. Submit written notifications documenting any and all field dimensions and/or conditions which are at variance with those on the reviewed shop drawings. The Contract documents and/or detrimental to the proper and timely installation of job site materials. The decision regarding corrective measures shall be obtained from the Consultant prior to the fabrication of the item affected. Ensure the suitability of adjacent items in relationship to the work of this Section.
- .2 Report to Consultant in writing, defects in Work prepared by other trades and unsatisfactory Site conditions. Commencement of work shall imply acceptance of conditions.
- .3 Workmanship shall be best trade shop and field practice known to recognized manufacturers specializing in work of this Section. Joints and intersecting members shall be accurately fitted to true planes, adequately and securely fastened and made completely weathertight. Component fastenings shall be concealed of adequate strength.
- .4 Fabricate units to profile and sizes indicated complete with rabbets, interlocks, flashings, trim and filler sections, as required to interface with work of other trades.
- .5 Fabricate all devices required for erection and adequate anchorage and attachment required to be built into or attached to the steel structural or steel deck and main building structure for the support of the Work.

- .6 Anchorage brackets and devices shall be designed and fabricated to compensate for unevenness and dimensional difference in the structure and permit unrestricted expansion and contraction of framing members.
- .7 Steel Welding: Conform with CSA W59-03 (R2008) and executed in accordance with CSA W47.1-09 or CSA W55.3-08.
- .8 Fabricate preformed metal siding systems where indicated. The systems shall be formed to meet design requirements, and of prefinished steel sheet. The system shall be accurately cut and fitted, all fastenings shall be concealed. Method of attachment shall be to the Consultant's approval and clearly detailed on shop drawings. Panel faces shall be flat and true without waves, buckles or oil canning.
- .9 Supply sufficient prefinished metal of same thickness and colours as the preformed metal siding to Section 07 62 00 for his use in installing roof flashings.
- .10 Form starter strips of same material as flashings 1-1/2" wide and continuous.
- .11 Exposed steel surfaces shall be smooth and free from imperfections such as warping, buckling, scratches, dents and abrasion.
- .12 Thickness of metal shall be adequate for various conditions.
- .13 Isolate where necessary to prevent electrolysis due to dissimilar metal to metal contact or metal to masonry or concrete. Use bituminous paint or other approved divorcing membrane.

3 Execution

3.1 INSTALLATION

- .1 Erect preformed metal siding and accessories in strict accordance with reviewed shop and erection drawings and manufacturer's instructions to give a complete and weatherproof system.
- .2 Install underlayment and protective membrane under preformed metal siding and elsewhere as required in strict accordance with manufacturer's written instructions forming a complete waterproof barrier, free of leaks.
- .3 Install girts, 'Z' girts, thermally broken clips, sub-girts, cleats and retention clips and other attachment members necessary to complete the work of this Section.
 - .1 Co-operate with other trades to ensure proper installation and anchorage of work of this Section. Install steel bracing and framing and continuous clip angles and secure plumb and in line.
 - .2 Damaged, bent or dished sheets will be rejected.
- .4 Place preformed metal siding against supporting substrate and adjust to final position before permanently securing. Bring each unit to bear evenly on framing.
- .5 Align units to provide accurate fit with corresponding sections parallel and straight. Ensure complete nesting of interlocking and sealed side lap joint and fasten sheets to structural supports.
- .6 Fasten exterior sheets of panels to horizontal sub-girts, using colour matching fasteners, where indicated.
- .7 Install necessary closure and trim or neoprene closures at openings and penetrations, fastening at 12" O.C. Make cut-outs neatly by saw cutting.
- .8 Where welding has been performed on work of this Section, or field cutting or scratches have been made, field coat such areas with touch-up paint after thoroughly cleaning affected surfaces.

- .9 Seals:
 - .1 Fit flexible seals, tapes, formed gaskets and the like at locations required to provide air/vapour barriers and weathertight junctions. Ensure that end joints, between lengths of material have been properly sealed.
 - .2 Caulk junctions of preformed metal siding system components to themselves and work of other Sections with sealant in accordance with the requirements of Section 07 92 00, to maintain continuity of air/vapour and weather barriers.
- .10 Rigidly connect all prefinished flashing pieces with specified colour matching fasteners at 12" O.C. along length. Use preformed corner pieces and erect with ample allowance for thermal movement.
- .11 Furnish adequate quantity of prefinished flat stock flashing sheet to Section 07 62 00 for forming and installation. Trim members in this category are cap flashing, base flashing and those specifically shown on drawings as being prefinished and in close proximity to roofing. Flashing pieces entirely remote from roofing flashing and the like are furnished in place under work of this Section.
- .12 Install work of this Section only during period of no rain, fog, sleet or snow, or upon surfaces covered with dust, water, dew, ice, frost or snow.

3.2 CLEANING

- .1 Remove debris and surplus materials from the Site upon completion of work of this Section.
- .2 Clean dirt, soil and misplaced sealants from preformed metal siding systems with recommended cleaners and solvents.

END OF SECTION

1 General

1.1 SUMMARY

- .1 This Section includes requirements for the supply and installation of fully adhered modified bituminous membrane roofing system on both wood and metal deck/structure.
- .2 Section includes:
 - .1 Preparation of Wood/Metal Deck Surface
 - .2 Vapour Retarder
 - .3 Roof Insulation & Insulation Overlay Board
 - .4 Base Sheet Membrane
 - .5 Base Sheet Flashing
 - .6 Cap Sheet Membrane
 - .7 Cap Sheet Flashing
 - .8 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 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
 - .6 CAN/CGSB-51.34-M86, Vapour Retarder, Polyethylene Sheet, for Use in Building Construction
- .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 S701-05, 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

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 sloped insulation manufacturer's proposed roofing diagrams and layouts for review by the Consultant.
 - .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.

1.4 MOCK-UPS

- .1 Provide mock-ups in accordance with Section 01 43 39.
- .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.
 - .1 Design roofing membrane to resist the following site specific dynamic wind uplift:
 - .1 Corner: -2.8kPa;
 - .2 Edge: -2.1kPa;
 - .3 Field: -1.5kPa.
 - .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 Adhesives: Manufacturers recommended adhesives specifically formulated for installation of materials outlined below, meeting the wind resistance rating indicated in this Section.
- .2 Vapour Retarder
 - .1 Vapour Barrier (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: 0.92 ng/Pa.s.m² (0.016 Perm).
 - .3 Basis of Design Product: SOPRAVAP'R by Soprema Inc. (or approved equivalent).
 - .2 Sheet Vapour Barrier (VB-02)
 - .1 Polyolefin-based membrane composed of variable-permeance polymers and non-woven polypropylene film, reinforced by polypropylene mesh.
 - .2 Resistance to water vapour transmission
 - .1 45 ng/Pa.s.m² (0.8 Perm) at 25% mean relative humidity
 - .2 176 ng/Pa.s.m² (3 Perm) at 75% mean relative humidity
 - .3 Basis of Design Product: SOPRASEAL HVM 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 Insulation INS-03a – (Flat Lower Layer):
 - .1 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).
- .5 Insulation INS-03a – (Tapered Layer):
 - .1 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 Tapered by Soprema Inc. (or approved equivalent).
- .6 Insulation INS-03b (Upper Layer)
 - .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).
- .7 Asphaltic Overlay Boards
 - .1 CSA A123.23, semi-rigid asphaltic roofing substrate board composed of a mineral fortified asphaltic core formed between two asphaltic saturated fibreglass liners. Length 1200 mm x width 1500 x thickness 6.4 mm.
 - .2 Specified product: SOPRABOARD by SOPREMA or approved equivalent.
- .8 Base Sheet Membrane (Adhered):
 - .1 A high performance base sheet membrane composed of SBS modified bitumen and a composite reinforcement. Both sides are sanded
 - .2 Basis of Design Product: COLDPLY BASE 410 by Soprema Inc. (or approved equivalent).
 - .3 Adhesive: As recommended by membrane manufacturer.
- .9 Base Sheet Membrane Flashing:
 - .1 Membrane composed of SBS modified bitumen and non-woven polyester mat reinforcement.
 - .2 Surface: Fine mineral aggregate for cold adhesive applications; Underside: High tack, self-adhesive layer, protected by polyethylene release film.
 - .3 Basis of Design Product: SOPRALENE STICK by Soprema Inc. (or approved equivalent).

- .10 Cap Sheet Field Membrane and Cap Flashing:
 - .1 Membrane composed of SBS modified bitumen and composite reinforcement.
 - .2 Thickness: 3.5mm
 - .3 Surface: Covered and protected by coloured granules; Underside: Fine mineral aggregate for cold adhesive applications.
 - .1 Colour of Granules: As selected by the Consultant from the manufacturer's standard product line.
 - .4 Basis of Design Product: COLPLY TRAFFIC CAP 460 by Soprema Inc. (or approved equivalent).
- .11 Jointing Mastic / Caulking: SOPRAMASTIC by Soprema Inc. (or approved equivalent).
- .12 Metal Flashings: As indicated in Section 07 62 00.
- .13 Concrete Unit Pavers: As indicated in Section 32 14 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 Barrier (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 Sheet Vapour Barrier (VB-02)
 - .1 Verify that services are installed and have been accepted by the Consultant and Authorities Having Jurisdiction prior to installation of vapour retarder.
 - .2 Install sheet vapour barrier (VB-02) on warm side of exterior wall, and ceiling assemblies, as indicated on the Drawings, prior to installation of gypsum board to form continuous retarder in accordance with manufacturers written instructions.
 - .3 Use sheets of largest practical size to minimize joints.
 - .4 Install materials in a manner the maintains continuity; repair punctures and tears with sealing tape before work is concealed.
- .7 Insulation:
 - .1 Adhere insulation INS-03a 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 secondary insulation INS-04b as the first layer, followed by installation of manufacturer's required primary flat insulation ready for installation of cold adhesive applied membrane roofing.
 - .4 Stagger vertical joints between primary insulation boards and secondary insulation modules and between two rows of insulation board.

- .5 Install only as much insulation as can be covered by roof membranes in the same day.
- .6 Install tapered insulation panels INS-03a in conformance with manufacturers instructions and layout indicated on reviewed shop drawings.
- .7 Install secondary insulation INS-03b as the top layer, followed by installation of overlay board.
- .8 Cold Adhesive Applied Field Base Sheet Installation:
 - .1 Install membrane base sheet in full bed of adhesive applied at rate recommended by roofing membrane manufacturer using a notched 5mm (3/16") neoprene squeegee starting at drain and perpendicular to slope.
 - .2 Apply base sheet in parallel strips, butting board joints up and covering the joints with self-adhesive strip attached to adjacent board.
 - .3 Roll surface installed membrane using a 30 kg steel roller to smooth membrane and to provide continuous and uniform adhesion to insulation.
 - .4 Seal lap joints of base sheet at end each workday; perform work without interruption to avoid tears and formation of fish mouths, air pockets or wrinkles.
 - .5 Cut off corners at end laps being covered by next roll.
 - .6 Terminate base sheet at top of cant or at perimeter.
- .9 Self-Adhere Base Sheet Flashing:
 - .1 Apply base sheet flashing when primer coat is dry and in accordance with manufacturer's written instructions.
 - .2 Position pre-cut membrane pieces; peel back 100mm to 150mm (4" to 6") of silicone release paper to hold the membrane in place at the top of the parapet, then gradually peel back remaining silicone release paper, pressing down on the membrane with aluminum applicator to provide good adhesion and to provide smooth transition between up-stand and field surface; smooth entire membrane surface with a roller for full adhesion.
 - .3 Cut off corners at end laps being covered by next roll.
 - .4 Seal overlaps at the end of each workday.
- .10 Installation of Cap Sheet (Field):
 - .1 Starting at drain, unroll membrane on base sheet, taking care to align the edge of the first selvedge with the edge of the roof.
 - .2 Cut off corners at end laps at areas to be covered by the next roll.
 - .3 Each selvedge 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.

- .11 Cold Applied Cap Sheet Flashings:
 - .1 Install cap sheet flashings in 1000mm (3.25') wide strips.
 - .2 Each selvedge 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 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 shape 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 PREINSTALLATION MEETING

- .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.

1.5 MOCK-UPS

- .1 Provide mock-ups in accordance with Section 01 43 39.
- .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.

1.6 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.

1.7 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.

1.8 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: 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 24 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, 'Galvafroid, 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 equivalent. 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. Use rubber-asphalt sealing compound for joints between sheet metal and bitumen.
- .8 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.
- .9 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.
- .10 Caulking shall be installed as per written manufacturer's recommendations.
- .11 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. If exposed screws or bolts are used, use cupped neoprene washers.
- .12 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 This Section includes requirements for the supply and installation of precast concrete unit pavers installed on bedding and drainage board systems:

- .1 Precast concrete pavers.
- .2 Joint aggregate.
- .3 Setting bed aggregate.

1.2 REFERENCE STANDARDS

- .1 American Society for Testing and Materials (ASTM):
 - .1 ASTM C29, Bulk Density and Voids in Aggregate Materials.
 - .2 ASTM C33, Standard Specification for Concrete Aggregates.
 - .3 ASTM C136, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
 - .4 ASTM C936, Standard Specification for Solid concrete Interlocking Paving Units.
 - .5 ASTM C979, Standard Specification for Pigments for Integrally Colored Concrete.
 - .6 ASTM C1491, Standard Specification for Concrete Roof Pavers.
 - .7 ASTM C1645, Standard Test Method for Freeze-thaw and De-icing Salt Durability of Solid Concrete Interlocking Paving Units.
 - .8 ASTM D488, Standard Classification for Sizes of Aggregate for Road and Bridge Construction.
- .2 Canadian Standards Association (CSA):
 - .1 CSA A23.1/A23.2, Concrete Materials and Methods of Concrete Construction.
 - .2 CSA A231.2, Precast Concrete Pavers
 - .3 CSA A283, Qualification Code for Concrete Testing Laboratories.

1.3 SUBMITTALS

- .1 Provide submittals in accordance with Division 01. Submit manufacturer's product specifications, standard details, certified product test results, and general recommendations, as applicable to materials and finishes for pavers and aggregate products.
- .2 Shop drawings shall indicate:
 - .1 Perimeter conditions.
 - .2 Relationship to adjoining materials and assemblies.
 - .3 Layout, pattern, and joint locations.
 - .4 Relationship of paving joints to drains, fixtures, and formed details.
- .3 Precast concrete pavers
 - .1 Submit three (3) full-size samples of each paver type, thickness, colour and finish that indicate the range of colour variation and texture expected upon project completion. Acceptable samples become the standard of acceptance.

1.4 QUALITY ASSURANCE

- .1 Qualifications:

- .1 Installer executing the work on this Section shall have a minimum five (5) years continuous experience in successful completion of concrete paving slab installation similar in design, material, and extent indicated on this project.
- .2 Installer should hold a current certificate from the Interlocking concrete Pavement Institute Concrete Paver Installer Certification Program.
- .2 Test Reports:
 - .1 Certified test reports showing compliance with specified performance characteristics and physical properties.
 - .2 Submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics, criteria and physical requirements.

1.5 MOCK-UPS

- .1 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.
- .2 Mock-up requirements: Install mock-up for area of 1.8m x 1.8m.
- .3 Mock-ups shall demonstrate the following:
 - .1 Installation quality.
 - .2 Joint alignment and spacing.
 - .3 Colour and texture range.
 - .4 Mock-up will demonstrate minimum standard of quality required for this work. Approved mock-up may remain as part of finished work. If mock-up is not retained, remove from site and dispose legally.
- .4 Pre-installation meetings:
 - .1 Conduct pre-installation meeting to review project requirements, installation procedures, and coordination requirements in accordance with Division 01.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Examine units upon arrival at jobsite. Notify the carrier and manufacturer of any damage immediately.
- .2 Store units under roof, if possible until installation; or, if stored outside, store under a tarp or suitable cover.
- .3 Store materials off ground and protect from mud, dirt, contamination, and to prevent damage, distortion, or deterioration.
- .4 Do not exceed structural load limits indicated in Contract Documents

1.7 WARRANTY

- .1 Provide warranty of five (5) years against defective material and workmanship, covering parts only, no labor or freight. Defective parts, shall be replaced at no charge.

2 Products

2.1 MANUFACTURER

- .1 Basis of Design Products: Products named in this Section were used as the basis of design for the project; additional manufacturers offering similar products may be incorporated into the work of this Section.

2.2 MATERIALS

- .1 Performance Requirements

- .1 Pavers shall comply with CSA A231.2
- .2 Aggregate bedding shall be capable of supporting imposed loads without settlement, displacement, or instability.
- .3 Installed paving system shall:
 - .1 Remain stable under pedestrian loading.
 - .2 Resist rocking or movement.
 - .3 Allow positive drainage.
 - .4 Accommodate thermal movement.
- .4 Maximum lippage between adjacent pavers: 1.5mm.
- .5 Finished surface tolerance:
 - .1 Maximum deviation of 5mm or 3m.
- .6 Pavers shall be free of cracks, chips, or defects that impair durability or appearance.

2.3 CONCRETE PAVERS

- .1 Precast concrete pavers:
 - .1 Size: 12" x 12" (300mm x 300mm)
 - .2 Colour/Finish: To be selected by Consultant from product's standard range.
 - .3 Basis of Design Product:
 - .1 Diamond Texture Slab by Brooklin Concrete Products
 - .2 Urban Slab by Permacon
 - .3 Or approved equivalent.

2.4 JOINT AND BEDDING AGGREGATE

- .1 Provide permeable joint and bedding aggregate materials as follows:
 - .1 Washed, clean, non-plastic, free from deleterious or foreign matter, symmetrically shaped, natural or manufactured from crushed rock.
 - .2 Do not use limestone screenings or stone dust.
 - .3 Sieve according to ASTM C136.
 - .4 Conforming to the gradation requirements of ASTM D488 No. 89, as shown in the following table:

Sieve Designation	% Passing
3/8" (9.5mm)	95-100%
No.4 (4.75mm)	20-55%
No.8 (2.36mm)	4-30%
No.16 (1.18mm)	0-10%
No.50 (0.30mm)	0-5%
No,200 (0.075mm)	0-2%

2.5 ACCESSORIES

- .1 Drainage mat: Drainage mat shall consist of a dimple raised core bonded to high strength geotextile fabric designed for horizontal installations, Miradrain 3800 by Henry Company (or approved equivalent).

3 Execution

3.1 EXAMINATION

- .1 Verify site conditions prior to installation, including the following:
 - .1 Roof deck elevations and slopes.
 - .2 Locations of drains and penetrations.
 - .3 Completion of waterproofing and protection layer.
 - .4 Surfaces are clean and free of debris.
- .2 Examine areas indicated to receive paving for compliance with requirements for installation tolerances and other conditions affecting performance for the following items before placing the concrete pavers.
 - .1 Verify that permeable setting bed and base aggregate materials, thickness, compacted density, surface tolerances and elevations conform to specified requirements.
- .3 Do not begin installation until deficiencies affecting installation are corrected.

3.2 INSTALLATION

- .1 Exercise care in handling face mix pavers to prevent surfaces from contacting backs or edges of other units.
- .2 Set surface elevation of pavers 1/8" (3mm) above adjacent drainage inlets, concrete collars or channels.
- .3 Maintain consistent joint widths and alignment. Provide space between paver units of 1/32" (1mm) wide to achieve straight bond lines.
- .4 Cut pavers neatly using masonry saws. Provide clean edges without chipping.
- .5 Cut units shall not be less than one-third of full unit size. Use full units without cutting where possible.
- .6 Prevent all traffic on installed pavers until permeable joint aggregate has been vibrated into joints.
- .7 Replace damaged units that do not meet specified performance or appearance requirements prior to installing permeable joint aggregate material.
- .8 Replace removed units to maintain layout and specified tolerances.
- .9 Provide, spread and sweep permeable joint aggregate into joints immediately after vibrating pavers into setting bed aggregate until full. Vibrate pavers and add joint aggregate until joints are completely filled, then remove excess surface material.
- .10 Remove debris from paving surface and roof areas as work progresses.

3.3 ADJUSTING AND CLEANING

- .1 At completion and continuously as Work proceeds, remove all surplus materials, debris and scrap.
- .2 At completion of Work, clean surfaces in accordance with manufacturer recommendations. Use cleaning methods that do not damage finishes.
- .3 Finished surfaces shall be free of stains, debris, and contaminants.
- .4 Remove all debris resulting from work of this Section from site.

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

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 Provide mock-ups in accordance with Section 01 43 39.
 - .2 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.
 - .3 Allow 24-hours for inspection of work before proceeding with 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 PREINSTALLATION MEETING

- .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 personal before commencement of work for this Section.

1.5 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.

1.6 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.

1.7 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.

1.8 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 Spectrum 2 by Tremco
 - .7 SikaSil WS-295 by Sika
 - .8 Or approved equivalent.
- .6 Sealant Type "B" – Exterior Wall Joints; Control Joints; Expansion Joints in EIFS:
 - .1 One-part, ultra low modulus, non-staining neutral curing 100% silicone joint sealant, conforming to ASTM C920-11, Type S, Grade NS, Class 50.
 - .1 DC 790 by Dow Corning.
 - .2 Spectrem 1 by Tremco
 - .3 SCS2700 SilPruf LM by GE
 - .4 SikaSil WS-290 by Sika
 - .5 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 DC 795 by Dow Corning
 - .2 SCS2000 by GE.
 - .3 Multiseal by Chemtron.
 - .4 Spectrum 2 by Tremco
 - .5 SikaSil WS-295 by Sika
 - .6 Or approved equivalent.
- .10 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.
- .11 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.
- .12 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.
- .13 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.
- .14 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 QUALITY ASSURANCE

- .1 Sealant manufacturer representative to review site conditions, joint design, and installer's qualifications.
- .2 Recommend random test cuts of installed work in at least five (5) locations.

3.5 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 includes residential metal overhead doors of the following type:

.1 Non-insulated steel sectional overhead doors.

1.2 RELEATED SECTIONS

- .1 Section 05 05 00 - Metal Fabrications: Steel frame and supports.
- .2 Section 06 10 00 – Rough Carpentry: Rough wood framing and blocking for door opening.
- .3 Section 07 09 00 - Sealants: Perimeter sealant and backup materials.
- .4 Section 08 07 10 - Door Hardware: Cylinder Locks
- .5 Section 09 90 00 - Paints and Coatings: Field painting.
- .6 Section 26 05 03 - Raceway and Boxes for Electrical Systems.
- .7 Section 26 05 83 - Wiring Connections: Electrical service to door operator.

1.3 REFERENCE STANDARDS

- .1 American National Standards Institute (ANSI):
 - .1 ANSI/DASMA 108 - Standard Method for Testing Sectional Garage Doors and Rolling Doors: Determination of Structural Performance Under Uniform Static Air Pressure Difference.
- .2 Underwriters Laboratories of Canada (ULC)

1.4 DESIGN REQUIREMENTS

- .1 Wiring Connections: Requirements for electrical characteristics.
 - .1 115 volts, single phase, 60 Hz.
- .2 Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories, Inc. acceptable to authority having jurisdiction as suitable for purpose specified.
- .3 Single-Source Responsibility: Provide doors, tracks, motors, and accessories from one manufacturer for each type of door. Provide secondary components from source acceptable to manufacturer of primary components.

1.5 SUBMITTALS

- .1 Submit under provisions of Section 01 33 00.
- .2 Product Data: Manufacturer's data sheets on each product to be used, including:
 - .1 Preparation instructions and recommendations.
 - .2 Storage and handling requirements and recommendations.
 - .3 Installation methods.
- .3 Shop Drawings: Indicate plans and elevations including opening dimensions and required tolerances, connection details, anchorage spacing, hardware locations, and installation details.
- .4 Selection Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns.
- .5 Verification Samples: For each finish product specified, two samples, minimum size 6 inches (150 mm) square, representing actual product, color, and patterns.

- .6 Manufacturer's Certificates: Certify products meet or exceed specified requirements.
- .7 Operation and Maintenance Data.

1.6 QUALITY ASSURANCE

- .1 Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum five years documented experience.
- .2 Installer Qualifications: Authorized representative of the manufacturer with minimum five years documented experience.
- .3 Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories, Inc. acceptable to authority having jurisdiction as suitable for purpose specified.

1.7 DELIVERY, STORAGE HANDLING AND PROTECTION

- .1 Store products in manufacturer's unopened labeled packaging until ready for installation.
- .2 Protect materials from exposure to moisture until ready for installation.
- .3 Store materials in a dry, ventilated weathertight location.
- .4 Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.8 WARRANTY

- .1 Warranty: 15 year limited against splitting and cracking, 10 year on hinge and track and all other components for 1 year.

2 Products

2.1 MANUFACTURERS

- .1 Basis of design: Overhead Door Corp., or approved equivalent.

2.2 RESIDENTIAL METAL OVERHEAD DOORS

- .1 Non-Insulated Steel Sectional Overhead Doors: Traditional Steel Collection 170/171/177 Series Non-Insulated Steel Doors by Overhead Door Corporation.
- .2 Door Assembly: High tensile strength steel construction.
 - .1 Size: As indicated on the Drawings.
 - .2 Panel Thickness: 2 inches (51 mm) nominal.
 - .3 Panel Style: tongue in groove
 - .1 Short Panel, 170 Series.
 - .2 Long Panel, 171 Series.
 - .3 V5 Panel, 175 Series.
 - .4 Exterior Steel: Residential grade high strength hot-dipped galvanized steel with an embossed simulated wood grain texture. 26 gauge (.0183) nominal.
 - .5 Windload Design: Provide to meet the Design/Performance requirements specified.
 - .6 Finish/Color: Two coat baked-on polyester. Color to be selected by Consultant from full standard colour range.
 - .7 Hardware: Standard garage door hardware.
 - .8 Lock: Interior mounted slide lock.
 - .9 Bottom fixture - DASMA 103 tamper resistant fasteners.

- .10 Weatherstripping: Extruded PVC bulb-type strip at bottom.
- .11 Track: Provide track as recommended by manufacturer to suit loading required and clearances available.
- .12 Nylon rollers.
- .13 Electric Openers.

3 Execution

3.1 EXAMINATION

- .1 Do not begin installation until openings and substrates have been properly prepared.
- .2 Verify wall openings are ready to receive work and opening dimensions and tolerances are within specified limits.
- .3 Verify electric power is available and of correct characteristics.
- .4 If preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

- .1 Clean surfaces thoroughly prior to installation.
- .2 Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

- .1 Install overhead doors, track and openers in accordance with approved shop drawings and the manufacturer's printed instructions.
- .2 Coordinate installation with adjacent work to ensure proper clearances and allow for maintenance.
- .3 Anchor assembly to wall construction and building framing without distortion or stress.
- .4 Securely brace door tracks suspended from structure. Secure tracks to structural members only.
- .5 Fit and align door assembly including hardware.
- .6 Coordinate installation of electrical service with Section 26 05 83.

3.4 CLEANING AND ADJUSTING

- .1 Adjust door assembly to smooth operation and in full contact with weatherstripping.
- .2 Clean doors, frames and glass.
- .3 Remove temporary labels and visible markings.

3.5 PROTECTION

- .1 Do not permit construction traffic through overhead door openings after adjustment and cleaning.
- .2 Protect installed products until completion of project.
- .3 Touch-up, damaged coatings and finishes and repair minor damage before Substantial Completion.

END OF SECTION

1 General

1.1 SUMMARY

- .1 This Section includes requirements for supply and installation of double glazed, fibreglass windows, having a combination of both fixed and operable sealed glass units, as indicated on the Window Schedule on Drawing A0.0.
- .2 Drawings contain details that suggest directions for solving some of the major design requirements; these details can be developed further by the Contractor provided that the final installation adheres to aesthetic criteria established by the drawings and specified dimensions with all elements in planes as drawn, maintaining their relationships with all other building elements.

1.2 REFERENCE STANDARDS

- .1 North American Fenestration Standard (NAFS):
 - .1 NAFS-08 - Canadian Supplement to AAMA/WDMA/CSA 101/I.S.2/A440-08, NAFS - North American Fenestration Standard/Specification for windows, doors, and skylights
- .2 National Fenestration Rating Council (NFRC):
 - .1 ANSI/NFRC 100-2020, Procedure for Determining Fenestration Product U-factors
 - .2 ANSI/NFRC 400-2020, Procedure for Determining Fenestration Product Air Leakage
 - .3 ANSI/NFRC 500-2020, Procedure for Determining Fenestration Product Condensation Resistance Values
- .3 American Architectural Manufacturers Association (AAMA):
 - .1 AAMA/NWWDA 101/I.S.2-97, Voluntary Specifications for Aluminum, Vinyl (PVC) and Wood Windows and Glass Doors
 - .2 AAMA 502-12, Voluntary Specification for Field Testing of Newly Installed Fenestration Products
 - .3 AAMA 1503-09, Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections
- .4 Canadian Standards Association (CSA):
 - .1 CAN/CSA A440-00/A440.1-00, Windows/User Selection Guide to CSA Standard CAN/CSA A440-00, Windows
 - .2 CSA-G40.20-04/G40.21-04(R2009), General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel
 - .3 CSA W47.1-09, Certification of Companies for Fusion Welding of Steel Structures
 - .4 CSA W47.2-11, Certification of Companies for Fusion Welding of Aluminum.
 - .5 CSA W59-03(2008), Welded Steel Construction (Metal Arc Welding), Metric.
- .5 Canadian General Standards Board (CGSB):
 - .1 CAN/CGSB-1.108-M89, Bituminous Solvent Type Paint
 - .2 CAN/CGSB-51.20-M87, Expanded Polystyrene Thermal Insulation
- .6 American Society of Testing and Materials (ASTM):

- .1 ASTM A167-99(2009), Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet and Strip
- .2 ASTM B209-06/B209M-06,
- .3 ASTM E90-09(2016), Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements
- .4 ASTM E283/E283-19, Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Skylights, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen
- .5 ASTM E330/E330-14(2021), Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference
- .6 ASTM E331-00(2016), Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference
- .7 ASTM E1105-15, Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors, and Curtain Walls, by Uniform or Cyclic Static Air Pressure Difference

1.3 PREINSTALLATION MEETING

- .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.

1.4 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 including construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of product indicated.
 - .2 Shop Drawings:
 - .1 Submit Shop Drawings prepared by or under the supervision of Professional Engineer, familiar with fibreglass window construction, and registered to practice in the Province of the Work, detailing fabrication and assembly of glazed fibreglass systems. Seal and sign Shop Drawings by same Professional Engineer.
 - .2 Clearly indicate each type of window, door, extrusion profiles, method of installation, hardware reinforcement, anchorages and locations of exposed fasteners, finishes and glazing.
 - .3 Indicate structural attachment of entire assembly back to supporting structure. Identify locations of tempered glass in accordance with OBC.
 - .3 Certificates:
 - .1 Statement signed by glass manufacturer clearly stating that glass used on this project is part of manufacturer's system and are acceptable to manufacturer.
 - .2 Statement signed by the glass manufacturer that the glass manufacturer has reviewed the contract documents and can issue warranty incorporating components for system; Letters signed by installer for this section are not acceptable.

1.5 PROJECT CLOSEOUT SUBMISSIONS

- .1 Provide operations and maintenance information in accordance with Division 01.
- .2 Submit data for cleaning of finishes and maintenance of operational hardware.

1.6 QUALITY ASSURANCE

- .1 Qualifications: Provide proof of qualifications when requested by the Consultant:
 - .1 Installer: Use personnel experienced with the materials specified, with work of similar complexity to that indicated for the project, and who are acceptable to manufacturer.
- .2 Pre-Construction Testing:
 - .1 Laboratory tests to be conducted on at least one full size sample taken from each batch of windows manufactured for the Project, including operable components.
 - .2 Submit certified copies of test results from an approved independent testing agency to confirm compliance with the CSA A440 minimum specified A, B, C ratings.
 - .3 Additional windows may be specified for testing at the discretion of the Consultant.
 - .4 The test data to be submitted to the Consultant for review and approval prior to installation. Include cost of testing in the Contract Price.

1.7 DESIGN REQUIREMENTS

- .1 Fibreglass window design is established in details on Drawings and performance requirements in Specifications.
- .2 Design requirements are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sight lines, to one another and to adjoining construction.
- .3 Performance characteristics and design criteria specified are subject to verification by 1 or more methods including preconstruction testing, field testing and in-service performance.
- .4 Do not modify intended architectural design effects without Consultant's direction. If modifications are proposed, submit comprehensive explanatory data to Consultant for review.
- .5 Comply with requirements of OBC and regulations of authorities having jurisdiction, which shall be minimum, except where more stringent requirements are specified herein.
- .6 Design glazing systems and framing to prevent thermal shock and pressure fracture damage to glass. Design glass and glazing to meet CAN/CGSB-12.20-M. Comply with published recommendations of glass manufacturers and GANA's "Glazing Manual" unless more stringent requirements are indicated.
- .7 Provide flashing and trim systems to prevent water leakage to the building interior. Include flashings with frames to divert water away from glazing edges.
- .8 Internal Drainage System: Drain water entering joints, condensation occurring in glazing channels, or migrating moisture occurring within system to exterior by weep drainage network.
- .9 Failure of performance requirements will be considered to include, but not be limited to, the following:
 - .1 Deflection exceeding specified limits;
 - .2 Thermal stresses transferred to building structure;

- .3 Framing members transferring stresses, including those caused by thermal and structural movements, to glazing;
- .4 Glazing-to-glazing contact in structural silicone glazed systems;
- .5 Noise or vibration created by wind and thermal and structural movements;
- .6 Loosening or weakening of fasteners, attachments, and other components;
- .7 Sealant failure;
- .8 Failure of operating units to function properly.

1.8 PERFORMANCE VERIFICATION TESTING

- .1 Performance Testing:
 - .1 Windows will be performance tested by an independent testing agency designated by the Consultant.
 - .2 All in situ testing, except for re-testing, shall be paid directly by the Owner.
 - .3 Coordinate testing activities with the testing agency. Provide timely notice to affected parties prior to scheduled testing.
 - .4 Testing agency shall distribute written results of all tests within three days of completing testing.
- .2 Field testing shall include:
 - .1 Water Penetration: in accordance with ASTM E1105-15.
 - .2 Air Leakage: in accordance with ASTM E783-02(2010).
- .3 Testing Stage 1 – Mock-Up Testing:
 - .1 Prior to installation of any windows, the mock-up shall be tested to verify compliance with specified air and water penetration performance requirements. Testing area shall include the window and surrounding building envelope components.
 - .2 Upon passing the mock-up test, installation of the remaining windows may proceed.
- .4 Testing Stage 2 – In Situ Testing:
 - .1 Throughout the progress of the Work and at the discretion of the Owner, up to 5% of installed windows may be tested for air and water penetration to verify compliance with specified performance requirements.
- .5 Re-Testing:
 - .1 Should testing result in a failure to meet specified performance requirements:
 - .1 Re-test the failed unit and test one (1) additional window at Contractor's expense.
 - .2 Provide a written explanation of the cause of the failure and propose a recommendation to ensure specified performance requirements are met for all windows. Further testing will not be scheduled until this written explanation is received.
 - .3 Any proposed modifications to the window design or installation are subject to review and acceptance by the Consultant and the Owner.
 - .4 The cost of retesting including the Testing Agency, and the Engineers and Owners time, will be paid by the Contractor.

1.9 SITE CONDITIONS

- .1 Site Measurements: Verify actual locations of structural supports by site measurements before fabrication and indicate measurements on Shop Drawings.
- .2 Established Dimensions: Establish dimensions and proceed with fabrication, where site measurements cannot be made without delaying the Work; coordinate construction to ensure that actual dimensions correspond to established dimensions.
- .3 Ambient Conditions: Confirm installation requirements for ambient and surface temperatures of sealants with manufacturer and apply sealants when temperatures are greater than manufacturer's stated minimum from time of application until sealants have cured.

1.10 MOCK-UPS

- .1 Provide mock-ups in accordance with Section 01 43 39.
- .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 Requirements:
 - .1 1 window within each typical exterior wall assembly type.
- .5 Provide performance testing by independent testing agency for water penetration and air leakage.
 - .1 Mock-up to be tested before remaining windows are installed and in-situ testing as well.
 - .2 If testing results in failure, re-test the failed unit and one (1) additional window at Contractor's expense to ensure compliance.

1.11 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 the time stated from date of Substantial Performance:
 - .1 Framing, Panels and Glazing: Failure of performance requirements specified in Contract Documents; 5 years
 - .2 Sealed Glass Units: Misting, dusting and seal failure; 5 years
 - .3 Sealants: Failure to maintain seal; 5 years

2 Products

2.1 MANUFACTURERS

- .1 Basis-of-Design products are named in this Section; additional manufacturers offering similar Products may be incorporated into the work provided they meet the performance requirements established by the named products provided they submit requests for substitution in a minimum of five (5) days in advance of Bid Closing.
- .2 Acceptable Materials and Manufacturers: Subject to compliance with requirements specified in this Section and as established by the Basis-of-Design Materials, manufacturers offering products that may be incorporated into the Work include; but are not limited to, the following:
 - .1 Fixed Vinyl Windows:
 - .1 Cascadia Windows and Doors, Universal Series

- .2 Inline Fibreglass Ltd, 3000 Series
- .3 Duxton Windows and Doors, 458 Series
- .4 Or approved equivalent
- .2 Casement Vinyl Windows:
 - .1 Cascadia Windows and Doors, Universal Series
 - .2 Inline Fibreglass Ltd, 3000 Series
 - .3 Duxton Windows and Doors, 458 Series
 - .4 Or approved equivalent

2.2 WINDOWS DESIGN CRITERIA

- .1 Design fixed/operable fibreglass window system to accommodate and interface with work of other Sections as applicable.
- .2 Glass and Glazing.
 - .1 Glazing Assemblies: As indicated in Section 08 80 00.
- .3 Ensure faces of panels, flashings, caps, bases and soffits are visually flat under all lighting conditions. Ensure finish on aluminum is uniform and consistent within each component and from component to component.
- .4 Ensure glazing gaskets and sealants on inside of glass units are conductive type and installed in a manner to ensure interior building heat is conducted through vinyl framing, mullions and sills, through gaskets and sealants to glass edge while maintaining air seal. Ensure no voids occur between glass edges, gaskets and sealants. Use non-conductive glazing gaskets and sealants on building exterior side of glass units.
- .5 Locate sealants, gaskets, air/vapour seals, thermal separations, drainage slots and holes as shown or specified in this Section, as required to obtain design requirements. Ensure components and assemblies exterior to air barrier drain to building exterior.
- .6 Design, assemble and secure Work in a manner that will keep any stresses on sealants within sealant manufacturer's recommended working range within factors of safety specified.
- .7 Accurately shape members at intersecting joints to obtain hairline joints, just wide enough to permit thermal expansion and contraction.
- .8 Conceal securement devices unless otherwise specified.
- .9 Design attachments that will permit replacement of individual units during construction or in subsequent usage of building without dismantling or disturbance to adjoining components or units. In addition, accomplish such replacement without use of extra fasteners, splices, covers and like that alter original design features.
 - .1 Provide accessories, closures and trims required and necessary to complete work.

2.3 PERFORMANCE REQUIREMENTS

- .1 Design windows in accordance with following CAN/CSA A440S1 (17), Canadian Supplement to AAMA/WDMA/CSA 101/I.S.2/A440-17, North American Fenestration Standard/Specification for windows, doors, and skylights:
 - .1 Performance class: CW.
 - .2 Minimum Performance Grade (PG): PG30.

- .3 Air tightness:
 - .1 Operable: A3; 0.5 L/s/m² at 75 Pa
 - .2 Fixed: 0.2 L/s/m² at 75 Pa
- .4 Uniform Load Structural Test pressure (STP): 3240 Pa
- .5 Minimum Positive Design Pressure: 1140 Pa
- .6 Minimum Negative Design Pressure: -1140 Pa
- .7 Minimum Water Penetration Test Pressure: 300 Pa
- .8 Condensation Resistance:
 - .1 Operable: I56
 - .2 Fixed: I60

2.4 MATERIALS

- .1 Performance/Design Criteria:
 - .1 Components and cladding design wind pressure (DP) for the Project of: use limit state design calculation method for design of mullions, reinforcing and other spanning members.
 - .2 Design glass according to AAMA/WDMA/CSA 101/I.S.2/A440.
 - .3 Design fiberglass according to AAMA/WDMA/CSA 101/I.S.2/A440.
 - .4 Design glazing and spanning window frame members, including any required reinforcing, in accordance with AAMA/WDMA/CSA 101/I.S.2/A440. Ensure there is no deflection in excess of L/175 of the span of any framing member.
 - .5 Allow for deflection of building structure. Ensure no structural loads are imposed on window assemblies. In lieu of other specific requirements, minimum requirements are as specified by structural engineer.
- .2 Frame and Sash Profiles: Manufactured from Pultruded Fiberglass.
 - .1 Fibreglass pultrusions are manufactured using clamp-action equipment. No surface texture from rollers is permitted.
 - .2 Glass content average for pultruded profiles: 55% or more.
- .3 Brackets and Reinforcements: Manufacturer's standard high strength aluminum with non-staining, nonferrous shims for aligning system components.
- .4 Fasteners and Accessories: Manufacturer's standard corrosion-resistant, non-staining, non-bleeding fasteners and accessories compatible with adjacent materials.
 - .1 Use self locking devices where fasteners are subject to loosening or turn out from thermal and structural movements, wind loads, or vibration.
 - .2 Reinforce members as required to receive fastener threads.
 - .3 Use only concealed fasteners, unless use of exposed fasteners has been accepted in writing by the Consultant. When approved, use exposed fasteners with countersunk Phillips screw heads.
 - .4 Finish exposed portions to match framing system.
 - .5 Use slip joint linings, spacers, and sleeves at movement joints of material and type recommended by manufacturer.
- .5 Anti-Rotation Channels: Extruded aluminum anti-rotation channel designed to mechanically retain air seal membrane to the face of the tubular back section.

- .6 Anchors: Three way adjustable anchors that accommodate fabrication and installation tolerances in material and finish compatible with adjoining materials and recommended by manufacturer.
- .7 Concealed Flashing: Manufacturer's standard corrosion resistant, non-staining, non-bleeding flashing compatible with adjacent materials.
- .8 Glazing Sealants: Provide a multi component structural silicone sealant for pre-assembled glazing units.
 - .1 Basis of Design Materials:
 - .1 Proglaze II by Tremco;
 - .2 Illmod 600 by Tremco;
 - .3 983 by Dow Chemical;
 - .4 Or approved equivalent.
- .9 Transition Membranes: Full length mechanically anchored, extruded silicone rubber transition membrane to perimeter of frame profile to provide continuous air/vapour retarder to adjacent wall construction:
 - .1 Basis-of-Design Materials: Tremco Proglaze ETA Engineered Transition Assembly, or approved equivalent.
- .10 Glazing Gaskets: Manufacturer's standard sealed corner pressure glazing system of black, resilient elastomeric glazing gaskets, setting blocks, and shims or spacers; as recommended by manufacturer for joint type.
- .11 Dielectric separator: Bituminous paint CAN/CGSB-1.108.
- .12 Thermal separator: Provided by window manufacturer.
- .13 Expanding Foam Insulation Tape: pre-compressed and impregnated multifunctional joint sealing tape for the sealing of all function areas in window joint sealing with a single product. The tape meets all of the requirements pertaining to air-tight and heavy rain-tight sealing. Roll width/thickness to suit detail; follow manufacturers written installation instructions.
 - .1 Hannoband-3e
 - .2 ExoAir Flex Foam by Tremco
 - .3 Or equivalent.
- .14 Fasteners: To ASTM A167, stainless steel, type 304 selected to prevent galvanic action with the components fastened, of suitable size to sustain imposed loads.
- .15 Supporting angles, plates, bars, rods, and other steel accessories: Mild steel CAN3-G40.20/G40.21, shop painted with zinc chromate primer, thickness as required to sustain imposed loads and in no case less than 5 mm thick.
- .16 Metal air seal/vapour barrier (by window supplier) to be bonded to window frame and extend behind wood mounting frame as indicated on details. Seal all corners to maintain air sea/vapour retarder. Note that flexible flashing with continuous metal retaining strip will be supplied and installed by the interior finishing contractor.
- .17 Sill Angle: Extruded aluminum sill to suit sill depth, with perpendicular turn up to under sill and back with custom preformed black EPDM sill joint seal and with aluminum sliding closure.

2.5 HARDWARE

- .1 Windows:
 - .1 Operable windows to have single lever operator/multi-point locking, as supplied by the window manufacturer.

- .2 Profile and finish to be selected by Consultant from full manufacturer range.

2.6 INSECT SCREENS

- .1 Design windows and hardware to accommodate screens in a tight-fitting, removable arrangement, with a minimum of exposed fasteners and latches, and as follows:
 - .1 Fabricate screens and frames in accordance with CAN/CSA A440 and CAN/CGSB 79.1.
 - .2 Fabricate insect screens to fully integrate with window frame.
 - .3 Locate screens on outside of window and provide for each operable exterior sash.
- .2 Screen Frames:
 - .1 Extruded Aluminum or Aluminum Tubular Framing Sections: Aluminum sections having 1/32" minimum nominal wall thickness, with finish matching aluminum window members.
- .3 Screen Fabric:
 - .1 Screen Class: Class A in accordance with CAN/CGSB 79.1.
 - .2 Screen Strength: S2 in accordance with CAN/CSA A440 and CAN/CGSB 79.1.
 - .3 Screen Style: Style 1 in accordance with CAN/CGSB 79.1.
 - .4 Fabric Mesh Material: Aluminum Wire: Charcoal grey or black finish; in accordance with CAN/CGSB 79.1.

2.7 FABRICATION

- .1 Fit and assemble all Work in the shop insofar as practical.
- .2 Carefully fit and match all Work for continuity of line and design, using rigidly secured joints with hairline contact, unless otherwise shown.
- .3 Reinforce members and joints with steel plates, bars, rods or angles for rigidity and strength as needed to fulfill performance requirements. Use concealed stainless steel fasteners for jointing which cannot be welded.
- .4 Separate unlike metals or alloys with a heavy coating of bituminous paint, separator gaskets or slip gaskets as required to prevent galvanic action.
- .5 Provide weepholes in the glazing recess and an airseal at the interior glassline.

2.8 FINISHES

- .1 2-component waterborne polyurethane, meeting requirements of AAMA 625.
- .2 Interior Frame Finish: To be selected by Consultant from manufacturer's standard colour range.
- .3 Exterior Frame Finish: To be selected by Consultant from manufacturer's standard colour range.

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 Ensure that all flashings built-in or provided by others integrate with system to divert moisture to exterior.
- .3 Ensure that all reglets, anchor blocks or inserts required to receive system are correctly located and installed.

- .4 Ensure that all anchors and setting or installing components provided by this Section for installation are properly located and installed.
- .5 Ensure that building air and vapour retarding membranes can be sealed to window units to maintain system integrity.

3.2 PREPARATION

- .1 Obtain all dimensions from the job site.
- .2 Provide data, dimensions and components, anchors and assemblies to be installed by others in proper time for installation.

3.3 INSTALLATION

- .1 Assemble and install window units according to manufacturer's instructions and approved Shop Drawings.
- .2 Set window framing in its correct location, level, square and plumb and at proper elevations and alignment with other work. Fasten and anchor framing in place in accordance with CSA A440.4. Install in accordance with approved Shop Drawings.
- .3 Erection Tolerances: Maintain required clearance to allow for movement and thermal expansion and contraction.
- .4 Conceal all anchors and fitments. Exposed heads of fasteners not permitted. All joints in exposed work to be flush hairline butt joints.
- .5 Use anchors that will permit sufficient adjustment for accurate alignment. Make allowance for deflection of building structure.
- .6 Build in and provide any supplementary reinforcing and bracing required by assembly loads and deflections.
- .7 Secure Work adequately to structure in a manner not restricting thermal and wind movement.
- .8 Correctly locate and install flashings, deflectors and weep holes to ensure proper drainage of moisture to exterior.
- .9 Maintain alignment with adjacent Work.
- .10 Install flexible, low expansion polyurethane foam tape insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.

3.4 SEALANT

- .1 Caulk and seal full perimeter of windows to building air/vapour retarder to provide and maintain the designed air/vapour/thermal barrier integrity and weather tightness.
- .2 Install sealants and back-up materials in strict accordance with manufacturer's written instruction.

3.5 TOLERANCES

- .1 Maximum Variation from Level or Plumb: 3mm in 900mm (1/8" in 3').

3.6 FIELD QUALITY CONTROL

- .1 Window Site Tests:
 - .1 Costs for first tests by independent testing agency are included in the Work of this Project.
 - .2 Re-testing costs which are required, are to be paid for by window manufacturer or installer, depending on the failure. Fully cooperate with testing agency.
 - .1 Preform field tests 1% of the windows and not less than five windows. Minimum of 2 windows to be tested before 5% of the windows are

installed. Number of tests may increase, depending on failure rate of window tests.

- .2 Test window mock-up to determine if windows meet CAN/CSA A440 for standard indicated in description above.
- .3 If window mock-up fails to meet requirements indicated in this Section, reasons for failure to be determined by testing agency. Make repairs to window units and re-test at window manufacturer or installers cost until tested window passes the requirements.
- .4 If non-mock-up window fails to meet requirements indicated in this Section, reasons for failure to be determined by testing agency. Make repairs to window units and re-test at window manufacturer or installers cost until tested window passes the requirements.
- .1 Plus, test two (2) different window units at window manufacturer or installers cost to ensure windows are performing as required.

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.

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 MOCK-UPS

- .1 Provide mock-ups in accordance with Section 01 43 39.
- .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.

1.5 QUALITY ASSURANCE

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

1.6 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.

1.7 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.

1.8 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 Foam PVC glazing tape, '#25 PVC Glazing Tape' by H-O Products or 'SG635' by Tremco Ltd., 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: 4mm thick, clear glass complete with Low-E coating on Surface #2.
 - .1 Low-E Coating (Surface #2) Basis of Design Materials: SunGuard Neutral 78/65 by Guardian Glass, or approved equivalent.
 - .2 Gas Infill: 13mm (½"); 90% Argon, 10% air filled.
 - .3 Inner Lite: 4mm thick, clear glass complete with on Surface #4.
 - .2 Unit Characteristics:
 - .1 Unit Thickness: 21mm
 - .2 Visible Light Transmittance: 72%
 - .3 Visible Light Reflectance: 11%
 - .4 Solar Heat Gain Coefficient (SHGC): 0.39
 - .5 Glass U-Value Winter: 1.4 (w/m2*K)
 - .3 Basis of Design Manufacturer: Guardian Glass, or approved equivalent.

2.3 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.

2.4 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.

2.5 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 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 The work in this section includes supply and installation for the following:

- .1 Porcelain Floor Tile
- .2 Ant-Fracturing Waterproof Membrane
- .3 Edge trims, Transition Strips and Accessories

1.2 REFERENCE STANDARDS

.1 American National Standards Institute/Ceramic Tile Institute (ANSI/CTI):

- .1 ANSI/CTI A108.1-2011, Specification for the Installation of Ceramic Tile: Collection of 20 ANSI/CTI A108, A118 and A136 Series of Standards on Tile Installation

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

- .1 ASTM C241/C241M-09, Standard Test Method for Abrasion Resistance of Stone Subjected to Foot Traffic
- .2 ASTM C627-10, Standard Test Method for Evaluating Ceramic Floor Tile Installation Systems Using the Robinson-Type Floor Tester
- .3 ASTM C920-11, Standard Specification for Elastomeric Joint Sealants
- .4 ASTM C1028-07e1, Standard Test Method for Determining the Static Coefficient of Friction of Ceramic Tile and Other Like Surfaces by the Horizontal Dynamometer Pull-Meter Method

.3 Canadian General Standards Board (CGSB):

- .1 CAN/CGSB-75.1-M88, Tile, Ceramic

.4 Terrazzo, Tile and Marble Association of Canada (TTMAC):

- .1 2019-2021 Specification Guide 09 30 00, Tile Installation Manual
- .2 Hard Surface Maintenance Guide

1.3 EXAMINATION

.1 Examine all areas and conditions affecting work of this Section and report any discrepancies or defects which would affect finished results.

1.4 SUBMITTALS

.1 Submit submittals in accordance with Division 01.

.2 Samples:

- .1 Submit sample panel of each type and colour tile, 610mm x 610mm (24" x 24").
- .2 Adhere to a rigid board with setting compound, grout and a dummy control joint showing sealant as specified. Identify samples by project number, date, name of sub-contractor and tile type.
- .3 Tile and grout used in the building shall correspond to appearance of approved samples in all respects. Do not install tile until samples are approved.
- .4 Upon Consultant's request submit samples of base, trim and fittings.

- .3 Material Lists:
 - .1 Prior to ordering any materials submit list of products to be used. Products proposed must be recommended by their manufacturer for purpose intended. Upon Consultant's request submit evidence of manufacturer's endorsement.
 - .2 Take care to ensure compatibility of all materials. Consult the manufacturers in case of doubt.
 - .3 The supplementary materials shall come from the same production batch as installed materials.
- .4 Safety Data Sheets:
 - .1 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.
- .5 Maintenance Instructions:
 - .1 Upon completion of the Work, furnish Consultant with copies of maintenance instructions, containing complete detailed and specific instructions for maintaining, preserving and keeping clean the surfaces of this Work and in particular, giving adequate warning of maintenance practices of materials detrimental to the work of this Section for inclusion in the Operation and Maintenance Manual.
- .6 Maintenance Materials:
 - .1 Supply five percent (5%) extra of each colour of tile and of each tile type for future repairs by the Owner.
 - .2 Place maintenance materials where directed by the Owner and store in their original containers.

1.5 QUALITY ASSURANCE

- .1 Subcontractor executing work of this Section shall employ installers having 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 Work of this Section shall be executed by workers especially trained and experienced in this type of work. Have a full time, qualified representative at the Site to direct the work of this Section at all times.
- .3 Ensure proper use of proprietary materials in strict accordance with the material manufacturer's directions. It shall be the responsibility of the material manufacturer or supplier to furnish these directions to the Contractor and to check periodically at the site to ensure that they are being carried out.

1.6 PRE-INSTALLATION CONFERENCE

- .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 personal before commencement of work for this Section; agenda for meeting will include; but not be limited to, the following:
 - .1 Substrate conditions, non-structural cracks, structural cracks and preparation requirements;
 - .2 Floor and wall surface irregularities and levelness tolerances, including all remedial requirements;
 - .3 Installation of anti-fracturing membranes and setting bed materials;
 - .4 Installation of tiles and grouting;
 - .5 Edge details and treatments;

- .6 Installation of tile and grout sealers.

1.7 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 Store material in original, undamaged containers or wrappings with manufacturer's seals and labels intact.
- .4 Restrict traffic by other trades during installation.
- .5 Provide adequate protection of completed tiled surfaces to prevent damage by other trades until final completion of this project. Minimum protection shall consist of 4 mil polyethylene sheets lapped 100mm (4") and taped.
- .6 Heavily travelled areas shall have additional 13mm (1/2") thick fibreboard sheet protection with taped joints over polyethylene sheet protection as specified above.
- .7 Protect exposed edges of floor tile with same thickness as tile x 100mm (4") wide tapered strip of plywood adhered to floor until adjoining floor finish is to be installed.

1.8 SITE CONDITIONS

- .1 Ambient Conditions: Apply tile after completion of work by other Sections is complete; to surfaces sufficiently dry, clean, firm, level, plumb and free from oil or wax or any other material deleterious to tile adhesion and as follows:
 - .1 Temperature: Maintain tile materials and substrate temperature between TTMAC recommended minimum and maximum temperature range; unless indicated otherwise by manufacturer, for forty-eight (48) hours before and during installation until materials are fully set and cured; provide additional heat during winter months or at any other time when there is a risk that surface temperatures may drop below minimum recommended temperatures.
 - .2 Ventilation: Maintain adequate ventilation where Work of this Section generates toxic gases or where there is a risk of raising relative humidity to levels that could damage building finishes and assemblies.

1.9 WARRANTY

- .1 Warrant the work of this Section against defects in materials and workmanship in accordance with the General Conditions, but for a period of five (5) years, and agree to promptly make good defects which become evident during the warranty period without cost to the Owner.
- .2 Defects shall include but not be limited to the following:
 - .1 Cracking and crazing;
 - .2 Discolouration and staining;
 - .3 Pitting, splitting, and;
 - .4 Deformation of tiles and grout.

2 Products

2.1 MATERIALS

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

- .2 Porcelain Floor Tiles (POR-1):
 - .1 Size: 305mm x 305mm
 - .2 Finish: Matte
 - .3 Basis of Design Model and Manufacturer: Regal Series through body porcelain tile, manufactured by Olympia; Or approved equivalent.
 - .1 Colour to be selected from full colour range, allow for up to 2 colours.
- .3 Control Joint Caulking:
 - .1 As supplied by the Grout Manufacturer.
 - .2 Colour: To match adjacent grout, as approved by the Consultant.
- .4 Tile Straight Edge Trim:
 - .1 Extruded clear satin anodized aluminum edge trim, 3mm (1/8") wide at top edge; Height as required to suit tile installation; with integral perforated anchoring leg for setting the strip into the setting material.
 - .2 Basis of Design Materials: Schlüter Schiene AE by Schlüter.

2.2 MORTAR SETTING MATERIALS

- .1 Manufacturers: Mortar and grout materials listed in this Section shall be of a uniform quality for each mortar, and grout component from a single manufacturer and each aggregate from one source or producer as follows:
 - .1 Flextile Ltd.
 - .2 MAPEI Inc.
 - .3 Custom Building Products Ltd.
 - .4 Laticrete International Inc.
 - .5 Or approved equivalent.
- .2 Surface Preparation Materials: As indicated in Section 03 35 00.
- .3 Interior Thin Set Wall System: Dry set mortar meeting or exceeding the requirements of ANSI A108.1 formulated for thin set applications of ceramic biscuit tile, factory sanded mortar consisting of portland cement, sand and additives requiring only potable water to be added for installation:
 - .1 Acceptable mortar materials:
 - .1 #51 Floor and Wall Mix by Flextile Ltd.
 - .2 Kerabond by MAPEI Inc.
 - .3 Premium Blend Thinset by Custom Building Products.
 - .4 Laticrete 317 Mortar by Laticrete International Inc.
 - .5 Or approved equivalent.
- .4 Interior Thin Set Floor System: Dry set mortar meeting or exceeding the requirements of ASTM C627 for Heavy installation using latex modified, portland cement mortar meeting requirements of ANSI A108.1:
 - .1 Acceptable mortar materials:
 - .1 #53 Floor Mix by Flextile Ltd.
 - .2 Kerabond by MAPEI Inc.
 - .3 Master Blend Thinset by Custom Building Products.
 - .4 Laticrete 253 Thinset by Laticrete International Inc.

- .5 Or approved equivalent.

2.3 GROUT MATERIALS

- .1 Grout Colours: As selected by the Consultant from manufacturer's full product range.
- .2 Portland Cement Grout for Wall and Floor Joints $\leq 3\text{mm}$ (1/8") Interior Only: factory blended polymer modified mixture meeting requirements of ANSI A108.1:

- .1 Acceptable Materials:

- .1 500 Series Unsanded Grout by Flextile Ltd.
- .2 Ker 800 Unsanded Grout by MAPEI Inc.
- .3 Polyblend Unsanded Grout by Custom Building Products.
- .4 Peracolor Grout Laticrete International Inc.
- .5 Or approved equivalent.

- .3 Latex-Portland Cement Grout for Floors with Joints $\geq 3\text{mm}$ (1/8") Interior or Exterior: factory blended stain resistant latex modifiers, portland cement and graded silica sand and dry-set grout and meeting requirements of A108.1:

- .1 Acceptable Materials:

- .1 600/100 Series Sanded Grout by Flextile Ltd.
- .2 Keracolor S Sanded Grout by MAPEI Inc.
- .3 Polyblend Sanded Grout by Custom Building Products.
- .4 Peracolor Grout Laticrete International Inc.
- .5 Or approved equivalent.

2.4 WATERPROOFING ANTI-FRACTURING MEMBRANES

- .1 Waterproofing Anti-Fracturing Membranes: Load bearing, reinforced, liquid applied membrane; manufactured to accommodate flood testing and reduce the incidence of thermal shock cracking to tiling installations; meeting requirements of ANSI A108.1. Waterproof Anti Fracture Membrane to be provided at all horizontal and vertical surfaces scheduled to receive tile finish:

- .1 Acceptable Membrane Materials:

- .1 Flex WP-980 Waterproof and Crack Isolation Membrane by Flextile Ltd.
- .2 Mapelastic 315 Waterproofing and Reinforcing Fabric by MAPEI Inc.
- .3 Level Quik Waterproof and Anti-Fracture Membrane by Custom Building Products.
- .4 Hydroban Waterproofing by Laticrete International Inc.
- .5 Or approved equivalent per Specification 01 25 00

- .2 Reinforcing Fabric: strong, absorbent, flexible, alkali-resistant, polyester reinforcing fabric for use at coves, corners, cracks and around drains.

- .1 Acceptable product: Reinforcing Fabric by Mapei
- .2 Or approved equivalent per Specification 01 25 00

2.5 ACCESSORY MATERIALS

- .1 Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers and as follows:

- .1 Job Site Cleaner: Phosphoric acid/nitric acid based cleaning solution mixed in accordance with cleaner manufacturer's recommendations and as recommended by tile manufacturer.
- .2 Maintenance Cleaner: Non-toxic, electrolytic, biodegradable, non-ammonia containing, pH controlled cleaning solution mixed in accordance with manufacturer's recommendations.

3 Execution

3.1 EXAMINATION

- .1 Maintain minimum temperature of 13 deg C at tile installation area for twenty-four (24) hours prior to curing and for twenty-four (24) hours after installation. Do not apply work to frozen surfaces.
- .2 Examine carefully surfaces to which tile is to be installed and report any defects to the Consultant.
- .3 Anti-Fracturing Membranes:
 - .1 Prepare all surfaces of non-structural and structural cracks in strict accordance with the anti-fracturing membrane manufacturer's written instructions.
 - .2 Prime and fill all surfaces of non-structural and structural cracks in strict accordance with the anti-fracturing membrane manufacturer's written instructions.
- .4 Commencement of installation shall signify complete acceptance of surfaces and conditions.

3.2 PREPARATION

- .1 Surface Preparation:
 - .1 Make backing surfaces level and true to a tolerance in plane of 3mm in 2439mm ($\pm 1/8"$ in 8') for walls and 3mm in 3048mm ($\pm 1/8"$ in 10') for floors using levelling bed mortar.
 - .2 Surfaces shall be structurally sound, well fastened, clean and free from dust, oil, grease, paint, tar, wax, curing agents, primers, sealers, form release agents or any deleterious substances that may act as bond barriers.
 - .3 Backing surfaces shall be dry and fully cured. Dampness must not exceed five percent (5%) by volume.
- .2 Examine concrete substrate, repair as required to produce level, clean surface for new tile installation. Repair Work shall include levelling, filling, grinding or cutting, in accordance with Section 03 35 00.
- .3 Work of other trades that are required before new tile installation (i.e. electrical conduit installed below ceramic tile) shall be installed, complete and approved before tile installation.

3.3 INSTALLATION – ANTI-FRACTURING MEMBRANES

- .1 Install waterproofing anti-fracturing membrane in accordance with waterproofing manufacturer's written instructions to produce a waterproof membrane of uniform thickness bonded securely to substrate.
- .2 Do not install tile over waterproofing membrane until waterproofing has cured and been tested to determine that it is watertight.
- .3 Prepare floor and wall substrates in accordance with manufacturers written instructions.
 - .1 All substrates should be structurally sound, stable, dry, clean and free of any substance or condition that may reduce or prevent proper adhesion.

- .2 Do not use chemicals (acid etching or stripping) to prepare approved substrates.
- .3 Concrete substrates should have a concrete surface profile of #2 per the International Concrete Repair Institute (ICRI). Mechanically clean and profile by diamond-cup grinding or other engineer-approved method when necessary.
- .4 Application
 - .1 Fill all cracks, control joints and gaps in corners and coves that are greater than 1/32" (1 mm) with an appropriate filler material. Force material into crack and finish smooth with trowel. Let dry.
 - .2 Pre-treat cracks, corners, coves and floor wall intersections with 2 coats of waterproof membrane.
 - .3 Pre-treat drains by filling space between drain pipe and substrate with appropriate expansion joint materials and apply 2-coats of waterproof membrane
- .5 Fabric Reinforcing Application
 - .1 Lay reinforcing fabric into wet waterproof membrane at all "pre-treat" sections as outlined in application section below (cracks, coves, corners and penetrations). Allow for 50mm fabric on horizontal surface and 100mm fabric on vertical surface. Use brush to press fabric into corners until liquid comes through fabric. Work out any wrinkles or bubbles.
 - .2 While fabric is wet, apply additional waterproof membrane over fabric until completely covered to create void-free surface. Let dry. Apply a second coat and let dry.
 - .3 Install reinforcing fabric through main/field areas by placing into wet first coat of waterproof membrane. Using a roller, apply pressure to the fabric, working out wrinkles or bubbles while forcing liquid waterproof membrane to come through the fabric. Overlap seams and ends of the fabric by 2" (50mm). While fabric is still wet, apply additional liquid waterproof membrane over the fabric until completely covered, creating a void-free surface. Let dry completely.
 - .4 Apply a second coat of liquid waterproof membrane to entire area. Let dry.
 - .5 Apply a bead of commercial-grade silicone or urethane sealant between the membrane and the drain flange, about 1/2" (12 mm) in from the drain opening.
 - .6 Bolt the drain collar into place while the sealant is still fresh.
 - .7 Install tile as per following section below.

3.4 INSTALLATION - GENERAL

- .1 Unless otherwise specified, execute tile work according to the latest issue of Specification Guide 09 30 00, Tile Installation Manual - published by Terrazzo, Tile and Marble Association of Canada, as the minimum standard except as varied by this Specification.
- .2 Thoroughly clean surfaces to which tile is to be applied.
- .3 Back butter all floor tile.
- .4 Neatly cut tile around fitments, fixtures, access panels, and the like. Splitting of tile is expressly prohibited except where no alternative is possible. Form intersections, corners and returns accurately.
- .5 Finish surfaces flat and level or, sloped and graded as required.
- .6 Joint Widths: Install tile with the following joint widths, unless indicated on drawings:
 - .1 Wall Tile: 1.6mm (1/16")
 - .2 Floor Tile: 6mm (1/4"), unless otherwise indicated on the Drawings.

- .3 Quarry Tile: As per manufacturers recommendations.
- .4 Make joints consistent width and alignment within tile area.
- .5 Maintain 2/3 of grout joint depth free of setting material.
- .7 Joints in base shall match floor patterns. Joints shall be watertight without voids, cracks or excess grout.
- .8 Lay out tile so that fields or patterns are centred on wall areas or architectural features and so that no tile less than 1/2 size occurs.
- .9 Arrange and set recessed accessories in tile work so that they are evenly spaced, centred with joints and set true with correct projection. Rigidly install accessories.
- .10 Provide manufacturer's standard trim pieces at changes of direction and at terminations. Unless otherwise indicated provide the following corner and edge conditions:
 - .1 Internal horizontal corners: Coved.
 - .2 External vertical and horizontal corners: Bullnosed.
 - .3 Internal vertical corners and unexposed edges: Square.
- .11 Install tiles in patterns and locations as indicated on drawings.
- .12 Install wall tile full wall height unless shown otherwise.
- .13 Coordinate work of this Section with work of other Sections for items requiring to be recessed into work of this Section.
- .14 Sound tiles after setting and remove and replace tiles not fully bedded.
- .15 Re-point joints after cleaning to eliminate imperfections. Avoid scratching tile surfaces.
- .16 Finished tile work shall be clean and free of tiles which are pitted, chipped, cracked or scratched. All damaged tile shall be removed and replaced.
- .17 Where indicated on Drawings or as required, install continuous single piece metal edge trims centred under doors in closed position and other locations where tile meets other floor finishes.

3.5 MORTAR APPLICATION METHOD

- .1 Thin-Set Application Method:
 - .1 Install wall tile to gypsum wallboard and moisture resistant wallboard in dry areas using latex modified thin-set setting bed and latex modified wall grout in strict accordance with tile manufacturers written installation instructions as per the pre-installation conference.
 - .2 Apply floor tile and prepare floor slabs in strict accordance with tile manufacturers written installation instructions as per the pre-installation conference.

3.6 GROUTING

- .1 Grout tiles in accordance with ANSI A108.10 and as specified herein.
- .2 When grouting a fresh laid floor, make certain that traffic and grouting will not cause movement of floor in setting bed. Protect floor by using kneeling boards or gypsum board to defend floor against traffic while grouting.
- .3 Mix grouts and install in strict accordance with the manufacturer's instructions.
- .4 Excess grout shall be removed from the surface of tiles using the edge of a rubber float held at a 45 deg angle, moving it diagonally to the joints. Fill all gaps and air holes.
- .5 Do not allow grout to harden on face of tile. Refer to manufacturer's instructions for thorough removal.

- .6 Floors which required damp curing shall be cured for the required length of time using heavy kraft paper, not polyethylene sheets. Consult manufacturer for instructions.

3.7 CONTROL JOINTS AND SEALING

- .1 Control joints of a flexible caulking material shall be placed every 4877mm to 6096mm (16' to 20') apart, directly over existing control joints and/or where indicated on drawings or as required in accordance with TTMAC Detail No. 301MJ-2019-2021, Details E, F and G, whichever is applicable.
- .2 Control joints shall be placed around the floor perimeter at walls, around columns, and where tile abuts other hard materials or vertical surfaces. Saw cutting of tile after installation is prohibited. Tile shall be cut if required and installed along each side of control joints.
- .3 Expansion joints must always be placed directly over all slab expansion joints in accordance with TTMAC Detail No. 301MJ-2019-2021, Details A and B, whichever is applicable.
- .4 Locate expansion, control, contraction, and isolation joints, as indicated below, unless specifically indicated otherwise on the Drawings:
 - .1 Interior: 4877mm (16') maximum: 6mm (1/4") joint width.
- .5 Joints around fixtures, pipes or other fittings shall be sealed with a sealant. Refer to Section 07 92 00 for type of sealants to be used.
 - .1 Colour of sealant shall match grout as selected later by Consultant.

3.8 CLEANING AND PROTECTION

- .1 Clean tiled areas after grouting has cured, using compatible solutions and methods as recommended by the manufacturer.
- .2 Remove grout residue from tile as soon as possible.
- .3 Unglazed tile may be cleaned with acid solutions only when permitted by tile and grout manufacturer's written instructions, but no sooner than 10 days after installation.
- .4 Protect metal surfaces, cast iron, and vitreous plumbing fixtures from effects of acid cleaning.
- .5 Flush surface with clean water before and after cleaning.
- .6 Leave finished installation clean and free of cracked, chipped, broken, unbonded, or other tile deficiencies.

END OF SECTION

1 General

1.1 SUMMARY

- .1 Trowel application of breathable, low-VOC epoxy flooring, including surface preparation, primer, base coat, and finish coat.

1.2 SUBMITTALS

- .1 Provide required information in accordance with Division 01.
- .2 Samples:
 - .1 Submit sample panel 610mm x 610mm (24" x 24") of epoxy flooring adhered to a rigid board. Identify samples by project number, date, name of sub-contractor and tile type.
 - .2 Upon Consultant's request submit samples of base, trim and fittings.
- .3 Safety Data Sheets:
 - .1 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.
- .4 Maintenance Instructions:
 - .1 Upon completion of the Work, furnish Consultant with copies of maintenance instructions, containing complete detailed and specific instructions for maintaining, preserving and keeping clean the surfaces of this Work and in particular, giving adequate warning of maintenance practices of materials detrimental to the work of this Section for inclusion in the Operation and Maintenance Manual.

1.3 QUALITY ASSURANCE

- .1 Subcontractor executing work of this Section shall employ installers having 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 Work of this Section shall be executed by workers especially trained and experienced in this type of work.
- .3 Ensure proper use of proprietary materials in strict accordance with the material manufacturer's directions. It shall be the responsibility of the material manufacturer or supplier to furnish these directions to the Contractor and to check periodically at the site to ensure that they are being carried out.

1.4 PRE-INSTALLATION CONFERENCE

- .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; agenda for meeting will include; but not be limited to, the following:
 - .1 Substrate conditions, non-structural cracks, structural cracks and preparation requirements;
 - .2 Floor surface irregularities and levelness tolerances, including all remedial requirements;
 - .3 Installation of epoxy flooring;
 - .4 Edge details and treatments;
 - .5 Inspections during the work;

- .6 Protection of epoxy work.

1.5 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 Store material in original, undamaged containers or wrappings with manufacturer's seals and labels intact.
- .4 Restrict traffic by other trades during installation.
- .5 Provide adequate protection of completed epoxy surfaces to prevent damage by other trades until final completion of this project.
 - .1 Minimum protection shall consist of 6 mil polyethylene sheets lapped 100mm (4") and taped.

1.6 SITE CONDITIONS

- .1 Environmental Limitations: Comply with epoxy flooring manufacturer's written instructions for substrate temperature, ambient temperature, moisture, ventilation, and other conditions affecting resinous flooring application.
- .2 Lighting: Provide permanent lighting or, if permanent lighting is not in place, simulate permanent lighting conditions during epoxy flooring application.
- .3 Close spaces to traffic during epoxy flooring application and for twenty-four (24) hours after application unless manufacturer recommends a longer period.

1.7 WARRANTY

- .1 Warrant the work of this Section against defects in materials and workmanship in accordance with the General Conditions, but for a period of two (2) years, and agree to promptly make good defects which become evident during the warranty period without cost to the Owner.
- .2 Defects shall include but not be limited to the following:
 - .1 Cracking;
 - .2 Crazing;
 - .3 Discolouration; and
 - .4 Staining.

2 Products

2.1 SOURCE LIMITATIONS

- .1 Obtain primary epoxy flooring materials, including primers, resins, hardening agents, waterproof coats, and topcoats, from single source from single manufacturer.
- .2 Obtain secondary materials, including patching and fill material, joint sealant, and repair materials, of type and from manufacturer recommended in writing by manufacturer of primary materials.

2.2 MANUFACTURERS

- .1 Basis-of-Design products are named in this Section; additional manufacturers offering similar epoxy floor systems may be incorporated into the work provided they meet the performance requirements established by the named products.
- .2 Acceptable Materials Manufacturers: Subject to compliance with requirements specified in this Section and as established by the Basis-of-Design Materials, manufacturers

offering products that may be incorporated into the Work include; but are not limited to, the following:

- .1 Sika Canada Ltd.
- .2 Stonhard
- .3 Or approved equivalent.

2.3 MATERIALS

- .1 General Service Epoxy Flooring System (EPO):
 - .1 Base Coat and Primer:
 - .1 A multi-component, high solids, low viscosity, moisture tolerant, epoxy primer that forms a dense, low permeability film on concrete substrates to significantly reduce moisture vapour transmission in compliance with ASTM F3010
 - .2 Basis of Design Materials: Sikafloor 1620 by Sika Canada, or approved equivalent.
 - .2 Top Coat:
 - .1 A two-component, solid colour, high solids, silicone-free, low-viscosity, self-priming, glossy epoxy resin
 - .2 Basis of Design Materials: Sikafloor 261 CA by Sika Canada, or approved equivalent.
 - .3 Colour:
 - .1 To be selected by Consultant from manufacturers full colour range.
- .2 Detailing Mortar:
 - .1 A pre-proportioned, three-component, vertical-grade coving and detailing mortar based upon a solvent-free, solid-coloured epoxy resin and specially-graded aggregates used to provide a seamless connection between the floor and vertical surfaces such as walls, machinery bases or curbs.
 - .2 Basis of Design Material: Sikafloor Morritex Epoxy Cove Mortar

3 Execution

3.1 EXAMINATION

- .1 Examine surfaces and conditions under which flooring is to be applied. Moisture content of surfaces and building air temperatures must be within limits recommended by the flooring manufacturer. Do not start work until unsatisfactory conditions have been corrected. Application of materials indicates acceptance of surfaces.
- .2 Surfaces shall be free of membrane curing compounds, laitance, dust, dirt, grease, oil and other contaminants that may affect proper adhesion of the coating.
- .3 Do not apply coating system if ambient temperature is below 10 deg C (50 deg F) or above 32 deg C (90 deg F) or if relative humidity is above 80%.
- .4 Conduct moisture test on existing concrete slab. Moisture content of concrete substrate must be $\leq 6\%$ by mass (pbw – part by weight) as measured with a Tramex® CME/CMEX type concrete moisture meter on mechanically prepared surface according manufacturers published product data sheet (preparation ICRI / CSP 2-3). ASTM F2170 testing is not a substitute for measuring substrate moisture content. Use a Tramex® CME/CMEX type concrete moisture meter as described above.

3.2 SURFACE PREPARATION

- .1 Remove projections and other conditions that may affect the installation of the flooring system.
- .2 Protect adjacent surfaces, fixtures and equipment with drop cloths or masking as necessary to prevent damage from surface preparation.

3.3 INSTALLATION – COVE MORTAR

- .1 Installation of an integral cove base shall be terminated on vertical surface; mark a level, straight line at the appropriate height for termination (as per drawings/details).
- .2 Apply Epoxy Cove Mortar using steel trowels to spread and compact the mortar on vertical surfaces. Bottle coves and other shaped fillets shall be achieved using the appropriate tools. Lightly brush while the mortar is still workable to close any surface voids.

3.4 INSTALLATION – GENERAL SERVICE EPOXY FLOORING

- .1 Pre-stir each component separately prior to mixing. Mix components in the correct mix ratio and method, as indicated by flooring manufacturer, minimizing entrapping air while mixing. Mix only the quantity which can be used within its pot life.
- .2 Do not thin this product. Addition of thinners (e.g. water, solvent, etc.) will slow cure and reduce ultimate properties of this product. Use of thinners will void any applicable Sika warranty. Improper mixing procedure or incorrect mixing ratio may result in moisture sensitivity, whitening, slow cure, soft spots, and other defects.
- .3 Apply epoxy flooring by squeegee at the rate/thickness recommended by the epoxy flooring manufacturer. Back-roll with pressure using a high quality, lint-free roller.
- .4 After initial cure of first layer, apply second coat
- .5 Allow sufficient final cure time, as recommended by flooring manufacturer, before opening to traffic.

3.5 CLEANING

- .1 Clean flooring areas after completion, using compatible tools, solutions and methods as recommended by the manufacturer.

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 REFERENCE STANDARDS

- .1 ASTM International
 - .1 ASTM D698-12(2021), Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)).

1.2 EXISTING CONDITIONS

- .1 Examine subsurface investigation report which is available for inspection by the Owner.
- .2 Known underground and surface utility lines and buried objects are as indicated on site plan.

2 Products

2.1 MATERIALS

- .1 Fill material: As indicated in Section 31 23 00.
- .2 Excavated or graded material existing on site suitable to use as fill for grading work if approved by the Consultant.

3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for rough grading installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of the Consultant.
 - .2 Inform the Consultant of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from the Consultant.

3.2 STRIPPING OF TOPSOIL

- .1 Do not handle topsoil while in wet or frozen condition or in any manner in which soil structure is adversely affected as determined by Consultant.
- .2 Commence topsoil stripping of areas after area has been cleared of grasses, weeds and brush.
- .3 Strip topsoil to depths as indicated. Rototill grasses and retain as topsoil on site. Avoid mixing topsoil with subsoil.
- .4 Stockpile in locations as indicated. Stockpile height not to exceed 2 m.
- .5 Dispose of unused topsoil off site.

3.3 GRADING

- .1 Rough grade to levels, profiles, and contours allowing for surface treatment as indicated on Drawings.
- .2 Slope rough grade away from building 1:50 minimum, unless otherwise indicated on the Drawings.
- .3 Prior to placing fill over existing ground, scarify surface to depth of 150 mm minimum.
- .4 Maintain fill and existing surface at approximately same moisture content to facilitate bonding.

- .5 Compact filled and disturbed areas to maximum dry density to ASTM D698, as follows, unless otherwise indicated in the soils report:
 - .1 85% under landscaped areas.
 - .2 95% under paved and walk areas.
- .6 Do not disturb soil within branch spread of trees or shrubs to remain.

3.4 TESTING

- .1 Inspection and testing of soil compaction will be carried out by testing laboratory designated by ULC. Costs of tests will be paid under a Cash Allowance in accordance with Division 01.
- .2 Submit testing procedure, frequency of tests, testing laboratory as designated by ULC or certified testing personnel to the Consultant for review.
- .3 All planting bed areas to be tested for existing soil profiles

3.5 CLEANING

- .1 Progress Cleaning: Clean in accordance with Division 01.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Division 01.
- .3 Waste Management: separate waste materials for reuse or recycling in accordance with Division 01.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.6 PROTECTION

- .1 Protect existing trees, landscaping, natural features, buildings, and pavement which are to remain as directed by Consultant. If damaged, restore to original or better condition unless directed otherwise.
- .2 Maintain access roads to prevent accumulation of construction related debris on roads.

END OF SECTION

1 General

1.1 GENERAL REQUIREMENTS

- .1 The conditions of the Contract Division 1 apply to this section in full, as if repeated herein.
- .2 All depths of materials indicated on the drawings and in these specifications refer to minimum required depth of materials, after compacting.

1.2 SCOPE OF WORK

- .1 Excavation, backfill and site grading for this Work includes but is not necessarily limited to the following:
 - .1 Stripping and disposal off-site of native topsoil that is surplus or has been indicated by the Consultant to be undesirable.
 - .2 All required excavation.
 - .3 Stockpiling and reuse of on-site fill material approved by the Consultant.
 - .4 Disposal off-site of cut material that is surplus or has been indicated by the Consultant to be undesirable.
 - .5 Supplying imported topsoil and granular materials as well as trucking them to the site.
 - .6 Filling, backfilling and compacting granular materials, amended native topsoil or imported topsoil to attain indicated final grades.

1.3 SOURCE OF FILL

- .1 The Consultant must approve the soils and granular materials for use. If testing is required, it is to be paid for by Cash Allowance.

1.4 DISPOSAL OF EXCAVATED MATERIALS

- .1 All excavated sub-grade material generated by construction, may be used as fill on-site unless otherwise rejected by the Consultant, in which case it is to be disposed of legally off-site at a location determined and paid for by the Contractor.
- .2 All surplus sub-grade material generated by construction and not required to attain indicated final grades is to be disposed of legally off-site at a location determined and paid for by the Contractor.
- .3 Refer to Geotechnical Report for results of toxicity characteristic leaching procedure analysis. Any additional required testing of excavated material to be disposed of off-site shall be arranged and paid for by the Contractor.

1.5 INSPECTIONS AND TESTING

- .1 The Contractor shall engage a third party testing and inspections consultant satisfactory to the Owner for the testing/inspections outlined below. Cost for testing/inspections consultant shall be paid for from the project cash allowance.
- .2 The Contractor shall provide washed sieve gradation analysis for all aggregates and granular materials to be used in accordance with MTO Laboratory Testing Manual Section LS-602 and related standards.
- .3 The Contractor shall carry out field inspections and compaction testing of all compacted sub-grade and base materials in accordance with MTO Laboratory Testing Manual Section LS-623 and related standards.
- .4 The Contractor shall maintain a record showing the location and result of inspections and testing conducted. These records shall be submitted to the Consultant when requested, or prior to proceeding with work that depends upon the work of this Section.

2 Products

2.1 MATERIALS

.1 Soil, granular and backfill materials:

- .1 For Granular 'A' and 'B': All structural backfill material shall be manufactured granular crushed from limestone rock, described as Granular 'A' and Granular 'B', conforming to the requirements of Ontario Provincial Standard Specification OPSS 1010, "Material Specifications for Aggregates - Granular A, B, M and Select Subgrade Material". **Reclaimed concrete material (RCM) is not acceptable.**

- .2 19mm (or 20mm) crushed stone ("crusher run") shall be clean, durable, angular crushed gravel or stone conforming to the following limits:

Sieve Designation	% Passing
19.0mm	100%
4.75mm	40-80%
2.36mm	27-65%
600µm	12-35%

- .3 19mm (or 20mm) clear stone shall be clean, durable, angular crushed gravel or stone conforming to the following limits:

Sieve Designation	% Passing
19.0mm	100%
4.75mm	2%

- .4 Fill Material: Selected material from excavation or other sources, approved by the Consultant for use intended, unfrozen and free from rocks larger than 75mm, cinders, ashes, sods, refuse, contaminants or other deleterious materials.

.5 Other materials:

- .1 All other materials not specifically described but required for a complete and proper installation, shall be selected by the Contractor, subject to the review of the Consultant.
- .2 Geotextile: Terrafix 270R or equal.

3 Execution

3.1 REMOVAL OF TOPSOIL

- .1 Remove all topsoil from areas to be excavated or regraded. Strip topsoil when it is dry enough to prevent contamination with sub-grade material.
- .2 Do not handle topsoil in wet or frozen condition.
- .3 Stockpile any available topsoil on-site where directed. Piles shall not exceed 2000mm in height.

3.2 EXCAVATION

- .1 Provide, install and maintain adequate fences and barricades.
- .2 Excavate to lines, grades, elevations and dimensions indicated on the Drawings.
- .3 Remove concrete, masonry, rubble and other obstructions encountered during excavation and dispose of legally off-site.
- .4 Excavation required within proximity of underground utility lines or within the dripline of trees designated to remain are to be made by hand.
- .5 Excavation must not interfere with normal 45° plane of bearing from the bottom of any footing.
- .6 Earth bottoms of excavations to be undisturbed soil, level, free from loose, soft or organic material.

3.3 DEWATERING

- .1 Keep excavations free of water while Work is in progress.
- .2 Avoid excavation below groundwater table if quick condition or heave is likely to occur. Prevent piping or bottom heave of excavations by groundwater lowering, or other means.
- .3 Protect open excavations against flooding and damage due to surface run-off.
- .4 Dispose of accumulated water in a manner not detrimental to public and private property, or any portion of Work completed or under construction.
- .5 Provide flocculation tanks, settling basins, or other treatment facilities to remove suspended solids or other materials before discharging to storm sewers.

3.4 OVER-EXCAVATION

- .1 Where excavations are made below the indicated intended elevations, backfill with lean concrete, unshrinkable fill, crushed stone or granular material as directed by the Consultant. Compact to provide a firm, unyielding sub-grade at no additional cost to the Owner.

3.5 BACKFILLING

- .1 Do not place, spread or compact any backfill materials during unfavourable weather. Unfavourable weather includes temperatures below 0°C and/or precipitation.
- .2 Do not commence any backfill operation without adequate compaction equipment.
- .3 Protect the site of the backfilling and storage of backfill materials from freezing.
- .4 Prior to placing backfill, scarify the sub-grade surface to a depth of 50mm.

3.6 COMPACTION

- .1 All layers of backfill material shall be compacted to not less than the minimum density specified. The Contractor is not to proceed until approval of compaction has been granted.
 - .1 Refer to Pavement Design section of Geotechnical report and City of Toronto Pavement Structural Design Guidelines for specific compaction requirements.

3.7 STORAGE AND STOCKPILING OF MATERIALS

- .1 Stockpiled and imported materials to be stored away from existing trees, drainage areas and access points.

3.8 SITE GRADING

- .1 Perform all rough and finish grading and backfilling required to achieve the finished elevations indicated on the Drawings.
- .2 Ensure that the finished ground slopes are as indicated on the Drawings.

- .3 Regrade all areas that retain or pond water.
- .4 All areas shall be rough graded within a tolerance of plus or minus 50mm.

END OF SECTION

1 General

1.1 GENERAL REQUIREMENTS

- .1 Read and be governed by Conditions of the Contract and Sections of Division 1.

1.2 SCOPE OF WORK

- .1 Asphalt paving and grading for this Work includes but is not necessarily limited to the following:
- .1 Milling of existing asphalt paving and resurface with new asphalt paving.
 - .2 All required excavation, filling, backfilling, grading and disposal of materials as indicated in Specification 31 23 00.

1.3 QUALITY ASSURANCE

- .1 Subcontractors qualifications:
- .1 Paving Work shall be done only by skilled Workers, with suitable machinery, supervised by foremen experienced in type of Work specified.
 - .2 Execute the Work of this Section by a Subcontractors who has equipment adequate for Project, and skilled Workers so that Work is performed expeditiously; and is known to have been responsible for satisfactory installations similar to that specified.
 - .3 Materials and mixes that vary to a minor degree from those specified in this Section will be acceptable if they are based on standards of the engineering department of a jurisdiction having authority at the location of the Project and which are approved.
- .2 Perform Work on public property in accordance with design and material requirements of applicable local authorities which are imposed in addition to requirements specified in this Section.
- .3 Comply with requirements of Ontario Provincial Standard Specifications (OPSS) 501 and 1150.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Commence placing and perform compaction of granular base courses only when subgrade temperature is at least 2°C and rising.
- .2 Commence laying of asphalt binder courses only when base surfaces are at least 2°C, and the temperature is rising.
- .3 Commence laying of asphalt surface courses only when binder course surfaces are completely dry, at least 7°C and the temperature rising.
- .4 Suspend paving operations if temperature drops below specified minimums.

1.5 SUBMITTALS

- .1 A copy of the batch ticket from the asphalt plant shall be supplied certifying that aggregate and asphalt meet specifications and record the weight of each load.

1.6 WARRANTY

- .1 Provide a labour, material and Workmanship warranty against defects such as ponding, cracking in surfaces, excess settlement areas, for a period of two (2) years.

2 Products

2.1 MATERIALS

- .1 Granular base and sub base
 - .1 As per specification 31 23 33.
- .2 Asphaltic materials
 - .1 Asphaltic Material HL3A as conforming to the requirements of Ontario Provincial Standard Specification OPSS 1150.
- .3 Pavement composition

Pavement Layer	Minimum thickness	Compaction Requirements
Surface	40mm SP9.5 (HL-3 Fine)	OPSS 501 (TS-501)
Binder	60mm SP19.0 (HL-8)	OPSS 501 (TS-501)
Granular Base	150mm Granular A (TS 1010)	100% SPMDD (ASTM D-698)
Granular Subbase	150mm Granular B Type II (TS 1010)	100% SPMDD (ASTM D-698)

3 Execution

3.1 INSTALLATION

- .1 All work shall conform to OPSS and Details.
- .2 The Contractor is to ensure that the sub-grade has been approved by the Consultant prior to placing granular materials.
- .3 Lay granular base parallel to the final grade and compact to 98% Standard Proctor Density. Ensure there are no dips or uneven slopes. Ensure all areas are sloped to drain. Granular base to extend 150mm beyond edge of asphalt.
- .4 All asphalt edges not contained by hard edges shall have uniform lines with a hand tamped 45° angle. All pathway edges shall have a "smooth", curvilinear appearance. The Consultant reserves the right to request that sections of pathway be reworked to achieve the desired appearance.
- .5 Exercise care to prevent contamination of materials.

3.2 MAINTENANCE

- .1 Maintain all asphalt up until the date of acceptance by the Owner.
- .2 Maintenance shall include all repair work necessary to keep asphalt paving at required grades and to keep surface clean and intact until final acceptance.
- .3 The Contractor shall keep all pathways clean and clear of any mud tracks or other debris both on and off the site.

3.3 FIELD QUALITY CONTROL

- .1 An inspection and testing company will be selected to verify that compaction of granular base courses conform to specified requirements.
- .2 Payment for inspection and testing will be by cash allowance.

3.4 ADJUSTMENT AND CLEANING

- .1 Replace defective asphalt pavements with patches cut into pavement, in rectangular areas, and with joints made as specified.

END OF SECTION

CONTENTS

<u>SECTION</u>	<u>TITLE</u>
20 05 10	Demolition
20 05 11	Mechanical General Requirements
20 05 31	Pipe Hangers and Supports
20 05 32	Access Doors
20 05 33	Identification
20 05 60	Piping Insulation
20 06 11	Testing, Adjusting and Balancing
22 11 16	Domestic Water Piping
22 13 13	Drainage Piping and Vent
23 07 13	Ductwork Insulation
23 11 23	Natural Gas Piping
23 31 13	Metallic Ductwork
23 33 46	Flexible Ducts
23 74 07	Refrigerant Piping

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

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

CSA B51-03

CSA B52-99

CAN/CSA-G40.20/G40.21-98

CAN/CSA-S16-01

CSA W47.1-92(R2001)

CAN/CSA W48-01

CSA W59-M1989(R2001)

CAN/CSA W117.2-01

Primer, Structural Steel, Oil Alkyd Type

Boiler, Pressure Vessel, and Pressure Piping Code

Mechanical Refrigeration Code

General Requirements for Rolled or Welded Structural
Quality Steel/Structural Quality Steel

Limit States Design of Steel Structures

Certification of Companies for Fusion Welding of Steel
Structures

Filler Metals and Allied Materials For Metal Arc
Welding.

Welded Steel Construction (Metal Arc Welding)

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: Galvafruid 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

SURI & ASSOCIATES LTD.

TSSS PAPE

1076 PAPE AVENUE, TORONTO, ONTARIO. M4K 3W5

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.

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

2.1 AUTOMATIC CIRCUIT BALANCING VALVES

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

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

- 2.1.3 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.

- 2.1.4 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.

- 2.1.5 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.

- 2.1.6 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.

2.1.7 Sizes 40mm and smaller

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

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

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

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

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

2.1.12 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.

2.1.13 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.

2.1.14 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 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.

SURI & ASSOCIATES LTD.

TSSS PAPE

1076 PAPE AVENUE, TORONTO, ONTARIO. M4K 3W5

ROOF REPLACEMENT

METALLIC DUCTWORK

23 31 13-8

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 services 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

CONTENTS

SECTION

TITLE

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 Contractor in 2004 Format).
 - (f) Fire Alarm Verification Report.
 - (g) Fire Alarm CAN/ULC-S1001 Integrated Testing.

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